IJAIR
IMPACT FACTOR
7.36
International Journal of Advance and Innovative Research
· ISSN : 2394-7780 ·

# International Journal of
# Advance and Innovative Research

# International Journal of Advance and Innovative Research

**Dr. Mahendra Daiya**
Associate Professor,
JIET Group of Institutions, Jodhpur

**Dr. G. Valarmathi**
Associate Professor,
Vidhya Sagar Women's College, Chengalpet

**Dr. Parbin Sultana**
Associate Professor,
University of Science & Technology Meghalaya

**Dr. M. I. Qadir**
Assistant Professor,
Bahauddin Zakariya University, Pakistan

**Dr. Kalpesh T. Patel**
Principal (In-charge)
Shree G. N. Patel Commerce College, Nanikadi

**Dr. Brijesh H. Joshi**
Principal (In-charge)
B. L. Parikh College of BBA, Palanpur

**Dr. Juhab Hussain**
Assistant Professor,
King Abdulaziz University, Saudi Arabia

**Dr. Namita Dixit**
Associate Professor,
Shri Ramswaroop Memorial University, Lucknow

**Dr. V. Tulasi Das**
Assistant Professor,
Acharya Nagarjuna University, Guntur, A.P.

**Dr. Nidhi Agrawal**
Assistant Professor,
Institute of Technology & Science, Ghaziabad

**Dr. Urmila Yadav**
Assistant Professor,
Sharda University, Greater Noida

**Dr. Ashutosh Pandey**
Assistant Professor,
Lovely Professional University, Punjab

**Dr. M. Kanagarathinam**
Head, Department of Commerce
Nehru Arts and Science College, Coimbatore

**Dr. Subha Ganguly**
Scientist (Food Microbiology)
West Bengal University of A. & F Sciences, Kolkata

**Dr. V. Ananthaswamy**
Assistant Professor
The Madura College (Autonomous), Madurai

**Dr. R. Suresh**
Assistant Professor, Department of Management
Mahatma Gandhi University

**Dr. S. R. Boselin Prabhu**
Assistant Professor,
SVS College of Engineering, Coimbatore

**Dr. V. Subba Reddy**
Assistant Professor,
RGM Group of Institutions, Kadapa

**Dr. A. Anbu**
Assistant Professor,
Achariya College of Education, Puducherry

**Dr. R. Jayanthi**
Assistant Professor,
Vidhya Sagar Women's College, Chengalpattu

**Dr. C. Sankar**
Assistant Professor,
VLB Janakiammal College of Arts and Science

**Dr. Manisha Gupta**
Assistant Professor,
Jagannath International Management School

**IJAIR**

**IMPACT FACTOR**

**7.36**

ISSN : 2394-7780

International Journal of Advance and Innovative Research

Scientific Journal Impact Factor

# CERTIFICATE OF INDEXING (SJIF 2018)

This certificate is awarded to

### International Journal of Advance & Innovative Research
### (ISSN: 2394-7780)

The Journal has been positively evaluated in the SJIF Journals Master List evaluation process
SJIF 2018 = 7.363

**SJIF (A division of InnoSpace)**

SJIFactor Project Manager
International Advisory Services
INNOSPACE INTERNATIONAL

SJIFactor Project

# CONTENTS

## *Research Papers*

**TEACHING: AN OVERVIEW**

Dr. Debabrata Bhattacharjee

## DIAGNOSIS OF INFECTIOUS BRONCHITIS VIRUS (CORONA VIRUS) BY HEMAGGLUTINATION USING TRYPSIN

**Thenmozhi M[*1], Dhasarathan P[2], Shyam Sundar N[3], Divya Theza K[4] and Gajalakshmi P[5]**
[1,2,4,5]Department of Biotechnology, Prathyusha Engineering College, Thiruvallur
[3]Department of Zoology, Sri Paramakalyani College, Alwarkurichi

## ABSTRACT
*Background: Avian infectious bronchitis virus (IBV) is a corona virus which infects chicken, causing the associated disease; infectious bronchitis (IB).The main purpose of this study is to diagnose the IBV by inducing hemagglutination. The study was aimed to diagnose the infectious bronchitis virus caused in poultry using embryonated chicken eggs. The objectives of the study are a standard HA test of IBV will be a useful laboratory method that can be adopted as a cost effective for sero monitoring the commercial layer poultry population within a short period of time.*

*Materials and Methods: A trypsin - induced hemagglutination (THA) assay was standardized to diagnose IBV in Allantoic fluid of embryonated eggs. Hemaglutination of trypsinized AF was reported to be efficient, specific, sensitive and economical to perform in our routine diagnostic practices.*

*Results: Trypsinized AF could be stored at -65$^o$C for more than 3 weeks without any lose of hemagglutinating activity of virus HA inducing capacity of trypsin on infectious bronchitis virus was found to be effective and very specific in its ability to elicit HA activity of IBV. Hence the presence study will be advantageous over other methods and quite useful for protein serological assay.*

*Keywords: Allantoic fluid, Bronchitis virus, Hemaglutination, Trypsin*

## INTRODUCTION
Avian infectious bronchitis (IB), caused by a corona virus, is an acute and highly contagious disease. The corona virus was first isolated from chickens in 1937. The virus infects not only man, cattle, pigs, rodents, cats, dogs and birds, causing respiratory and enteric diseases. Young chickens infected with IBV can acquire permanent damage to their oviducts. (Brown and Bracewell, 1988 and Carsado, 2005). The infection is confirmed by the isolation of IBV in either embryonated chicken eggs or tracheal organ cultures. Various techniques are suggested for the diagnosis IBV infection. Primarily the diagnosis of IBV was done by convectional virus isolation test (VI). Other recent advancements in IBV diagnostics is the detection and sero typing of AF containing IBV with the use of monoclonal antibodies (Cavanagh, 1984, Cavanagh and Naqi, 1997). Sereo logic tests such as hemagglutination inhibition (HI), agar gel precipitations test (AGPT) and the enzyme linked immune sorbent assays (ELISA) are used. The hemagglutination assay (HA) is a method of quantifications for viruses by hemagglutination. IBV is selected for the present study because HA of IBV may be more useful for sero monitoring the commercial layer poultry population and all the strains of IBV sample are easily available commercially in the form of live vaccine.

## MATERIALS AND METHODS
**Corona virus:** *Coronavirus* are species in the genera of virus belonging to the subfamily *Coronavirinae* in the family *Coronaviridae. Coronaviruses* are grouped in the order *Nidovirales. Coronaviruses* are enveloped viruses with a positive strand RNA genome.

**Embryonated chicken eggs:** Nine-day-old embryonated chicken eggs were obtained from poultry farm, Institute of Poultry Production and Management (IPPM) Madavaram, Chennai, Tamil Nadu, India.

**Virus inoculum:** A commercial H120 belonging to Massachusetts (Mass) serotype was used. The vaccines received from Namakkal.

**Egg driller:** It is used for drilling hole gently in the egg shell for inoculation of IBV.

**Egg candling box:** A simple modern box was used in embryology to study the movement of the growing embryo inside an egg.

**Trypsin:** 1% trypsin solution was prepared using normal saline and stored at -20°C. The enzyme was stored in small aliquots each for one time use.

**Chicken RBC:** Chicken RBC used for HA test was collected from the normal bird on the day doing the test, in Alsevers solution, mixed well and centrifuged at 1800 rpm for 10 minutes in cooling centrifuge to get a soft

gentle pellet. The clear supernatant was discarded completely without disturbing the cells. To the pellet cold saline was added 10 times the volume of the cells and mixed gently and centrifuged at 1800 rpm for 10 minutes. This washing step was repeated 2 to 3 times. These washed RBCs were used for the preparation of 1% RBC with saline.

**Microtiter Plates:** The 96 well microtiter plate with "V" bottom made of polystyrene was used for HA test. The entire experiment was carried out in the Laboratory of TANUVAS, Chennai.

**Virus cultivation:** Egg candling: 15 numbers of eggs were candled. The egg with active movement of the embryo and good development of blood vessels was selected.

**Preparation of inoculum:** Required volume of the reconstituted vaccine at the rate of 0.1 ml per egg inoculum was removed. They are ready for inoculation.

**Preparation of eggs for inoculation:** The eggs are candled in a dark room and the site of inoculation spotted by identifying the area of air sac and the placement of embryo seen like a dark spot (eye of the embryo) were marked using the marker. Using the egg shell driller, a fine hole was drilled just 1 mm below the air sac and opposite to that of embryo.

**Allantoic sac route of inoculation:** Using a 1ml of syringe with 11/2"x21G needle, the inoculums was drawn. Keeping the needle and syringe with 0.1 ml of inoculum vertical, place the needle through the hole in the eggshell. The needle will need to penetrate approximately 16 mm into the egg to reach the allantoic cavity and away from that of the embryo or major blood vessels. About 0.1 ml of inoculum was injected into the egg and check to that no inoculum is coming out of the egg. Place the inoculated egg in an incubator for further period of 3days.

**Virus harvest:** Those eggs which were died within 48 hours post inoculation, those eggs were removed from the incubator and kept in the refrigerator at 4°C for one overnight to reduce the contamination of the allantoic fluid rich in virus with blood during harvesting. Removed the eggshell above the air sac, using the sterile Pasteur pipettes the clear allantoic fluid from the eggs was collected into sterile containers. They were stored at -20°C until use.

**HA Antigen Preparation:**
**HA induction by trypsin:** The infectious bronchitis virus (IBV) of volume1 ml was mixed with 500 µl of enzyme trypsin and was kept in the incubator at 37°C for one hour.

**Hemagglutination test (HA test) (Sujatha et al., 2010):** One clean "V" bottomed microtiter plate was taken. Add 50 µl of normal saline to all the wells. Meanwhile, 500 µl of trypsin enzyme was added to 1 ml of IBV and kept in the incubator for an hour. After 1 hour of incubation, 50 µl of sample was taken from the incubated tube and added to the 1st well. From the1st row, 1st well, 50 µl of sample was taken and serially diluted the sample up to 8th well and finally 50 µl was discarded. The procedure was repeated to the next row. Then 50 µl of 1% RBC was added to all the 8 wells in the entire row. The highest dilution at which agglutination was observed was known as the hemagglutination titer.

## RESULTS AND DISCUSSION
### Propagation of Virus
H120 strain is a commercially available live vaccine against Infectious Bronchitis serotype Massachusetts in poultry, which was propagated by cultivating in embryonated chicken egg by allantoic route. The characteristic symptoms observed were dwarfing and curling of embryo and in some cases hemorrhage occurred as shown in figure 1. In higher concentration of H120 strain the dwarfing and curling lesions are more pronounced when compared to that of lower concentration. The allantoic fluid was collected and incase if any RBCs or yolk content were mixed, it was centrifuged to get the clear allantoic fluid and stored at -20°C for further use.

**Harvest of allantoic fluid:** About 4 ml of allantoic fluid was harvested from the virus propagated embryonated eggs which was used as an antigen in HA test.

**HA Induction on IOBV with trypsin:** The HA induction on infectious bronchitis virus was done with 1% concentration of trypsin for half an hour. Agglutination reaction was observed in 1st four wells with dilutions ½, ¼, 1/8, and 1/16. Whereas when the HA induction on infectious bronchitis virus was done without trypsin treatment, button formation was observed in all the wells (Table 1).

Corona viruses cause about one third of common colds and the newly recognized severe acute respiratory syndrome (SARS), making them extremely important. Corona viruses lack self-agglutinating property of their

own, so trypsin was used as an inducer to initiate the agglutinating property. Hemagglutination is nothing but mat formation which occurs only when the adjacent RBCs adhere to the same virus with specific receptor sites and formation of many such adherences without the presence of specific antibody. Few publications are there on the application of C-ELISAs for virus detection, although this technique has shown its effectiveness to detect protein antigens, like hormones and immunoglobulins or virus antigens (Jackwood, 2003 and 2005 and Prince, 2003).

From this we infer that the infectious bronchitis virus does not have the agglutinating property of its own. By the use of trypsin enzyme the antigenic receptor gets exposed and the hemagglutination property has occurred in IBV. Hence this shows that the enzyme trypsin diagnosis the infectious bronchitis virus by HA test. Virus propagation in embryonated eggs was attempted for 2 main reasons, increase the virus quality required for various tests and To check the purity of virus to be employed for the test.

Allantoic fluid from inoculated eggs was harvested for three main reasons: They are prepared I-2 Newcastle disease working seed or vaccine, uses as antigen in the Hemagglutination test and tested for the presence or absence of Newcastle disease virus by the Hemagglutination test. The similar kind of observations like disease management using bacterial antigens were reported by Dhasarathan and Theriappan (2011). The result showed that the trypsin induction on IBV produced a good and high tittered HA antigen.

## CONCLUSION

Hemagglutination of trypsinized AF was reported to be efficient, specific, sensitive and economical to perform in our routine diagnostic practices. Trypsinized AF could be stored at -65°C for more than 3 weeks without any loss in Hemagglutinating activity of virus. HA inducing capacity of trypsin on infectious bronchitis virus was found to be effective and very specific in its ability to elicit HA activity of IBV. Hence the present study will be advantageous over other methods and quite useful for routine serological assay.

## REFERENCES

- Brown AJ and Bracewell CD (1988). Effect of repeated infections of chicken with IBV on the specificity of their antibody response. *Veterinary Research*. **122:** 207-208.

- Carsado TC (2005). Evaluation of serum and animal protein free media for the production of IBV (M41) strain in a continuous cell line. *Altex*. **22:** 152-156.

- Cavanagh D (1984). Induction of humoral neutralization and Hemagglutination inhibition antibody by the spike protein of IBV. *Avian pathology*. **13**: 573-583.

- Cavanagh D. and Naqi SA (1997). Infectious bronchitis In. Calnet BW, Borens HJ, Beard W, Mcdougald LR and Saif Y M (Eds) *Diseases of poultry*, State university, press. Ames., IA. **10**th ed: pp. 511-526.

- Dhasarathan P and Theriappan P (2011). Evaluation of immune complex as vaccine tool in disease management. *Journal of Pharmacy Research*. **4** (3): 604-606.

- Jackwood MW (2003). Detection of IBV by RT-PCR reaction and identification of a quasispecies in the Beaudette strain. *Avian diseases*. **47**: 718-724.

- Jackwood MW (2005). Data from 11 years of molecular typing IBV isolates. *Avian Diseases*. **49**: 614-618.

- Prince H E (2003). Performance characteristics of an In-House Assay system used to detect West Nile virus (WNV)-specific IgM during the 2001 WNV season in United States. *Clinical and Diagnostic Laboratory Immunology* **10**: 177-179.

- Sujatha.M., Karthick.B and P. Dhasarathan. (2010). Antibiotic susceptibility and immunomodulatory potential of chosen bacterial pathogens. *American Journal of Immunology*. **6** (2): 15-19.

**Table:- 1 Concentration of trypsin and its symptoms in chicken embryo**

| S. No | Concentration of trypsin in inoculum | Symptoms in chicken embryo |
|---|---|---|
| 1. | 1% | The dwarfing and curling lesions are more pronounced |
| 2. | 0.5% | The dwarfing and curling lesions are less pronounced |

**Figure:- 1** Characteristic embryo lesions caused by infectious bronchitis virus after 48hrs post inoculation revealing dwarfing and curling with hemorrhage. C-control from uninoculated embryo.

## A REVIEW ON RHEUMATOID ARTHRITIS - CAUSES, SYMPTOMS, AND THE OVERVIEW OF THE TREATMENT

**Soumi Acharya and Rajakumari K**[*]
Department of Bio-Engineering, School of Engineering, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai, Tamil Nadu, India

**ABSTRACT**

*Inflammation of one or more joints, causing pain and stiffness that worsens with aging, is the state of Arthritis or Joint Inflammation. Numerous types of arthritis exist, each resulting from wear and tear, infections, or underlying diseases. Patients suffering from this condition may experience pain, swelling, reduced range of motion, and stiffness. Medication, physiotherapy, or surgical treatment can help relieve the symptoms and improve quality of life. Rheumatoid Arthritis (RA) is one such type of arthritis where an individual's immune system attacks his or her own tissues, including joints. The immune system can also infect internal organs in severe cases. Joint linings become swollen and painful due to RA. During the course of chronic inflammation associated with rheumatoid arthritis, bone erosion and joint deformity can occur. Although treatment can help, but this condition can't be cured. DMARDs are anti-rheumatic drugs that can be used to manage most cases.*

*Keywords: arthritis, DMARDs, inflammation, joints, rheumatoid arthritis (RA)*

**INTRODUCTION:**

Arthritis is most commonly characterized by swelling and tenderness of one or more joints. Joint pain and stiffness are the major symptoms of arthritis, which typically worsen with age. Among the most common types of arthritis are rheumatoid arthritis and osteoarthritis . An autoimmune disease, RA attacks the joints from the lining of the joints upward. A high level of uric acid causes crystals to form, which can result in gout. Other types of arthritis can be caused by infections or underlying diseases such as lupus and psoriasis. Different types of arthritis require different treatments. Treatments for arthritis are primarily focused at reducing symptoms and improving quality of life. [1]

An autoimmune disease, RA occurs more frequently in women than in men, and is commonly seen in people who are elderly. A primary symptom of RA is tender synovial linings, which can lead to progressive disability, premature death, and significant socioeconomic burdens. Symmetrical joint involvement can cause symptoms such as arthralgia, swelling, and redness. A timely diagnosis is the key to achieving the most desirable outcomes (i.e., reducing joint destruction, reducing radiologic progression, preventing permanent disability, and attaining the most cost-effective outcomes, since the first 12 weeks following onset are regarded as the optimal therapeutic window).[2] Synovitis caused by RA can currently be treated through disease-modifying antirheumatic drugs (DMARDs) and biologic agents. Researchers have unequivocally demonstrated that aggressive treatment schedules started early cause less joint damage and disability. Treatment initiated within 12 weeks of disease onset has been shown to cause less joint loss and increase the possibility of achieving remission, which is increasingly considered the desired outcome in clinical trials. [3]

Delays in diagnosis differ markedly between different countries with different healthcare systems, while delays in initiating DMARD therapy in RA patients depend both on the patient and on the physician.[4] The treatment strategy for RA, in spite of the lack of a cure, aims to expedite diagnosis and reach a low disease activity state as quickly as possible.A number of composite scales measure disease activity, such as the Disease Activity Score, which uses 28 joints (DAS-28), the Simplified Disease Activity Assessment Index (SDAI), and the Clinical Disease Assessment Index (CDAI). [5]



*FIGURE 1:* **Joint deformities associated with RA**

Rheumatologists need to monitor disease activity continuously and accurately to achieve a full remission of disease activity (clinical remission). Pharmaceutical treatment with non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids provides relief of stiffness and pain, but does not slow disease progression. Due to their ability to significantly decrease disease activity and delay joint deformity, DMARDs have gained attention over the last two decades.[6] A patient with RA can have two major subtypes based on whether they have anti-citrullinated proteins antibodies (ACPAs). As a result of a post-translational modification, citrulline is formed after arginine is deiminated by the calcium-dependent enzyme peptidyl-arginine-deiminase (PAD). In approximately 67% of RA patients, ACPAs can be detected, serving as a useful diagnostic reference for patients with early, undifferentiated arthritis, providing insights into the likelihood of disease progression to RA.[7,8] RA with an ACPA-positive phenotype displays a more aggressive clinical phenotype than RA with an ACPA-negative phenotype.[9] A study reports differential responses from immune cells to citrullinated antigens in RA patients who are ACPA-negative compared with RA patients who are ACPA-positive.[10,11]

## SIGNIFICANCE OF STUDY:

Rheumatoid arthritis affects more than just joints; it can also affect internal organs, resulting in permanent disability in many cases. In the current state of this autoimmune disease, it is not possible to cure it, rather, symptoms are treated on an individual basis. In this article, we summarize the classic and current treatment options available to patients with this complex illness.[12]

## SYMPTOMS:

The major symptoms surrounding RA are Multiple joints aching or in pain, Joint stiffness, Swelling and tenderness in multiple joint, Similar symptoms in both hands or in both knees (e.g., on both sides of the body), Symptoms of weight loss, High temperature, Fatigue, Lethargic

## DIAGNOSIS:

The early diagnosis of RA can alter the course of the disease, prevent joint erosions from developing or prevent joint destruction from occurring. [13,14] Even in remission states, early diagnosis and treatment may affect the outcome of the disease. [15,16] Despite limitations in the use of the American College of Rheumatology revised criteria (ACR criteria) for early diagnosis, it is not easy to distinguish early RA from non-RA at the onset of disease. The criteria is not sensitive enough to identify early RA due to insufficient clinical or laboratory evidence at the onset of arthritis. [17,18] With the use of recently developed diagnostic criteria, inflammatory arthritis patients at risk for developing RA could be identified and treated. These criteria can be used to separate those who develop RA in the future from those who do not. Compared to the previous ACR criteria, the new 2010 criteria are more sensitive and specific. New criteria classify a greater number of patients with reasonable discrimination ability at an earlier stage. [19]

## PREDICTION OF EARLY DIAGNOSIS:

An individual with inflammatory arthritis may go through a number of stages before developing a specific form of rheumatic disease such as RA. Phase one refers to the period preceding the onset of arthritic pain. Phase two refers to the period during which persistence or remission is determined. Phases 3 and 4 relate to the development of specific forms of inflammatory arthritis and their outcome/severity. Patients may go through these phases in rapid succession in some cases, while other patients may undergo a gradual progression that lasts several months or years. There can be a variation in the natural history of arthritis depending on the genetic background and environmental factors or treatment received. It appears that a substantial proportion of UA patients progress to RA, whereas about 10% of early RA patients experience natural remission. Treatment of inflammatory arthritis early enough may prevent and even cure RA for some patients, however overtreatment of patients who do not develop RA is harmful and should be avoided. Treatment of patients who have persistent symptoms of arthritis is the main challenge in predicting RA development. According to different studies, the proportion of UA patients who progress to RA varies considerably. Possibly, this is due to the difference in inclusion criteria or diagnostic methods used in UA or RA, or to the characteristics of UA patients, or to the different follow-up periods. Several published studies found that after one year, between 6% and 55% of UA patients developed RA.[20]

## CLINICAL MANIFESTATIONS:

An examination of the history and physical examination can identify many rheumatic conditions. In addition to clinical findings, diagnostic laboratory tests are also selected based on those findings in order to confirm RA or rule out other rheumatic diseases.[21] There are no specific clinical features or laboratory tests that can be used to diagnose RA. However, sometimes a diagnosis of RA can be made based on clinical factors alone. Around three-quarters of people with RA develop it insidiously as polyarticular disease. In the early stages of RA, there may be no classic symptoms of joint swelling or tenderness; instead, there will be vague pain with progressive

onset. In the majority of cases, these symptoms are non-specific and can persist for a prolonged period of time. Rheumatoid arthritis may appear like other rheumatic diseases in its early stages. The presence of prolonged morning stiffness combined with arthralgia, or arthritis in only a few joints, may be a clue to RA diagnosis. [22] It is very suggestive of RA when small joints of the hands or feet are involved with swelling and tenderness, as well as a positive compression test. [23] The presence of painful hands at baseline was found to be a significant predictor of RA in a study by Quinn et al. [24]

It can be helpful not only to estimate the future course of arthritis but also to limit the spectrum of differential diagnoses if certain clinical features are present such as polyarthritis, symmetric arthritis, hand arthritis, and stiffness on awakening greater than 30 minutes. A precise clinical examination is necessary to identify all involved joints.To determine the severity of the disease and the effectiveness of treatment, counting the tender and swollen joints, and calculating disease activity scores are logical methods. [25]

## LABORATORY TESTS:

An abnormal laboratory test result is the most common symptom of RA. The best indicators of acute phase response are erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP). A significant relationship has been found between the level of CRP and the severity of the disease as well as changes in radiographic appearance.[26] A synovial fluid analysis and arthritis syntheses can help diagnose inflammatory arthritis as well as distinguish it from non-inflammatory arthritis. Detecting RA from non-RA arthritis by testing synovial fluid anti-CCP is extremely useful.[27] Patients with arthritis should be monitored for acute phase reactants such as ESR and CRP, as both can be used to confirm and quantify inflammation. The higher the level of these inflammatory markers, the more active the disease is.[25] Testing these markers may also be useful in evaluating treatment effectiveness. Relative to the efficiency of treatment, acute phase reactant levels decrease as evidenced by a decline in DAS. [28]

## IMAGING:

At a later stage of RA, radiographic signs such as joint space narrowing, erosions, and subluxation appear. Anatomic changes associated with RA are typically evaluated using plain radiography. A conventional radiographic examination, however, does not appear to be an important tool for evaluating recent-onset arthritis. A high risk of bone erosion is associated with synovitis, one of the early symptoms of RA. Radiographic findings of hand joints may include soft tissue swelling and mild juxta articular osteoporosis in early RA. [26] These findings are indicative of synovitis but are not visible on conventional radiographs and are not precise enough to be relied upon in the regular assessment of synovitis. Plain radiography is insensitive in detecting bone erosion, a characteristic of RA, because radiographic changes occur later. Radiographic bone erosions were observed in 12.8% of initial radiographs compared with 27.6% after one year in a study of very recent-onset arthritis with symptom duration < 3 months. [20]

MRI and sonography are more sensitive and seem promising, but they can only be used in certain locations. Sonography can be a reliable method for detecting early RA erosion more accurately than radiography. [29] In one study, conventional radiography had a sensitivity of 13% to detect bone erosion, while MRI and ultrasonography had a sensitivity of 98% and 63%, respectively. [30] This is why RA bone erosions are increasingly being detected by MRI, especially in patients with early symptoms of arthritis. Patients with UA may have joint erosions indicative of the development of RA. Tami et al. reported 70.5% positive predictive value, 68% specificity, and 79.7% sensitivity from MRI evaluated patients with at least two detectable symmetric synovitis or bone edema and bone erosion at 1 year. [31]

## TREATMENT:

DMARD therapy may be required for patients with at least one affected joint, based on new developed criteria. The disease course of RA may be altered by aggressive early treatment, even if the disease develops into an established condition (from inflammatory arthritis to established condition). [16] Providing highly effective DMARDs or biological treatments in the current era encourages remission as opposed to the control of inflammation as the primary goal of treatment. [32] In patients at risk of developing persistent erosive arthritis, early identification of high-risk individuals and the use of effective DMARDs is crucial. [33] As a result, structural damages and long-term disabilities may be prevented. [34] DMARDs were shown to have a significant effect on long-term outcome when treated late. [35] Patients with UA are often suffering from RA in a very early phase; therefore, it is critical to identify those patients ahead of time who will develop RA and treat them. [36]

## INITIATION OF TREATMENT:

DMARDs constitute a mainstay of therapy, and therefore should be initiated as early in the course of the disease as possible [22] their very early intervention has been shown to be cost-effective. [37] The efficacy of monotherapy, combination DMARDs, and biologics is higher in early disease than in long-established RA. [32,38] Compared to monotherapy, combination therapy is more effective on clinical remission and has a greater effect on radiographic progression. A study compared early treatment with three DMADRs for two years with one DMARD for two years. The remission rates after two years were 40% and 18%, while after five years they were 28%, and 22%. A study showed that combination therapy with three drugs for the first two years reduced peripheral joint damages for at least five years. [39] Patients with early RA benefit a lot from combination therapy. Initiating the combination therapy early provides greater protection for joint damage and early clinical improvements. [14] Some patients with early RA may achieve remission by combining biological agents (infliximab, adalimumab) with methotrexate or by using biological agents alone. When anti-CCP, radio frequency, joint erosion, and a shared epitope are present in patients, such as those with high levels of anti-CCP or RF, combination therapy should be considered.[38] In studies conducted previously, treatment of high risk patients has been shown to slow the progression of early inflammation to definite RA and to slow the progression of joint damage. [16] Radiographic progression can be prevented by combination therapy even in patients with risk factors like RF or anti-CCP while monotherapy may not be effective [40].

## STEROIDS:

A combination of steroid administration with DMARDs or biological therapies can induce a greater rate of remission, and control radiological progression in early RA than monotherapy with DMARDs alone. A better outcome can be achieved with this regimen and should be considered in all patients [34,38] The systemic intake of glucocorticoids can also provide short-term pain relief and swelling relief, so they are often prescribed for these purposes but are mostly temporary. [33] Additionally, DMARD therapy and steroids have additional effects on bone erosion.

## TREATMENT OUTCOMES:

A radiographic evaluation of the treatment's effectiveness on joint damage. A meta-analysis of 12 studies, by Finckh et al., showed long-term effects of early treatment on bone radiographic progression in RA. Comparing patients treated with DMARDs earlier than 2 years of disease duration to those treated later, there was a 33% reduction in radiographic progression. Results persisted for as long as 5 years [13]. In a study by Svensson et al. in patients with active RA and disease duration of more than one year, prednisolone addition to DMARD therapy retarded progression of radiographic damage [23]. After two years, fewer newly eroded joints were observed in patients taking prednisolone 7.5 mg daily compared to those not taking it. In 2 years, the corresponding remission rates were 55.5% and 32.8% [23]. According to a study by Korpela et al., treatment with a combination of 3 DMARDs reduced radiographic erosions in early RA compared with a single DMARD [39]. Harfstrom et al. found that the prednisolone group's two-year remission rate was significantly greater (55 percent vs 30 percent) and that the prednisolone group had a higher probability of being in remission during longitudinal analysis. Between the two groups, there was no difference in changes to bone density over 4 years [41]. The presence of glucocorticoids in addition to standard treatment substantially reduced the rate of progressive erosions in rheumatoid arthritis [42].

## NEW MEDICATIONS:

A treatment using leflunomide is done which is converted to malononitrilamide, inhibiting the synthesis of ribonucleotide uridine monophosphate pyrimidine. RA symptoms are relieved and the disease is retarded. It is recommended to use it in conjunction with MTX, but can serve as a monotherapy if MTX does not work. There are several side effects associated with the drug, including hypertension, gastrointestinal disturbance, leukopenia, interstitial lung disease, neuropathy, rashes, and bone marrow damage [43,44].

It is medically accepted that biologics, which are also called biological DMARDs, are rapidly effective for the treatment of RA-induced joint damage. The method of treatment is considered to be more "direct, defined, and targeted" [45]. The problem with biologics is that they can cause serious side effects, including an increased risk of infections. Additional side effects include neurological diseases like multiple sclerosis and lymphoma [46,47].

Inflammation in joints is caused by tumor necrosis factor (TNF). These biologic medications include etanercept (Enbrel), infliximab (Remicade), adalimumab (Humira), golimumab (Simponi), and certolizumab pegol (Cimzia) which all inhibit the actions of TNF2, thus providing rapid symptom relief. When other second-line medications are not effective, they are recommended. Due to their high cost, these medications are very difficult to afford and are being investigated as a potential treatment for patients at various stages of RA and with various

mechanisms of action. In addition to other DMARDs, especially MTX, they are often used in combination. When a patient has congestive heart failure or demyelinating diseases, TNF inhibitors are contraindicated. Biological medications differ in their modes of administration. [48,49]

The drug Anakinra (Kineret) is administered subcutaneously every day. An inflammatory chemical messenger, IL-1, is bound by the compound. Despite its versatility, it is not used as frequently due to its low response rate compared to other biologic agents [50,51]. As a result of depleting the B cells responsible for inflammation and abnormal antibody production, Rituximab (Rituxan) is useful in RA. In cases of RA where TNF inhibitors have failed, this drug can be used in cases of lymphoma. Additionally, rituximab has been demonstrated to benefit patients with RA's complications, such as vasculitis and cryoglobulinemia, that result from the disease. Two infusions are given every 6 months, two weeks apart [52,53]. Activating T cells is the mechanism by which Abatacept (Orencia) functions. As an intravenous infusion or subcutaneous injection once a week, this medication is administered. DMARDs are used in those patients whose condition has not responded to traditional treatments [54].

Inflammation is triggered by IL-6, which is blocked by tocilizumab (Actemra). It is administered via intravenous infusion given monthly or via subcutaneous injection given weekly. Also, it is employed for people whose treatment with traditional DMARDs has not been effective [55]. The last class of drugs is tofacitinib (Xeljanz), which blocks inflammation-related enzymes within cells called Janus kinases. Therefore, it is referred to as a JAK inhibitor. In patients who have not been able to receive effective treatment with MTX, this medication may be prescribed. In addition to or instead of MTX, tofacitinib is taken twice daily by mouth. A combination of this medication with traditional biologic medications or other powerful immunosuppressants is not recommended [56, 57].

## SURGERY:

In the 1990s, joint surgery in patients with RA reached a peak. However, RA patients 40–59 years of age had lower rates of joint surgery according to a 2010 study. The rate of surgery, however, was higher in patients over 60 years old [58]. Surgery is generally a last resort for the treatment of rheumatoid arthritis. Joint pain or functional decline from joint destruction that cannot be treated non-surgically can be an indication for joint replacement surgery. An "end-stage" disease, at this point, seeks to relieve pain for the patient and restore the patient's ability to move. There are many different types of surgeries, so each patient's needs should be evaluated individually.

The most common applications of tenosynovectomy are in the hand, where chronically inflamed tendon sheaths are removed or a recent tendon rupture is repaired [59]. Radiosynovectomy is a non-surgical alternative to surgical synovectomy; it involves injections of radioactive particles into the joint, is cost-effective, and can treat multiple joints simultaneously [60]. Most commonly, ruptured tendons are repaired with arthroscopy, predominantly in the rotator cuff of the shoulder. Inflamed synoviums are no longer commonly excised via arthroscopy or an open synovectomy due to more effective alternatives. One of those surgical options is osteotomy. The goal is to reposition the weight bearing bones in order to correct deformities in the knees, most commonly valgus or varus [61]. An ankle, wrist, thumb, or cervical spine can be fused to stabilize joints that cannot easily be replaced. In order to correct severe contractures around joints that cause decreased range of motion, soft-tissue release is performed; this is an older procedure that is not as commonly used as it once was, however [62].

## REMISSION:

RA progresses differently according to different studies. About 10% of early cases of RA experience natural remission. Wolfe studied 458 RA patients over 1000 years of follow-up. Of these, 14 percent accomplished remission without treatment [63]. In a separate study, 10% of 227 RA patients who were monitored for 4 years experienced remission. Twenty percent of 183 patients with early RA with mean disease duration of 11 months were in remission for at least 6 months in one study. 52% experienced spontaneous remission [64]. Remission according to ARA criteria was rare in another study by Eberhardt et al., and it occurred in only 7% of patients. Five out of ten patients had relapsing-remitting disease patterns, while 53 others had persistent course patterns [65]. In a study by Allart et al. , 508 patients with recent-onset arthritis were divided into four treatment groups and their outcomes assessed. The functional ability of patients treated with three DMADRs (methotrexate+sulfasalazine+prednisolone) or methotrexate + infleximab was compared with those treated with one DMARD alone. Combination therapy resulted in significant improvement and a lower progression of radiographic joint damage, as well as a greater rate of remission than monotherapy. Additionally, more patients were able to taper antirheumatic drugs while remaining in remission and maintaining higher life quality measures in the former group than in the latter group [66].

**CONCLUSION:**

RA is an inflammatory disease that can lead to long-term disability as well as joint damage. In order to prevent serious injuries and functional loss, early diagnosis and intervention are essential. Following treatment-to-target (T2T) recommendations, the treating physician should outline the aims and then implement the protocols to achieve and assess them. A referral to a specialist early in the treatment process can further help to ensure good results. As molecular medicine advances, we gain a better understanding of disease mechanisms, which helps in developing more effective treatments. Several ancient treatments have been optimized, and others have been developed entirely from scratch. Treatment methods for RA are expected to improve tremendously over the next decade.

**REFERENCE:**

1. https://www.mayoclinic.org/diseases-conditions/arthritis/symptoms-causes/syc-20350772

2. Guo Q, Wang Y, Xu D, Nossent J, Pavlos NJ, Xu J. Rheumatoid arthritis: pathological mechanisms and modern pharmacologic therapies. Bone research. 2018 Apr 27;6(1):1-4.

3. van der Linden MP, Le Cessie S, Raza K, van der Woude D, Knevel R, Huizinga TW, van der Helm-van Mil AH. Long-term impact of delay in assessment of patients with early arthritis. Arthritis & Rheumatism. 2010 Dec;62(12):3537-46.

4. Raza K, Stack R, Kumar K, Filer A, Detert J, Bastian H, Burmester GR, Sidiropoulos P, Kteniadaki E, Repa A, Saxne T. Delays in assessment of patients with rheumatoid arthritis: variations across Europe. Annals of the rheumatic diseases. 2011 Oct 1;70(10):1822-5.

5. Ometto F, Botsios C, Raffeiner B, Sfriso P, Bernardi L, Todesco S, Doria A, Punzi L. Methods used to assess remission and low disease activity in rheumatoid arthritis. Autoimmunity reviews. 2010 Jan 1;9(3):161-4.

6. Grennan DM, Gray J, Loudon J, Fear S. Methotrexate and early postoperative complications in patients with rheumatoid arthritis undergoing elective orthopaedic surgery. Annals of the rheumatic diseases. 2001 Mar 1;60(3):214-7.

7. Nishimura K, Sugiyama D, Kogata Y, Tsuji G, Nakazawa T, Kawano S, Saigo K, Morinobu A, Koshiba M, Kuntz KM, Kamae I. Meta-analysis: diagnostic accuracy of anti–cyclic citrullinated peptide antibody and rheumatoid factor for rheumatoid arthritis. Annals of internal medicine. 2007 Jun 5;146(11):797-808.

8. Bizzaro N, Bartoloni E, Morozzi G, Manganelli S, Riccieri V, Sabatini P, Filippini M, Tampoia M, Afeltra A, Sebastiani G, Alpini C. Anti-cyclic citrullinated peptide antibody titer predicts time to rheumatoid arthritis onset in patients with undifferentiated arthritis: results from a 2-year prospective study. Arthritis research & therapy. 2013 Feb;15(1):1-9.

9. Malmström V, Catrina AI, Klareskog L. The immunopathogenesis of seropositive rheumatoid arthritis: from triggering to targeting. Nature Reviews Immunology. 2017 Jan;17(1):60-75.

10. Padyukov L, Seielstad M, Ong RT, Ding B, Rönnelid J, Seddighzadeh M, Alfredsson L, Klareskog L, Epidemiological Investigation of Rheumatoid Arthritis (EIRA) study group. A genome-wide association study suggests contrasting associations in ACPA-positive versus ACPA-negative rheumatoid arthritis. Annals of the rheumatic diseases. 2011 Feb 1;70(2):259-65.

11. Schuerwegh AJ, Ioan-Facsinay A, Dorjee AL, Roos J, Bajema IM, Van Der Voort EI, Huizinga TW, Toes RE. Evidence for a functional role of IgE anticitrullinated protein antibodies in rheumatoid arthritis. Proceedings of the National Academy of Sciences. 2010 Feb 9;107(6):2586-91.

12. Bullock J, Rizvi SA, Saleh AM, Ahmed SS, Do DP, Ansari RA, Ahmed J. Rheumatoid arthritis: a brief overview of the treatment. Medical Principles and Practice. 2018;27(6):501-7.

13. Finckh A, Liang MH, van Herckenrode CM, de Pablo P. Long-term impact of early treatment on radiographic progression in rheumatoid arthritis: a meta-analysis. Arthritis Care & Research: Official Journal of the American College of Rheumatology. 2006 Dec 15;55(6):864-72.

14. Goekoop-Ruiterman YP, de Vries-Bouwstra JK, Allaart CF, van Zeben D, Kerstens PJ, Hazes JM, Zwinderman AH, Peeters AJ, de Jonge-Bok JM, Mallée C, de Beus WM. Comparison of treatment strategies in early rheumatoid arthritis: a randomized trial. Annals of internal medicine. 2007 Mar 20;146(6):406-15.

15. van Der Helm-van Mil AH, Detert J, Cessie SL, Filer A, Bastian H, Burmester GR, Huizinga TW, Raza K. Validation of a prediction rule for disease outcome in patients with recent-onset undifferentiated arthritis: moving toward individualized treatment decision-making. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology. 2008 Aug;58(8):2241-7.

16. Finckh A. Early inflammatory arthritis versus rheumatoid arthritis. Current opinion in rheumatology. 2009 Mar 1;21(2):118-23.

17. Gossec, L., Combescure, C., Rincheval, N., Saraux, A., Combe, B. and Dougados, M., 2010. Relative clinical influence of clinical, laboratory, and radiological investigations in early arthritis on the diagnosis of rheumatoid arthritis. Data from the French Early Arthritis Cohort ESPOIR. The Journal of rheumatology, 37(12), pp.2486-2492.

18. Arnett FC, Edworthy SM, Bloch DA, Mcshane DJ, Fries JF, Cooper NS, Healey LA, Kaplan SR, Liang MH, Luthra HS, Medsger Jr TA. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology. 1988 Mar;31(3):315-24.

19. Van der Linden MP, Knevel R, Huizinga TW, van der Helm-van Mil AM. Classification of rheumatoid arthritis: comparison of the 1987 American College of Rheumatology criteria and the 2010 American College of Rheumatology/European League Against Rheumatism criteria. Arthritis & Rheumatism. 2011 Jan;63(1):37-42.

20. Heidari B. Rheumatoid Arthritis: Early diagnosis and treatment outcomes. Caspian journal of internal medicine. 2011;2(1):161.

21. Waits JB. Rational use of laboratory testing in the initial evaluation of soft tissue and joint complaints. Primary Care: Clinics in Office Practice. 2010 Dec 1;37(4):673-89.

22. Birch Jr JT, Bhattacharya S. Emerging trends in diagnosis and treatment of rheumatoid arthritis. Primary care. 2010 Dec 1;37(4):779-92.

23. Svensson B, Boonen A, Albertsson K, van der Heijde D, Keller C, Hafström I, BARFOT Study Group. Low-dose prednisolone in addition to the initial disease-modifying antirheumatic drug in patients with early active rheumatoid arthritis reduces joint destruction and increases the remission rate: a two-year randomized trial. Arthritis & Rheumatism. 2005 Nov;52(11):3360-70.

24. Quinn MA, Green MJ, Marzo-Ortega H, Proudman S, Karim Z, Wakefield RJ, Conaghan PG, Emery P. Prognostic factors in a large cohort of patients with early undifferentiated inflammatory arthritis after application of a structured management protocol. Arthritis & Rheumatism. 2003 Nov;48(11):3039-45.

25. Heidari B, Hajian K, Jahi AF. Correlation between serum CRP levels and disease activity in rheumatoid arthritis. Kowsar Med J. 2004;9:208-20.

26. Grassi W, De Angelis R, Lamanna G, Cervini C. The clinical features of rheumatoid arthritis. European journal of radiology. 1998 May 1;27:S18-24.

27. Heidari B, Abedi H, Firouzjahi A, Heidari P. Diagnostic value of synovial fluid anti-cyclic citrullinated peptide antibody for rheumatoid arthritis. Rheumatology international. 2010 Sep 1;30(11):1465-70.

28. Heidari B, Heidari P, TAYEBI ME. The value of changes in CRP and ESR for predicting treatment response in rheumatoid arthritis. APLAR Journal of Rheumatology. 2007 Apr;10(1):23-8.

29. Wakefield RJ, Gibbon WW, Conaghan PG, O'Connor P, McGonagle D, Pease C, Green MJ, Veale DJ, Isaacs JD, Emery P. The value of sonography in the detection of bone erosions in patients with rheumatoid arthritis: a comparison with conventional radiography. Arthritis & Rheumatism. 2000 Dec;43(12):2762-70.

30. Rahmani M, Chegini H, Najafizadeh SR, Azimi M, Habibollahi P, Shakiba M. Detection of bone erosion in early rheumatoid arthritis: ultrasonography and conventional radiography versus non-contrast magnetic resonance imaging. Clinical rheumatology. 2010 Aug 1;29(8):883-91.

31. Tamai M, Kawakami A, Uetani M, Takao S, Arima K, Iwamoto N, Fujikawa K, Aramaki T, Kawashiri SY, Ichinose K, Kamachi M. A prediction rule for disease outcome in patients with undifferentiated arthritis using magnetic resonance imaging of the wrists and finger joints and serologic autoantibodies.

Arthritis Care & Research: Official Journal of the American College of Rheumatology. 2009 Jun 15;61(6):772-8.

32. Cush JJ. Early rheumatoid arthritis--is there a window of opportunity?. The Journal of Rheumatology Supplement. 2007 Nov 1;80:1-7.

33. Combe B. Early rheumatoid arthritis: strategies for prevention and management. Best practice & research Clinical rheumatology. 2007 Feb 1;21(1):27-42.

34. Combe B. Progression in early rheumatoid arthritis. Best Practice & Research Clinical Rheumatology. 2009 Feb 1;23(1):59-69.

35. Graudal N. The natural history and prognosis of rheumatoid arthritis: association of radiographic outcome with process variables, joint motion and immune proteins. Scandinavian Journal of Rheumatology. 2004 Jan 1;33(sup118):1-37.

36. Verpoort KN, Van Dongen H, Allaart CF, Toes RE, Breedveld FC, Huizinga TW. Undifferentiated arthritis-disease course assessed in several inception cohorts. Clinical and experimental rheumatology. 2004 Sep 1;22:S12-7.

37. Finckh A, Bansback N, Marra CA, Anis AH, Michaud K, Lubin S, White M, Sizto S, Liang MH. Treatment of very early rheumatoid arthritis with symptomatic therapy, disease-modifying antirheumatic drugs, or biologic agents: a cost-effectiveness analysis. Annals of Internal Medicine. 2009 Nov 3;151(9):612-21.

38. Sizova L. Approaches to the treatment of early rheumatoid arthritis with disease-modifying antirheumatic drugs. British journal of clinical pharmacology. 2008 Aug;66(2):173-8.

39. Korpela M, Laasonen L, Hannonen P, Kautiainen H, Leirisalo-Repo M, Hakala M, Paimela L, Blåfield H, Puolakka K, Möttönen T. Retardation of joint damage in patients with early rheumatoid arthritis by initial aggressive treatment with disease-modifying antirheumatic drugs: five-year experience from the FIN-RACo study. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology. 2004 Jul;50(7):2072-81.

40. de Vries-Bouwstra JK, Goekoop-Ruiterman YP, Verpoort KN, Schreuder GM, Ewals JA, Terwiel JP, Ronday HK, Kerstens PJ, Toes RE, De Vries RR, Breedveld FC. Progression of joint damage in early rheumatoid arthritis: association with HLA–DRB1, rheumatoid factor, and anti–citrullinated protein antibodies in relation to different treatment strategies. Arthritis & Rheumatism. 2008 May;58(5):1293-8.

41. Hafström I, Albertsson K, Boonen A, Van Der Heijde D, Landewe R, Svensson B, BARFOT Study Group. Remission achieved after 2 years treatment with low-dose prednisolone in addition to disease-modifying anti-rheumatic drugs in early rheumatoid arthritis is associated with reduced joint destruction still present after 4 years: an open 2-year continuation study. Annals of the rheumatic diseases. 2009 Apr 1;68(4):508-13.

42. Kirwan JR, Bijlsma JW, Boers M, Shea B. Effects of glucocorticoids on radiological progression in rheumatoid arthritis. Cochrane database of systematic reviews. 2007(1).

43. Fox RI, Herrmann ML, Frangou CG, Wahl GM, Morris RE, Kirschbaum BJ. How does leflunomide modulate the immune response in rheumatoid arthritis?. BioDrugs. 1999 Oct;12(4):301-15.

44. Gibofsky A. Combination therapy for rheumatoid arthritis in the era of biologicals. HSS Journal. 2006 Feb;2(1):30-41.

45. Shiel WC Jr. Rheumatoid Arthritis. 2017 (accessed 2017 May 12). Available from: http://www.medicinenet.com/rheumatoid_arthritis/article.htm.

46. Rein P, Mueller RB. Treatment with biologicals in rheumatoid arthritis: an overview. Rheumatology and therapy. 2017 Dec;4(2):247-61.

47. Tovey MG, Lallemand C. Immunogenicity and other problems associated with the use of biopharmaceuticals. Therapeutic advances in drug safety. 2011 Jun;2(3):113-28.

48. Gay RD, Clarke AW, Elgundi Z, Domagala T, Simpson RJ, Le NB, Doyle AG, Jennings PA. Anti-TNFα domain antibody construct CEP-37247: Full antibody functionality at half the size. Inmabs 2010 Nov 1 (Vol. 2, No. 6, pp. 625-638). Taylor & Francis.

49. Perpétuo IP, Caetano-Lopes J, Rodrigues AM, Campanilho-Marques R, Ponte C, Canhão H, Ainola M, Fonseca JE. Effect of tumor necrosis factor inhibitor therapy on osteoclasts precursors in rheumatoid arthritis. BioMed research international. 2017 Feb 13;2017.

50. Mann DL. Innate immunity and the failing heart: the cytokine hypothesis revisited. Circulation research. 2015 Mar 27;116(7):1254-68.

51. Curtis JR, Singh JA. Use of biologics in rheumatoid arthritis: current and emerging paradigms of care. Clinical therapeutics. 2011 Jun 1;33(6):679-707.

52. Mok CC. Rituximab for the treatment of rheumatoid arthritis: an update. Drug design, development and therapy. 2014;8:87.

53. Emer JJ, Claire W. Rituximab: a review of dermatological applications. The Journal of clinical and aesthetic dermatology. 2009 May;2(5):29.

54. Rosman Z, Shoenfeld Y, Zandman-Goddard G. Biologic therapy for autoimmune diseases: an update. BMC medicine. 2013 Dec;11(1):1-2.

55. Gómez-Gómez GJ, Masedo Á, Yela C, del Pilar Martínez-Montiel M, Casís B. Current stage in inflammatory bowel disease: What is next?. World journal of gastroenterology: WJG. 2015 Oct 28;21(40):11282.

56. Hodge JA, Kawabata TT, Krishnaswami S, Clark JD, Telliez JB, Dowty ME, Menon S, Lamba M, Zwillich S. The mechanism of action of tofacitinib-an oral Janus kinase inhibitor for the treatment of rheumatoid arthritis. Clin Exp Rheumatol. 2016 Mar 1;34(2):318-28.

57. Cada DJ, Demaris K, Levien TL, Baker DE. Tofacitinib. Hospital pharmacy. 2013 May;48(5):413-24.

58. Louie GH, Ward MM. Changes in the rates of joint surgery among patients with rheumatoid arthritis in California, 1983–2007. Annals of the rheumatic diseases. 2010 May 1;69(5):868-71.

59. Chung KC, Pushman AG. Current concepts in the management of the rheumatoid hand. The Journal of hand surgery. 2011 Apr 1;36(4):736-47.

60. Knut L. Radiosynovectomy in the therapeutic management of arthritis. World journal of nuclear medicine. 2015 Jan;14(1):10.

61. Puddu G, Cipolla M, Cerullo G, Franco V, Giannì E. Which osteotomy for a valgus knee? Int Orthop. 2010 Feb;34(2):239–47.

62. Brooks F, Hariharan K. The rheumatoid forefoot. Current reviews in musculoskeletal medicine. 2013 Dec 1;6(4):320-7.

63. Wolfe F, Hawley DJ. Remission in rheumatoid arthritis. The Journal of Rheumatology. 1985 Apr 1;12(2):245-52.

64. Prevoo ML, Van Gestel AM, Van Thof MA, Van Rijswijk MH, Van de Putte LB, Van Riel PL. Remission in a prospective study of patients with rheumatoid arthritis. American Rheumatism Association preliminary remission criteria in relation to the disease activity score. Rheumatology. 1995 Nov 1;35(11):1101-5.

65. Eberhardt K, Fex E. Clinical course and remission rate in patients with early rheumatoid arthritis: relationship to outcome after 5 years. British journal of rheumatology. 1998 Dec 1;37(12):1324-9.

66. Allaart CF, Breedveld FC, Dijkmans BA. Treatment of recent-onset rheumatoid arthritis: lessons from the BeSt study. The Journal of Rheumatology Supplement. 2007 Nov 1;80:25-33.

## IN SILICO STUDY OF THE EFFECT OF THYMOQUINONE ON METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA)

**Akacha Madjda and Abdelhalim Khenchouche**

Laboratory of Applied Biochemistry, Faculty of Nature and Life Sciences, University of Ferhat Abbas Setif 1, Setif 19000, Algeria

**ABSTRACT**

*Staphylococcus aureus is a bacterium that have developed several resistance mechanisms, and cause infections ranging from the mildest to the most serious; mainly caused by strains resistant to methicillin (MRSA). These same strains emerge following the acquisition of new genes in their genome. These genetic changes give them the ability to resist antibiotics, especially β-lactams, either by modification of the target or by the production of β lactamase.*

*An interesting alternative to prevent this resistance is the use of many polyphenols that have antibiotic activity against S. aureus. The latter have been used for their ability to treat certain bacterial infections without harming the human body. The most widely used class of polyphenols are flavonoids. Here we used thymoquinone, which has been studied for its beneficial effects, including its antibacterial activity and its ability to inhibit MRSA infections in different ways. This study is done in silico (docking), to understand the interaction between thymoquinone and its target protein on the bacterium S. aureus -PBP2a-. Thymoquinone gave binding energy of -8.0193 Kcal/mol, which suggests the stability of the complex and would explain the possibility of inhibiting PBP2a by thymoquinone. This opens, therefore, the way to undertake in vitro studies and confirm the action of thymoquinone, but also to use it in the medicinal industry.*

*Keywords: MRSA, docking, thymoquinone, PBP2a, inhibition.*

## INTRODUCTION

Antibiotics are an excellent technique to control bacterial infections, but their abuse leads to the emergence of resistant strains in the population, which is a major challenge when treating these infections. Many strains of hazardous bacterial pathogens are now capable of combining multiple drug resistances. Staphylococcus aureus is probably the most well-known example of an antibiotic-resistant organism. Because its infections have gradually increased since obtaining resistance to methicillin, they have expanded outside of hospitals, infecting otherwise healthy persons, whereas they were previously isolated to the hospital setting (Mastouri et al., 2006; Otto, 2013).

The number of studies on the physiological effects of food-derived bioactive has exploded in recent years (Cutrim & Cortez, 2018), owing to the discovery that certain natural compounds (such as polyphenols) might boost the antibacterial activity of certain medicines, resulting in disease preventive advantages (Hennebelle et al., 2004; Moghaddam et al., 2009).

Plant products have been used to heal human foods, as evidenced by ancient scriptures from China, Egypt, and India. With the development of modern pharmacology. Active research has centered on finding the bioactive chemicals in traditional herbal remedies, as well as their mechanism of action, efficacy, and potential side effects. Flavonoids are the primary bioactive chemical elements of plants that are employed for therapeutic purposes (Swanson, 2015).

They've been demonstrated to boost antibiotic activity against S. aureus infection. In most cases, the connection between flavonoids and antibiotics was additive. However, synergy was seen in a few instances (Amin et al., 2015).

Thymoquinone is effective against MRSA infections and to boost the antibacterial activity of drugs used to treat them (Amin et al., 2015; Goel & Mishra, 2018; Teow & Atif Ali, 2015)

Herbal items that are "natural" are now regarded as a growing industry in our culture, and they are critical in the fight against various diseases (Somerville et al., 2016). Furthermore, biological investigations of screening natural-source chemical compounds allow researchers to assess their activity and establish the next steps in the hunt for new therapeutic solutions based on recognized active molecules in plants. This is especially noteworthy given the rise in bacterial resistance that has been documented (Adamczak et al., 2020).

## MATERIAL AND METHOD

The following work aims to identify the mode of action of a plant-derived phenolic metabolite (thymoquinone) through an *in silico* study.
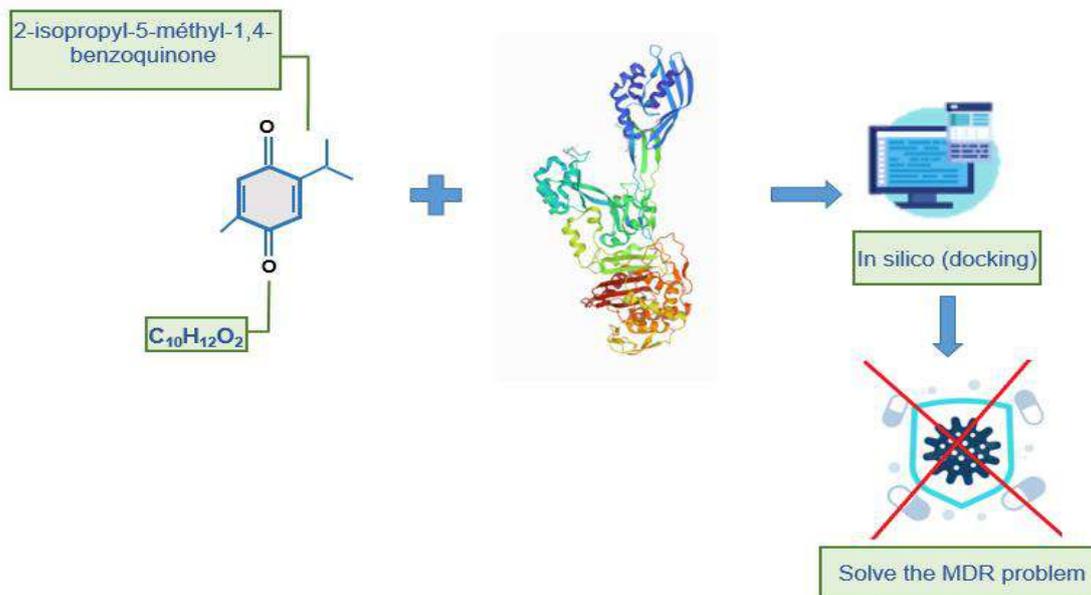


**Figure 1.** Main steps of the study.

### Software:

The docking was done with version 2008.10 of the MOE (Molecular Operating Environment) program, developed by the CCG group (Chemical Computing Group) which is a group of scientists, mathematicians, and engineers who work on a continuous program of research and development in the fields of computer-aided molecular design, computer science, Computational Chemistry, and Biology (https://www.chemcomp.com/Research.htm).

The MOE was chosen for this study because of the several benefits it offers, including:

- A simplified interface for ligand design.

- Active site detection and analysis

- Diagrams of protein-ligand interactions.

- Interaction visualization.

- Bond energy calculation

- Multiple molecule alignment that is flexible (https://www.chemcomp.com/Products.htm).

### MRSA proteins:

The crystal structure of Penicillin Binding Protein 2A (PBP-2a) was downloaded from the protein databank (http://www.rcsb.org).

**Table 1.** PBP2a (ID: 1VQQ) from the PDB (https://www.rcsb.org/structure/1VQQ).

| Classification | Biosynthetic protein |
|---|---|
| **Organism(s)** | *Staphylococcus aureus* |
| **Expression System** | *Escherichia coli* |
| **Mutation(s)** | No |
| **Experimental Data Snapshot** | Method:        X-Ray Diffraction<br>Resolution:        1.80 Å<br>R-Value Free:        0.274<br>R-Value Work:        0.237<br>R-Value Observed:    0.237 |

The origin (MRSA *S. aureus*) and high resolution of this PDB id (1VQQ) conducted us to choose it over other PDB structure IDs.
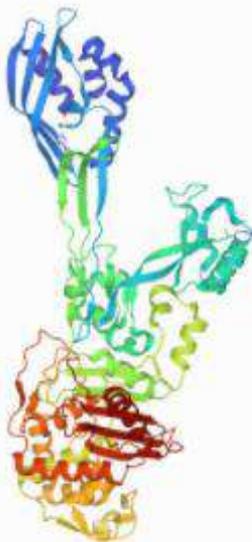
**Figure 2.** 3D structure of PBP2a from methicillin-resistant *Staphylococcus aureus* from the Protein Data Bank (**http://doi.org/10.2210/pdb1VQQ/pdb**).

**Thymoquinone:**

**Table 2.** Basic information about thymoquinone (https://pubchem.ncbi.nlm.nih.gov).

| | |
|---|---|
| **Chemical structure 1D** |  |
| **Chemical structure 3D** |  |
| **Name** | 2-methyl-5-propan-2-ylcyclohexa-2,5-diene-1,4-dione |
| **Other MeSH names** | 2-isopropyl-5-methylbenzoquinone<br>2-methyl-5-isopropyl-p-benzoquinone<br>Dihydrothymoquinone<br>Thymoquinone |
| **Molecular formula** | C10H12O2 |

## RESULTS

The protein in question was taken from the PDB "Protein Data Bank" by introducing its ID code, then its active site was identified by the site locator "MOE site finder". The score obtained after docking is shown in Table 3.

**Table 3.** *In silico* analysis of the PLP2a protein with its ligand; thymoquinone

| Compound | Score | Atoms and active site residues | | | |
|---|---|---|---|---|---|
| Thymoquinone | -8.0193 Kcal/mol | The atom of the compound | Receptor residue involved | Bond type | Bond length |
| | | O | Ser240 | H-acceptor | 2.14 Å |
| | | O | Arg241 | H-acceptor | 2.58 Å |

Within a molecule, hydrogen bonds are crucial because they govern the stability of the protein's 3D structure and allow researchers to evaluate the ligand-protein complex's stability (Verma et al., 2021). In this study, it was observed that thymoquinone performs 2 hydrogen bonds, one with Ser240 (a distance of 2.14 Å) and the other with Arg241 (a distance of 2.58 Å), both are linked to the target molecule through an oxygen atom.

Docking pictures are illustrated in Figure 3.
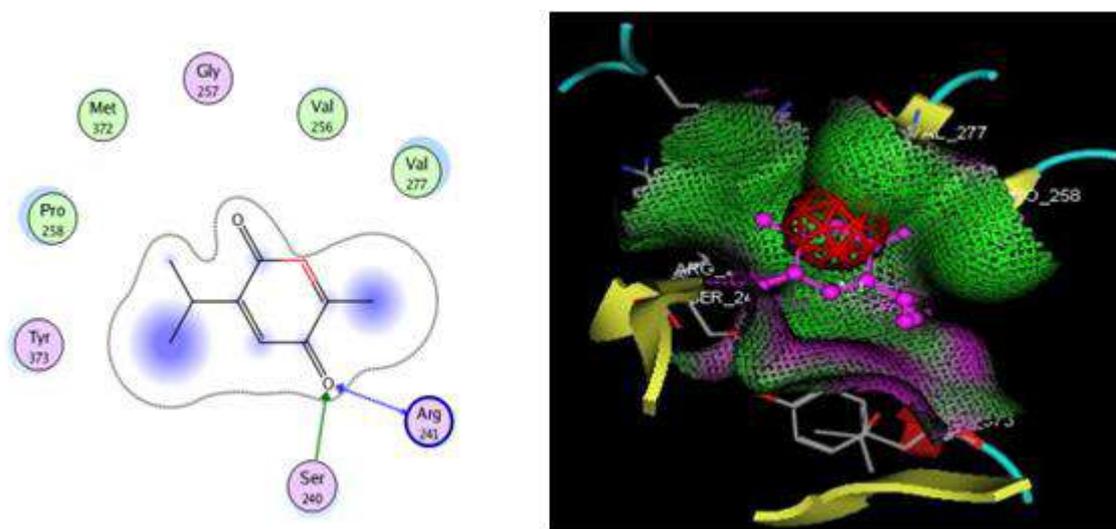


**Figure 3.** Interaction diagram (1D-3D) of TQ and PLP2a.

According to the results obtained, the PLP2a-TQ complex is quite stable, which could mean that there is a good affinity between the protein and the flavonoid in question.

## DISCUSSION

Plant metabolites like flavonoids are produced in large quantities to protect against harmful UV radiation. They can also act as intrinsic defense chemicals, protecting plant tissues from infections. As a result, this family of chemicals provides potential antibiotic candidates that can help us fight the spread of superbugs (Alhadrami et al., 2020).

Consequently, the goal of this study was to investigate the anti-MRSA potential of one of the most extensively distributed plant-derived phenolic metabolites, as well as to determine its likely mechanism of action using thorough in-silico analysis.

Thymoquinone looks to be a promising agent with a wide range of uses. Previous research has indicated that it has antibacterial activity as well as anti-inflammatory and antioxidant effects (Aggarwal & Kunnumakkara, 2009; Chaieb et al., 2011; Glamočlija et al., 2018).

Methicillin-resistant MRSA, or methicillin-resistant *Staphylococcus aureus*, is a common cause of hospital-acquired infections that are becoming increasingly difficult to treat due to resistance to all current drug classes. MRSA is formed when methicillin-susceptible *S. aureus* gains the mecA gene (the structural gene for the penicillin-binding protein PBP2a), which allows the bacteria to continue the manufacture of cell walls. Methicillin resistance is caused by the mecA gene being acquired, which reduces the bacteria's affinity for b-lactams (Enright et al., 2002; Mun et al., 2015).

Furthermore, many polyhydroxylated flavonoids have been shown to have a significant synergistic effect with -lactam antibiotics, and PBP-2a has been proposed as a potential target because it is one of the most important proteins in MRSA infections; as a result, these proteins have been identified as a potential drug target (Verma et al., 2021).

More docking and molecular dynamics research not only confirmed the primary inverse virtual screening predictions but also suggested that certain inactive derivatives could be able to change the PBP-2a allosteric site and so act as adjuvants in the treatment of MRSA resistance to b-lactam antibiotics (e.g. ampicillin). These findings backed up prior research that suggested flavonoids could help b-lactam antibiotics work better together (Gibbons, 2004; Hatano et al., 2005; Otero et al., 2013; Pushkaran et al., 2019).

*In silico* method can screen the best ligands from a vast number of molecules, making the drug discovery process easier. After that, more *in vivo*, and *in vitro* research are required to create new MRSA therapies.

## CONCLUSION

This search indicates that computer testing is a feasible and promising option to detect new inhibitors belonging to the class of plant metabolites, and that could be used to develop herbal antibiotics to combat MRSA infections. But, many responses remain to be made on the exact mechanism of action of many of these polyphenolic products. Also, the solubility of compounds such as flavonoids (which tend to crystallize when they are isolated and become very difficult to resolubilize) represents a serious obstacle.

## REFERENCES

- Adamczak, A., Ożarowski, M., & Karpiński, T. M. (2020). Antibacterial activity of some flavonoids and organic acids widely distributed in plants. *Journal of Clinical Medicine*, *9*(1). https://doi.org/10.3390/jcm9010109

- Aggarwal, B. B., & Kunnumakkara, A. B. (2009). Molecular Targets and Therapeutic Uses of Spices. In *Molecular Targets and Therapeutic Uses of Spices*. https://doi.org/10.1142/7150

- Alhadrami, H. A., Hamed, A. A., Hassan, H. M., Belbahri, L., Rateb, M. E., & Sayed, A. M. (2020). Flavonoids as potential anti-MRSA agents through modulation of PBP2A: A computational and experimental study. *Antibiotics*, *9*(9), 1–16. https://doi.org/10.3390/antibiotics9090562

- Amin, M. U., Khurram, M., Khattak, B., & Khan, J. (2015). Antibiotic additive and synergistic action of rutin, morin and quercetin against methicillin resistant Staphylococcus aureus. *BMC Complementary and Alternative Medicine*, *15*(1), 1–12. https://doi.org/10.1186/s12906-015-0580-0

- Chaieb, K., Kouidhi, B., Jrah, H., Mahdouani, K., & Bakhrouf, A. (2011). Antibacterial activity of Thymoquinone, an active principle of Nigella sativa and its potency to prevent bacterial biofilm formation. *BMC Complementary and Alternative Medicine*, *11*(1), 29. https://doi.org/10.1186/1472-6882-11-29

- Cutrim, C. S., & Cortez, M. A. S. (2018). A review on polyphenols: Classification, beneficial effects and their application in dairy products. *International Journal of Dairy Technology*, *71*(3), 564–578. https://doi.org/10.1111/1471-0307.12515

- Enright, M. C., Robinson, D. A., Randle, G., Feil, E. J., Grundmann, H., & Spratt, B. G. (2002). The evolutionary history of methicillin-resistant Staphylococcus aureus (MRSA). *Proceedings of the National Academy of Sciences of the United States of America*, *99*(11), 7687–7692. https://doi.org/10.1073/pnas.122108599

- Gibbons, S. (2004). Anti-staphylococcal plant natural products. *Natural Product Reports*, *21*(2), 263–277. https://doi.org/10.1039/b212695h

- Glamočlija, U., Padhye, S., Špirtović-Halilović, S., Osmanović, A., Veljović, E., Roca, S., Novaković, I., Mandić, B., Turel, I., Kljun, J., Trifunović, S., Kahrović, E., Pavelić, S. K., Harej, A., Klobučar, M., & Završnik, D. (2018). Synthesis, biological evaluation and docking studies of benzoxazoles derived from thymoquinone. *Molecules*, *23*(12), 1–17. https://doi.org/10.3390/molecules23123297

- Goel, S., & Mishra, P. (2018). Thymoquinone inhibits biofilm formation and has selective antibacterial activity due to ROS generation. *Applied Microbiology and Biotechnology*, *102*(4), 1955–1967. https://doi.org/10.1007/s00253-018-8736-8

- Hatano, T., Kusuda, M., Inada, K., Ogawa, T. O., Shiota, S., Tsuchiya, T., & Yoshida, T. (2005). Effects of tannins and related polyphenols on methicillin-resistant Staphylococcus aureus. *Phytochemistry*, *66*(17

SPEC. ISS.), 2047–2055. https://doi.org/10.1016/j.phytochem.2005.01.013

- Hennebelle, T., Sahpaz, S., & Bailleul, F. (2004). Polyphénols végétaux, sources, utilisations et potentiel dans la lutte contre le stress oxydatif. *Phytothérapie*, *2*(1), 3–6. https://doi.org/10.1007/s10298-004-0003-8

- Mastouri, M., Nour, M., Ben Nejma, M., Bouallegue, O., Hammami, M., & Khedher, M. (2006). Résistance aux antibiotiques de Staphylococcus aureus résistant à la méticilline: Détection des premières souches de sensibilité diminuée aux glycopeptides en Tunisie. *Pathologie Biologie*, *54*(1), 33–36. https://doi.org/10.1016/j.patbio.2004.10.009

- Moghaddam, K., Iranshahi, M., Yazdi, M., & Shahverdi, A. (2009). The combination effect of curcumin with different antibiotics against Staphylococcus aureus. *International Journal of Green Pharmacy*, *3*(2), 141–143. https://doi.org/10.4103/0973-8258.54906

- Mun, S. H., Lee, Y. S., Han, S. H., Lee, S. W., Cha, S. W., Kim, S. B., Seo, Y. S., Kong, R., Kang, D. H., Shin, D. W., Kang, O. H., & Kwon, D. Y. (2015). In vitro potential effect of morin in the combination with β-lactam antibiotics against methicillin-resistant staphylococcus aureus. *Foodborne Pathogens and Disease*, *12*(6), 545–550. https://doi.org/10.1089/fpd.2014.1923

- Otero, L. H., Rojas-Altuve, A., Llarrull, L. I., Carrasco-López, C., Kumarasiri, M., Lastochkin, E., Fishovitz, J., Dawley, M., Hesek, D., Lee, M., Johnson, J. W., Fisher, J. F., Chang, M., Mobashery, S., & Hermoso, J. A. (2013). How allosteric control of Staphylococcus aureus penicillin binding protein 2a enables methicillin resistance and physiological function. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(42), 16808–16813. https://doi.org/10.1073/pnas.1300118110

- Otto, M. (2013). Community-associated MRSA: What makes them special? *International Journal of Medical Microbiology*, *303*(6–7), 324–330. https://doi.org/10.1016/j.ijmm.2013.02.007

- Pushkaran, A. C., Vinod, V., Vanuopadath, M., Nair, S. S., Nair, S. V., Vasudevan, A. K., Biswas, R., & Mohan, C. G. (2019). Combination of Repurposed Drug Diosmin with Amoxicillin-Clavulanic acid Causes Synergistic Inhibition of Mycobacterial Growth. *Scientific Reports*, *9*(1), 1–14. https://doi.org/10.1038/s41598-019-43201-x

- Somerville, V. S., Braakhuis, A. J., & Hopkins, W. G. (2016). Effect of flavonoids on upper respiratory tract infections and immune function: A systematic review and meta-analysis. *Advances in Nutrition*, *7*(3), 488–497. https://doi.org/10.3945/an.115.010538

- Swanson, H. (2015). *Flavonoids, inflammation and cancer* (World Scie).

- Teow, S.-Y., & Atif Ali, S. (2015). Synergistic antibacterial activity of Curcumin with antibiotics against Staphylococcus aureus. *Pakistan Journal of Pharmaceutical Sciences*, *28*(6), 2109–2114.

- Verma, A. K., Ahmed, S. F., Hossain, M. S., Bhojiya, A. A., Mathur, A., Upadhyay, S. K., Srivastava, A. K., Vishvakarma, N. K., Barik, M., Rahaman, M. M., & Bahadur, N. M. (2021). Molecular docking and simulation studies of flavonoid compounds against PBP-2a of methicillin-resistant Staphylococcus aureus. *Journal of Biomolecular Structure and Dynamics*, *0*(0), 1–17. https://doi.org/10.1080/07391102.2021.1944911

## APPLICATIONS OF DIFFERENTIAL EQUATIONS IN SCIENCE AND ENGINEERING FIELD

**Jagadeesha K. C**
Department of Mathematics, IDSG Government College, Chikkamagaluru, Karnataka, India

**ABSTRACT**
*The importance and need of differential equations in engineering and in other core science field through their applications in various engineering disciplines and various types of differential equations are motivated by engineering and scientific applications. Theory and techniques for solving differential equations are applied to solve practical science problems.*

*Keywords: Differential equations, Applications, Partial differential equation, Heat equation.*

### INTRODUCTION
The Differential equations have wide applications in various engineering and science disciplines. In general, modelling of the variation of a physical quantity, such as temperature, pressure, displacement, velocity, stress, strain, current, voltage, or concentration of a pollutant, with the change of time or location, or both would result in differential equations. Similarly, studying the variation of some physical quantities on other physical quantities would also lead to differential equations. In fact, many engineering subjects, such as mechanical vibration or structural dynamics, heat transfer, or theory of electric circuits, are founded on the theory of differential equations. It is practically important for engineers to be able to model physical problems using mathematical equations, and then solve these equations so that the behaviour of the systems concerned can be studied.

### APPLICATIONS AND CONNECTIONS TO SCIENCE AND ENGINEERING AREAS
Many fundamental laws of physics and chemistry can be formulated as differential equations. In biology and economics, differential equations are used to model the behaviour of complex systems. The mathematical theory of differential equations first developed together with the sciences where the equations had originated and where the results found application. However, diverse problems, sometimes originating in quite distinct scientific fields, may give rise to identical differential equations. Whenever this happens, mathematical theory behind the equations can be viewed as a unifying principle behind diverse phenomena. As an example, consider propagation of light and sound in the atmosphere, and of waves on the surface of a pond. All of them may be described by the same second-order partial differential equation, the wave equation, which allows us to think of light and sound as forms of waves, much like familiar waves in the water. Conduction of heat, the theory of which was developed by Joseph Fourier, is governed by another second-order partial differential equation, the heat equation. It turns out that many diffusion processes, while seemingly different, are described by the same equation; the Black-Scholes equation in finance is, for instance, related to the heat equation.

### IN PHYSICS
**Classical mechanics:**
So long as the force acting on a particle is known, Newton's second law is sufficient to describe the motion of a particle. Once independent relations for each force acting on a particle are available, they can be substituted into Newton's second law to obtain an ordinary differential equation, which is called the equation of motion.

**Electrodynamics:**
Maxwell's equations are a set of partial differential equations that, together with the Lorentz force law, form the foundation of classical electrodynamics, classical optics, and electric circuits. These fields in turn underlie modern electrical and communications technologies. Maxwell's equations describe how electric and magnetic fields are generated and altered by each other and by charges and currents. They are named after the Scottish physicist and mathematician James Clerk Maxwell, who published an early form of those equations between 1861 and 1862.

**General relativity:**
The Einstein field equations (EFE; also known as "Einstein's equations") are a set of ten partial differential equations in Albert Einstein's general theory of relativity which describe the fundamental interaction of gravitation as a result of space time being curved by matter and energy. First published by Einstein in 1915 as a tensor equation, the EFE equate local space time curvature (expressed by the Einstein tensor) with the local energy and momentum within that space time (expressed by the stress-energy tensor).

## Quantum mechanics:

In quantum mechanics, the analogue of Newton's law is Schrdinger's equation (a partial differential equation) for a quantum system (usually atoms, molecules, and subatomic particles whether free, bound, or localized). It is not a simple algebraic equation, but in general a linear partial differential equation, describing the time-evolution of the system's wave function

## Other important equations:

Euler-Lagrange equation in classical mechanics, Hamilton's equations in classical mechanics, Radioactive decay in nuclear physics, Newton's law of cooling in thermodynamics, the wave equation, the heat equation in thermodynamics, Laplace's equation, which defines harmonic functions, Poisson's equation, the geodesic equation, the Navier-Stokes equations in fluid dynamics, the Diffusion equation in stochastic processes, the Convection-diffusion equation in fluid dynamics, the Cauchy-Riemann equations in complex analysis, the Poisson-Boltzmann equation in molecular dynamics, the shallow water equations, Universal differential equation and the Lorenz equations whose solutions exhibit chaotic flow.

## Radio-active Decay and Carbon Dating :

A radioactive substance decomposes at a rate proportional to its mass. This rate is called the decay rate. If $m(t)$ represents the mass of a substance at any time, then the decay rate $dm/dt$ is proportional to $m(t)$. Let us recall that the half-life of a substance is the amount of time for it to decay to one-half of its initial mass.

## Carbon Dating:

The key to the carbon dating of paintings and other materials such as fossils and rocks lies in the phenomenon of radioactivity discovered at the turn of the century. The physicist Rutherford and his colleagues showed that the atoms of certain radioactive elements are unstable and that within a given time period a fixed portion of the atoms spontaneously disintegrate to form atoms of a new element. Because radioactivity is a property of the atom, Rutherford showed that the radioactivity of a substance is directly proportional to the number of atoms of the substance present. Thus, if $N(t)$ denotes the number of atoms present at time $t$, then $dN/dt$, the number of atoms that disintegrate per unit time, is proportional to N; that is, $dN/dt = - \lambda N$

## Drug Distribution (Concentration) in Human Body:

To combat the infection to human a body appropriate dose of medicine is essential. Because the amount of the drug in the human body decreases with time medicine must be given in multiple doses. The rate at which the level $y$ of the drug in a patient's blood decays can be modeled by the decay equation $dy/dt = - ky$ where $k$ is a constant to be experimentally determined for each drug. If initially, that is, at $t = 0$ a patient is given an initial dose $y_p$, then the drug level $y$ at any time $t$ is the solution of the above differential equations, that is, $y(t) = y_p e^{-kt}$

## CONCLUSION:

This paper highlights a theoretical analysis in understanding how the concepts of physics and other areas of science have a balance between theory and applications using differential equations.

## REFERENCES

[1] J., Hale, Ordinary Differential Equations, Dover Publications, 2009

[2] P. E., Hydon, Symmetry Methods for Differential Equations, Cambridge University Press, Cambridge, 2000.

[3] D. W., Jordan and P., Smith, Nonlinear Ordinary Differential Equations, Third Edition, Oxford University Press, Oxford, 1999

[4] K. E. Brenan, S. L. Campbell, L. R. Petzold Numerical Solution of Initial Value Problems in DifferentialAlgebraic Equations, North-Holland, Amsterdam, 1989.

[5] Coddington, Earl A.; Levinson, Norman, Theory of Ordinary Differential Equations McGraw-Hill, New York,(1955).

[6] Hille, Einar, Ordinary Differential Equations in the Complex Plane, Mineola Dover Publications, (1976).

## ASSESSMENT OF AUTOTRONICS SERVICING SKILLS NEEDED BY AUTOMOBILE STUDENTS IN TECHNICAL COLLEGES IN ENUGU STATE

[1]Ariyo, Samson Oluwatimilehin, [2]Ogbu Damian, Kanayochukwu, [3]Vincent, Deborah A and Okonkwo, Emmanuel Chibuike[4]

[1, 3,4]Department of Industrial Technical Education, University of Nigeria, Nsukka
[2]Department of Science and Laboratory Technology, University of Nigeria, Nsukka

**ABSTRACT**

*The study was carried out to assess the autotronics servicing skills needed by automobile technology students in Technical Colleges in Enugu State. Survey research design was used for the study. The population for the study consists of 42 respondents comprising 9 Automobile technology technical teachers in Government Technical College Enugu, 9 Automobile technology teachers in Government Technical College Nsukka, 12 industrial technologists in ANAMCO Enugu and 12 industrial technologists in Innoson Motors, Enugu. A 22 item structured questionnaire was used as instrument for data collection. Three research questions and three null hypotheses were formulated. Cronbach alpha method was used to determine the reliability coefficient of the instrument which yielded 0.78. Frequency count and weighted mean was used to analyzed the data for answering the research questions while t-test statistics was used to test the hypotheses of no significant different at 0.05 level of significance.7 items were agreed on research question one, 7 out of 8 items were agreed on research question two while all the 7 items was agreed on research question three by the correspondents from the technical colleges and industrial technologists on the skills needed by the students on autotronics servicing. It was recommended that automobile technology teachers should be sent for further training in autotronics technologies in order to acquire more knowledge/competencies and transmit to leaner. Autotronics laboratory should be provided with machines and equipment for practical training at Technical College levels. Emphasis should be made on these deficiencies in the curriculum by curriculum planners to take care of technological changes that are taking place in the automobile industry globally. Government and members of society should equip the technical colleges with modern tools, machines, equipment and qualified personnel for effective teaching and learning.practical's. Students should be sent to the automobile industries in order for them to learn and experience those practical skills needed by the automobile industries that can enable them gain employment in such industries and also self-employed.*

*Keywords: Technical College; Autotronics, Automobile Technology, Servicing Skills, Technical Education*

## BACKGROUND TO THE STUDY

Technical Colleges are educational institutions established with the aim of training students to acquire appropriate vocational skills, knowledge, attitudes, habits of thoughts and qualities of character that enable them develop their intellectual, social, physical, emotional and economic capabilities become self-reliant and contribute to economic growth and development of their nations. Technical Colleges are different from normal secondary schools; the reason is that it places emphasis on vocational education and skills acquisition rather than how to read and write (Ariyo, Ezeda and Bamgboye, 2020). The Nigerian Technical Colleges are training grounds for individuals to acquire Technical awareness and useful skills necessary for mastering a particular trade. Students who acquired First School Leaving Certificates are of then admitted by Technical Colleges for six years of vocational Technical training. There is more time allotted for workshop practice per week than classroom theory lessons; this is to ensure that the learners acquire the practical skills that are expected of them in the world of works (Akpan, 2003). The technical subjects offered in Technical colleges include; furniture making, painting, electrical and electronics repairs and installations, welding and fabrication, plumbing, woodworking, carpentry, and Joinery and automobile technology.

Autotronics is a division under automobile technology, it is the blend of automobile and electronics, Autotronics is referred to as modern automotive technology in the field of automobile engineering (Ariyo, Udogu and Mamman, 2021). The advanced development of vehicles in the last few years was based mainly on electrical and electronic components and there is no end in sight to this development (Akshay et. al., 2016) All main functional areas in the automobile are strongly influenced by the field of electronics or even made possible by it such as anti-lock brake systems, low emission and reduced fuel consumption electronic motor management systems, anti-theft and electronic diagnosis systems. It has been observed by automotive engineers that more than eighty percent of all automotive innovation now starts from electronics. Autotronics is studied as part of automobile technology in technical colleges in Nigeria (Ariyo, Udogu and Mamman, 2021).

Automobile technology is one of the vocational education trades in Nigeria technical colleges and is designed to meet the need of craftsmen that will repair, and service automobile/autotronics parts such as head lamps, power locks, power windows, interior and exterior lighting, sensors, actuators, alternators, battery, oxygen sensors, generator, starter solenoid, starter drive, high power electrical system and other devices (Ike, Ariyo and Olaitan, 2020). It is very important that the technical colleges equip their students with the required skills that will enable them meet the need of the society in repair and services of automobile and autotronics components (National Board for Technical Education (NBTE), 2001).

Technical skill in autotronics are therefore those skills applied by the technician and students in the performance of such task as checking, detecting, servicing, maintenance and repair of automobile components (Akpakpavi, 2014). The skills of an auto mechanic will vary greatly. Some mechanics develop the skills to work on all parts of a vehicle, while others choose to specialize in a particular field; some of these skills are highlighted below. Ict skills, troubleshooting skills and electrical/electronic skills

Ict skills is the ability to use tools of information and communication technology to define one's information problem clearly, access information efficiently, evaluate the reliability, authority and bias of the sources, organize and synthesize one's information with the best ict tools available in order to use it effectively and responsibly and communicate one's new ideas effectively and ethically with the appropriate ICT tools available.

Troubleshooting skills is the act of diagnosing the source of a problem. It is used to fix problems with hardware, software, and many other products. The basic theory of troubleshooting is that you start with the most general (and often most obvious) possible problems, and then narrow it down to more specific issues, some of the troubleshooting skills are.

Electrical/electronic skills is the ability to repair and maintain wiring, switches, conduits, circuit breakers, lighting and other apparatus in buildings and other structures. They need electronics knowledge and trouble-shooting **skills** to provide maintenance services for electronically controlled systems.

According to Onifade (2005), most graduates are not properly prepared for work, especially for the industries. He maintained that, there is growing concern among industrialists that products of technical institutions do not possess adequate work skills necessary for employment in industries. However, it is expected that the knowledge acquired in schools and laboratories will prepare the students and equip them with the necessary competences that will enable them secure and maintain relevant jobs on graduation, but this is hardly being achieved. In view of this, it is obvious that, industrial growth and development will stall and continue to be delayed, if students are not fully equipped with the required knowledge. This however, certainly creates alarm and craves for assessment of the students' knowledge of autotronics servicing strategies in technical colleges.

## RESEARCH QUESTIONS
1.  What are the ICT skills needed for autotronics servicing by automobile technology students?

2.  What are the troubles shooting skills needed for autotronics servicing by automobile technology students?

3.  What are the electrical/electronic skills needed for autotronics servicing by automobile technology students?

## HYPOTHESES
**Ho$_1$**: There is no significant difference in the mean response of auto mechanics technologists and teachers on the ICT skills needed for autotronics servicing by automobile students.

**Ho$_2$**: There is no significant difference in the mean response of auto mechanics technologists and teachers on the trouble shooting skills needed for autotronics servicing by automobile students.

**Ho$_3$**: There is no significant difference in the mean response of auto mechanics technologists and teachers on the electrical/electronic skills needed for autotronics servicing by automobile students.

## METHODOLOGY
A descriptive survey design was adopted for this study. The study was carried out in all the technical colleges in Enugu State, Nigeria. The population for the study consists of 42 respondents comprising 18 Automobile technology technical teachers in two technical colleges nine from Government Technical College, Enugu and nine from Government Technical College, Nsukka and 24 technologists in automobile industries Anamco and Innoson vehicles both in Enugu state. . Since the population was not too large, the entire population was used because it was manageable for the study. A structured questionnaire was the instrument for data collection. The

questionnaire contains two sections, section A and B. Section A contains items on demographic information, while section B contains twenty two items sub-divided into three sections "1", "2" and "3". Section "1" is comprised of 7 items designed to identify the ICT skills needed for autotronics servicing by automobile technology students. Section "2" comprises of 8 items designed to identify the troubleshooting skills needed for autotronics servicing by automobile technology students. Section "3" comprises of 7 items designed to identify the Electrical/Electronic skills needed for autotronics servicing by automobile technology students. The response option of the questionnaire is structured on five-point Likert type scale as follows; Strongly Agree(SA), Agree(A), Undecided(UD), Disagree(D), Strongly Disagree(SD) with values of 5, 4, 3, 2 and 1 respectively. The instrument was subjected to face and content validation by three lecturers. The three experts are from the Department of Industrial Technical Education, University of Nigeria. The instrument was trial tested on 7 automobile technology teachers in Anambra State. This yielded a reliability co-efficience of 0.81 using the Cronbach Alpha formula. The data was collected by administering the questionnaire directly on the respondents by the researchers and two research assistants.

## METHOD OF DATA ANALYSIS

Data collected for the research were analyzed using SPSS version 20. The research questions were analyzed using mean while T-test will be used for testing the hypotheses at 0.05 level of significance. For answering the research question, any item with a mean response of 3.50 and above was considered as Agree while those below 3.50 will be regarded as Disagree. This is because 3.50 is the lower true limit of Agree. For testing the hypotheses, if the level of significance is less than 0.05 the null hypothesis was rejected otherwise it will be accepted.

## RESULTS

**Table 1 Mean responses of the ICT skills needed for autotronics servicing by automobile technology students**

| S/No | Item statement | mean | remark | Sig | remark |
|------|----------------|------|--------|-----|--------|
| 1. | How to boot up and shut down computer. | 4.40 | Agree | 0.40 | No sig |
| 2. | Knowledge on how to connect basic computer components and accessories. | 4.47 | Agree | 0.21 | No sig |
| 3. | Install computer application software's | 4.23 | Agree | 0.02 | sig |
| 4. | Run a diagnostic software, | 4.53 | Agree | 0.15 | No sig |
| 5. | Store and retrieve documents in the computer. | 4.17 | Agree | 0.76 | No sig |
| 6. | run a simulation software | 4.57 | Agree | 0.89 | No sig |
| 7. | Ability to launch, run and execute a computer programme | 4.23 | Agree | 0.17 | No sig |

Table1 shows that the mean scores range from 4.17 to 4.57. All items are above the mean rating of 3.50. This means that all the items are ICT skills needed for autotronics servicing by automobile technology students. The result also shows that there is no significant difference in the mean response of auto mechanics teachers and technologist on the ICT skills needed for autotronic servicing by automobile students for all the items except item number 3 where the result revealed that a significant different exist. This is because they all have significant value above 0.05 level of significant (P>0.05) except for item 3 which has 0.02(P<0.05). Therefore the null hypotheses of no significant different is accepted for item 1, 2, 4, 5, 6, and 7 and rejected for item 3.

**Table 2 Mean responses of the troubleshooting skills needed for autotronics servicing by automobile technology students.**

| S/No | Item statement | mean | remark | Sig | remark |
|------|----------------|------|--------|-----|--------|
| 8 | Usage of On board diagnostic machine (OBD ) Scanner | 4.33 | Agree | 0.60 | No sig |
| 9 | Constant usage of Vehicle Information and Communication System (VICS) | 4.60 | Agree | 0.02 | sig |
| 10. | Use of Advanced Car Navigation Systems for troubleshooting. | 4.50 | Agree | 0.33 | No sig |
| 11. | Connecting of auto scan tool using the appropriate connector for the vehicle | 4.43 | Agree | 0.49 | No sig |
| 12. | Usage of ohmmeter to measure resistance | 4.53 | Agree | 0.30 | No sig |
| 13. | Using diagnosis flowchart to localize trouble in sensor/actuator/circuitry | 4.63 | Agree | 0.37 | No sig |

| 14. | Usage of voltmeter to measure voltages | 4.43 | Agree | 0.18 | No sig |
|---|---|---|---|---|---|
| 15. | Navigating through vehicle emission control system to access the diagnostic trouble codes from the vehicle electronic control module. | 3.40 | Not Agree | 0.13 | No sig |

Table 2 shows that the mean items range 3.40 to 4.63. All items are above the mean rating of 3.50 except item 15 which has a mean rating of 3.40. This means that all the items except item number 15 are the troubleshooting skills needed for autotronics servicing by automobile technology students. The result in table shows that there is no significant difference in the mean response of auto mechanics teachers and technologist on the trouble shooting skills needed for autotronic servicing by automobile students for all the items except item number 9 where the result revealed that a significant different exist. This is because they all have significant value above 0.05 level of significant (P>0.05) except for item 9 which is 0.02(P<0.05). Therefore the null hypotheses of no significant different is accepted for item 8, 10, 11, 12, 13, 14, and 15 and rejected for item 9.

**Table 3 Mean responses of the Electrical/electronic skills needed for autotronics servicing by automobile technology students.**

| S/No | Item statement | Mean | remark | sig | remark |
|---|---|---|---|---|---|
| 16. | Reading and analyzing wiring diagrams | 4.43 | Agree | 0.28 | No sig |
| 17. | Ability to Check circuit resistance, continuity, using basic electrical/electronic testing devices like the voltmeter, ohmmeter, ammeter and oscilloscope. | 4.40 | Agree | 0.57 | Not sig |
| 18. | Ability to identify various wiring colour codes. | 4.37 | Agree | 0.86 | No sig |
| 19. | Ability to join the wires without mistaking one for the other. | 4.63 | Agree | 0.06 | No sig |
| 20. | Ability to use the basic electrical/electronic tools like pliers, screw drivers and testers | 4.37 | Agree | 0.75 | No sig |
| 21. | Ability to use multimeter and oscilloscope in tracing faults | 4.60 | Agree | 0.01 | Sig |
| 22. | Ability to maintain the tools before and after using them. | 4.40 | Agree | 0.21 | No sig |

Table 3 shows that the mean items range 4.37 to 4.63. All items are above the mean rating of 3.50. This means that all the items are the Electrical/electronic skills needed for autotronics servicing by automobile technology students. The result in table 3 also shows that there was no significant difference in the mean response of auto mechanics teachers and technologist on the electrical/electronic skills needed for autotronic servicing by automobile students for all the items except item number 21 where the result revealed that a significant different exist. This is because they all have significant value above 0.05 level of significant (P>0.05) except for item 21 which has 0.01(P<0.05). Therefore the null hypotheses of no significant different is accepted for item 16, 18, 17, 19, 20, 21, and 22 and rejected for item 17.

**DISCUSSION**

The findings of this study based on research question one revealed that all the 7 activities performed by students influenced their knowledge of autotronics servicing skills. This finding is in line with Usman, (2007); Ezeama, Oguejiofor, and Uzoejinwa, (2016) who revealed that the orthodox skills of auto technicians have been rendered valueless by emergence of computer technology in modern automobiles, and auto technicians lack knowledge and high ICT skills needed in order to use the modern computerized devices in testing and repairing modern automobiles.

The findings of this study based on research question two revealed that all the 8 items on the efficacy of skills in Autotronics servicing in technical colleges in Enugu State are useful. These findings confirm the necessity of improving the skills of science and technical college automobile graduates who are not performing as expected according to Ogbuanya and Fakorede (2009). They traced the inability of technical colleges' automobile graduates to perform due to lack of skills needed to diagnose faults and repair vehicles in a changing world of automobiles as a result of technological advancement in motor vehicle industry. This assertion is collaborated by Jika (2010) who observed that science technical college's automobile should complete their training as half-baked motor mechanics. Improvement in these skills will help the self-employed graduates to perform better in Autotronics, increase the life span of the vehicle and ensure safety of motor vehicle owners than relying on the traditional method.

The findings of this study based on research question three revealed that all the 7 items on activities required of automobile technology students in servicing of autotronics the following electrical and electronic skills were found useful. The findings were in agreement with Yakubu (2011). That the use of electronic circuit and advent

of computer have changed the operating systems in modern vehicles. The knowledge of Autotronics, which combines the inclusion of electronic circuits in automobile, has now posed a challenge to students in such field of study to meet up with the demands of modern technologies in automobile technologies (Horacio Martínez-Alfaro, 2011).

## CONCLUSION

Based on the study, the following conclusions are drawn:

The motivation for effective strategies of teaching practical skills in vocational and technical education colleges in Nigeria is to impart the basic scientific knowledge, attitudes and practical know-how necessary for self-reliance and national development. The practical skills can only be imparted through the use of appropriate and effective teaching methods and techniques that are capable of spurring the learners to creatively explore their potentials and maximize them for the betterment of the society.

Vocational and technical education colleges in Nigeria should not rely on the traditional methods of teaching, because imparting practical skills is paramount. Therefore, they should exhaust all effective measures to imparting the knowledge, attitudes and skills required for the individual to function effectively in the society. In order for students to acquire these skills, teachers are required to teach relevant skills to students by employing appropriate teaching and evaluation strategies.

## REFERENCES

- Akpakpavi, M. (2014). Modern automobile vehicle repair practices in micro, small and medium scale garages in Ghana. *International Journal of Science, Technology and Society,* 2(6), 216-222.

- Akpan, D K (2003). *Principles and practices of Technology Education in Nigeria.* Enugu: Floxtones Press. Benue State Science and Technical Education Board, Makurdi. December 7th, 2018

- Akshay, B. Z., Pradip, R. L., Prashant, W. W., Shubham, A. S., Rahul, R. G. (2016). Evolution of the Mechatronic systems and its Overview. *International Journal for Research in Applied Science & Engineering Technology (IJRASET).4(11), 49-54.*

- Ariyo, S.O., Ezeda, K., & Bamgboye, S. (2020). Strategies required to improve Students' Industrial Training Program between Local Businesses and Technical Colleges in Enugu State, Nigeria. *Journal of Advanced Research in Economics and Administrative Sciences,* 1 (2), 45-55.

- Ariyo, S.O., Udogu, K. C. & Mamman, D. (2021). Integration of Automobile Mechatronics Technology into the Curriculum of Automobile Trades Programmes at the Technical Colleges in Nigeria. *Randwick International of Education and Linguistics Science Journal,* 2 (1), 20-28.

- Ezeama, A.O., Oguejiofor, V. I. & Uzoejinwa, B. B. (2016).Integration of mechatronics and autotronics in technical education for greater technological innovation in Nigeria. *International Technology Research Journal (INTERJ)* 4(1), 21- 30.

- Horacio Martínez-Alfaro (2011). *Advances in mechatronics*, INTECH. DOI: 10.5772/875

- Ike, J., Ariyo, S. O. & Olaitan, O. O. (2020). Investigating the Effect of Mobile Apps on Student's Motivation and Achievement in Motor Vehicle Mechanic Work. *Middle Eastern Journal of Research in Education and Social Sciences.* 1 (2), 187-197

- Jika, O.F. (2010). Effect guided discovery method of instruction on students' performance on auto mechanics in technical colleges in Benue state. *An Unpublished M.Ed Project,* Department of Vocational Teacher Education, University of Nigeria, Nsukka.

- National Board for Technical Education (2001). *Revised national technical certificate and revised advance national technical certificate programmers for motor vehicle mechanics work trade curriculum and course specification.* Kaduna: NBTE.

- Ogbuanya, T.C. & Fakorede, S.O.A. (2009). Technical skills improvement needs of metal work technology teachers for entrepreneurship in response to MDG for quality assurance. *Journal of Nigerian. 13(1),58.*

- Onifade, O. J. (2005). Industry-Based skill Competencies Required of Graduates of Tertiary Technical Institutions for Employment in Electrical/Electronic Industries in Lagos State. *An Unpublished M.Ed Project, Department of Vocational Teacher Education, University of Nigeria, Nsukka.*

- Usman. (2007).Human resources development needs of Automobile technicians for effective maintenance of Automobiles in Niger State unpublished MED Thesis University of Nigeria Nsukka.

- Yakubu, S. (2011).The Roles and Challenges of Automobile Technology Education Teacher in Teaching NCE (Technical) Courses in Colleges of Education. *Sahel, 4*(2), 33-41.

## ASSESSMENT OF PEBRINE DISEASE IN MUGA SILKWORM

**Jonalee Barman Kakati[1*] and Tapashi Kashyap Das[2]**

[1]Research Scholar and [2]Assistant Professor, Discipline of Computer Science, HCB School of Science and Technology, Krishna Kanta Handiqui State Open University, Resham Nagar, Khanapara, Guwahati - 22, Assam, India

**ABSTRACT**

*Assam, a state in the Northeastern part of India is known for its lustrous golden silk known as Muga silk. It is the pride of Assam. Muga culture has been in practice from time immemorial. Although having a glorious history, the growth of Muga culture is not satisfactory. Disease of the silkworm is a key factor that acts as a hindrance in the development of the sericulture industry. Pebrine is the most dreaded and most infectious disease that causes heavy crop losses and thus results in significant impact on the economic parameters of Muga culture. Some rearers had to abandon sericulture due to the repeated occurrence of Pebrine disease. Pebrine is caused by the Nosema spp, a microsporidian species. The transmission of the disease occurs horizontally and vertically and spreads the infection in Antheraea assamensis silkworm colony and to their progeny. Rapid and accurate detection of the disease at an early stage can not only help the farmers involved in this industry but also can act as an catalyst in the growth of the rural economy of the countries.*

*Keywords: Sericulture, Muga, Pebrine, seed, mother moth*

**INTRODUCTION:**

India is the second largest producer of silk in the world and the highest consumer of raw silk in the world. Assam, the gateway to the Northeast of India, is the only state producing all the four varieties of natural silk namely, Muga, Eri, Mulberry and Tassar. Sericulture is an agro-based industry and plays a vital role in the rural economy. Sericulture is being practiced in the state from time immemorial. Muga is believed to have its origin in the Brahmaputra valley of Assam in India [1]. Assam holds a special position in sericulture in the production of the golden Muga silk. Sericulture is closely related to socio-economic scenario of Assam since time immemorial. The mention of Eri and Muga silk has been found in the *Kalika Purana* where they are referred to as '*Kasuga*'. The use and trade of eri and muga has also been mentioned by the famous Chinese traveler Hieun Tsang when he visited Kamrupa during the reign of King Bhaskar Barman [2]. Muga silk is the pride of Assam.

The non-mulberry silk, Muga and Eri are vanya silk. Eri and Muga rearing are not domesticated ones. They are reared outdoors. Muga silkworms are multivoltine in nature and they have about 5 to 6 generations in a year. The leaves of plants like som (Persea bombycina), soalu (Litsea monopetala) and dighloti (Litsea salicifolia) are being fed on by Antheraea assamensis. Muga silkworms produce a naturally lustrous golden yellow silk. This silk can last up to 100 years. It is also said that this silk can offer protection by absorbing up to 85% of the harmful UV rays. Such properties make the Muga silk very expensive.

Sericulture in Assam involves mostly the indigenous people, particularly the tribal communities and the women folks of the rural areas. A large number of rural people earn their livelihood from the sericulture sector and out of the total workforce nearby 60% are women. Sericulture is practiced in the traditional way by the people.

In 2014-2015, the raw Muga silk production in India was 158 metric ton and Assam's share was 86.08% of the total production [3]. Inspite of Muga silk's glorious history, the production of Muga raw silk, however, is not up to the mark in comparison to the other commercial silks of India. In 2021, only about 239 metric ton of Muga silk were produced in India. Compared to this, more than 24,000 metric ton of mulberry silk has been produced in India in the same year. This has led the price of the muga silk sour even higher. The limited supply of the authentic Muga silk has even led some producers to fill the gap with fake Muga. To combat the rise of the fake Muga, the government of India in 2007, designated Assam Muga silk as a protected Geographical Indication (GI).

**PROBLEMS OF SERICULTURE:**

There may be many different reasons attributed to the slow production of Muga. Changes in the climatic conditions, shortage of food plants, rainfall, humidity, non-availability of good seeds, pests and diseases, pollution may be some of them. Among these problems, shortage of disease-free healthy seeds is of main concern. A huge gap exists between the demand and supply of such seeds in the Eri and Muga rearing. Farmers have to collect the seed cocoons at very high price from different parts of the state. The reason for this is the unavailability of disease free Muga seeds. The success of sericulture crops mostly depends upon quality of seeds. On the other hand, a good and healthy crop can only ensure quality seed production. Thus the production

of this valuable silk is decreasing day by day. There is a lack of supply of the disease free layings (DFLs) from the government sources. Disease identification of the silkworm is one of the major constraints in sericulture industry [4]. Seed, known as *Polu koni* in Assamese, is the backbone of sericulture industry. Timely supply of diseases free healthy seeds can only ensure the sustainability of this industry. The seed production centers are known as *grainages*. Disease free layings are produced in these centers and then distributed to the Muga farmers for rearing.

## DISEASES OF MUGA SILKWORM:

Muga silkworms are susceptible to different diseases caused by bacteria, fungus, virus and protozoa. The different diseases of muga silkworm are namely,

Flacherie, Grasserie, Muscardine and Pebrine disease.

Flacherie, which is locally known as *Mughlaga rog*, is a bacterial disease caused by Streptococci, bacilus bacteria.

Grasserie is another disease which is also called *Phularog* in Assam. It is a viral diseases caused by *Borrelina virus*.

Muscardine is also a disease of Seri silkworms. Both white and green Muscardine are prevalent in Seri silkworm. The causal organism of this fungal disease in Seri silkworm is found to be *Beauvoria sp.*

The most potential threat is the dreaded Pebrine disease of seri. It is called as "*Phutuka*" disease locally. It is caused by a protozoan, *Nosema sp.* of the family Nosematidae. Nosema bombycis is the first identified microsporidia that causes silkworm pebrine disease.

Diseases cause heavy crop losses in sericulture and it is estimated that 20 to 30% of the losses is caused by the Pebrine (microsporidian) disease alone. The Muga rearing suffers a great deal by the Pebrine disease. The disease invades the tissues of the body of the embryo, larva, pupa and the moth. The disease does not have any early symptoms thereby making it difficult to detect and control its spread.  any During the nineteenth century, the Pebrine disease was responsible for wiping out the entire sericulture industry in Europe and it still remains as one of the biggest threat to this agro-based industry. This disease is the key factor that is obstructing the developmental progress of Muga culture. The disease is transmitted to the next generation either through the eggs (seeds) or through the consumption of contaminated leaves. The Pebrine disease is different from the other silkworm diseases as it transmits both horizontally and vertically. Horizontal transmission occurs through contamination of the contaminated leaves. Vertical transmission occurs through infected eggs. The unique feature of the disease makes it difficult to eliminate as it eventually reoccurs specially in tropical countries like India where sericulture is practiced throughout the year. Thus, it needs a great deal of attention and a continuous and effective implementation of disease management irrespective of the season and the status of the disease. The disease needs to be closely monitored and any lapse in monitoring the disease can lead to serious damage to the sericulture industry.

## EXISTING METHODOLOGY IN IDENTIFICATION OF THE PEBRINE DISEASE IN SERICULTURE:

The *Nosema sp.* has two stages in its lifecycle, spore stage and vegetative stage and it depends upon the season; 7 days in winter and 4 days in winter [5]. Louis Pasteur, in 1870, developed the first pebrine diagnostic method called *Mother Moth examination* for production of disease free seeds. The process includes random selection of the mother silk moths, after they have laid the eggs. This is followed by grinding, filtering, centrifuging and then finally examining those under the microscope with 600 magnifications. The size of the female Antheraea assamensis mother moth is about 3.5 to 4 cm. Pasteur's method involves crushing the mother moths, so that the spores of Nosema sp. are liberated, and manually analysing the body fluid using a brightfield microscope (objective: 40, eyepiece: 20) for detecting pebrine spores. But, the debris present in the crushed moths' and the fat bodies present in the test sample make the pebrine detection labourious.

Later, in 1984, Fujiwara upgraded this mother moth examination method by including sample purification procedures such as centrifugation (which eliminates debris) and post-treatment with KOH (which removes fat bodies). This upgraded approach is known as improved mother moth examination method.

At present, in the grainages, mother moth examination is done for the detection of the Pebrine disease and to screen out the infected eggs and the infected adults thereby ensuring a supply of Pebrine disease free eggs. The mother moth is cut and the tissues are examined for the presence of Pebrine disease. The success of commercial muga culture depends on good quality and Pebrine free seed production. The pathogen is characterized by its

spores and is transmitted through infected ovary (transovarially transmission). The female moth of the silkworm transmits the infection and male moth has no role in the transmission [6]. The disease enters the commercial cocoon producing areas through the seeds and as a result either the crops would fail or may have serious impact on the cocoon weight. Due to Pebrine, the seed cocoon would be unfit for Disease Free Layings (DFLs). With the increase in the flaw contents of the cocoons, the raw silk produced would be of inferior quality. Thus, the ultimate net profit of the silkworm rearers of both the seed area and commercial cocoon producing areas are brought down due to the menace of Pebrine.

Individual mother moth examination is not possible in commercial seed production centers as it is a tedious, time-consuming process and not a cost effective process. So, mass moth examination is performed to overcome such problems. It is simple and adaptable for testing a large number of moths.

The mother moths are selected randomly by following the process of statistical sampling. Mother moths are collected after 72 hours of oviposition to the site of examination. Out of the emerged mother moths, only 20% of them are being tested. All the resultant samples need to be Pebrine free after the examination. If any sample is found to be containing Pebrine, the entire crop would be burnt so as to prevent further infection.

The different types of mother moth examination methods practiced to detect pebrine disease are Prick and See, Conventional, Modified Fuziwara and Delayed Mother Moth Examination by Modified Fuziwara.

## LIMITATIONS:
The Mother Moth examination that is conducted in the Muga seed production centers for the Pebrine disease detection is a time consuming and labourious process. Out of the entire lot, the Mother Moth examination is being randomly performed on only some of them. If the samples tested are found free of infection, only then the corresponding seeds are distributed amongst the people practicing sericulture. If a mother moth shows Pebrine, then not only that mother moth but the entire group of moths, eggs produced by them and the entire batch of cocoons are destroyed as a safety measure. This is necessary as it spreads the disease through contamination. The existing system of the disease detection is a labour-intensive manual inspection process. A major limitation of the silkworm disease detection is a lack of timely, reliable and accurate detection of the disease at its earliest stage. Being a manual approach, the disease detection method is also prone to subjective errors. The potential of sericulture remains unexplored because of certain difficulties with the existing conventional practice.

## CONCLUSIONS:
Technological interventions can upgrade the sericulture industry and help in the growth of rural economy in many folds. There is very little technological intervention in Muga culture. Technical innovations can develop effective systems in sericulture industry. It is a need of the time to recover this industry with the help of Artificial Intelligence technologies.

Image processing algorithms can be used to identify and classify the silkworm diseases using feature extraction methods. The use of techniques like deep learning and image processing can build a system that is not only a labour-friendly one but also develop an automated, rapid and accurate system that would help the farmers involved in Muga rearing in the early detection of the diseases, and thereby help reduce the spread of the disease. The development of the silkworm in its different stages of its lifecycle can also be studied using deep learning methods.

## FURTHER SCOPE AND PROPOSED SYSTEM:
With the advancement in machine learning and deep learning techniques, automatic disease detection and classification system is proposed that can benefit the people engaged in the sericulture industry and help contribute to the national income of the country. Machine learning and deep learning techniques have received tremendous application in almost all fields over the last few years. The concept has recently fueled an interest in the sericulture research in the field of machine learning and computer vision. With image processing, the healthy and diseased seeds and cocoons can be segregated accurately and rapidly. The enormous amount of data generated by the systems would contain extremely valuable information and the deep learning models can analyze those data much easily surpassing the traditional methods of image analysis. The models act by learning the useful representation of images. The computer-aided disease detection and diagnostic systems can augment the sericulture developmental process.

Image recognition technology using a deep learning based disease detection and classification model is proposed to detect and classify the diseases of Antheraea assamensis. The model would involve the following steps:

o   Image acquisition

o   Preprocessing of the images

o   Segmentation

o   Feature extraction

o   Classification

Prior to applying the deep learning models, the images captured needs to be preprocessed. The aim of image preprocessing is to remove the artifacts in the captured images. The noises from the images need to be removed. Segmentation helps to reduce the complexity of the images and to detect the regions of interest. Rather than processing the image as a whole, the image recognition algorithm can be applied on the selected portion of the image only. Effective feature extraction and classification techniques are important because each disease has unique spots and symptoms. The goal of feature extraction is to extract useful information for machine learning tasks. Deep learning algorithms such as Convolutional Neural Network (CNN) would analyze the images after the feature extraction process [7]. Features and classifiers are simultaneously optimized in deep learning.

**REFERENCES:**

1.  Tikader A, Kunjupillai V, Saratchandra B. Improvement of host plants of Seri silkworm (Antheraea assamensis) for higher productivity and better adaptation-A review. Plant Knowledge Journal. (2013). 2(2): 83-88

2.  Roy K, Bhattacharya C, A histo-geographical account of silk route: the caravan of trade, culture and political hegemony. Int. J. Innov. Res. Adv. Stud. (2017). 4(3): 269-72.

3.  Anonymous. Annual Report. Central Silk Board. Ministry of Textiles, Govt. of India. (2014). 15a, 123

4.  Hatibaruah D, Borah D, Saikia  N. Constraints perceived by farmers in adoption of sericulture production technologies in Jorhat district of Assam. International Journal of Agricultural Science and Research (IJASR). (Dec 2021). vol. 11, Issue 2, 175–182

5.  https://sericulture.assam.gov.in/

6.  Kumar K P, Sinha A K, Madhusudhan K N, Kulshrestha V, Satayanarayana K. Rate of Horizontal and Vertical Transmission of Nosema mylittansis, a Microsporidian Sp. Causing Pebrine Disease in the Tasar Silkworm, Antheraea mylitta. IJSRST. (2015). Vol 1, Issue 4, ISSN: 2395-602X

7.  Srivastava P, Mishra K, Awasthi V, Sahu V K, Pal P K. Plant disease detection using Convolutional Neural Network. DOI:10.21474/IJAR01/12346

## EVALUATION OF *IN-VITRO* ANTI-INFLAMMATORY ACTIVITY OF ETHANOLIC EXTRACT OF *SENNA SINGUEANA* (DEL). LOCK

### Chakali Ayyanna[1]* and Sujatha.K[2]

[1]Department of Pharmacology, CES College of Pharmacy, Kurnool, A.P, India
[2]Department of Pharmaceutical Chemistry, Sri Ramachandra Institute of Higher Education and Research, Chennai, T.N, India

**ABSTRACT**

*The present investigation was carried out to evaluate the anti-inflammatory property of Senna singueana by two different methods, namely membrane stability assay and protein denaturation assay. Five different experimental concentrations (100, 200, 300, 400 and 500 µg/ml) were used in this study. Action is observed in a dose-dependent manner. In the protein denaturation method, 500 µg/ml of the selected extract showed maximum protection (78.06%) and the standard drug provided 81.14% protection. Similarly, in the membrane stability test, the extract selected at a concentration of 500 µg/ml showed maximum protection (74.09%) and the standard drug provided 91.05% protection. In addition, the hypotonic heat hemolysis test showed maximum protection (69.34%) at a concentration of 500 µg/ml. We conclude that the ethanolic extract of Senna singueana shows potent anti-inflammatory activity at different concentrations compared with the standard drugs of Diclofenac sodium and aspirin. In addition, phytochemical analysis of Senna singueana revealed the presence of saponins, flavonoids, tannins, anthracene, phenols, amino acids and sugars. It is shown that these phytochemicals are responsible for maximum protection from protein denaturation, and membrane stability testing. Future work will focus on anti-inflammatory activity using in vivo models.*

*Keywords: Senna singueana , Diclofenac sodium, Aspirin , Human red blood cells, inflammation and membrane stabilization .*

**INTRODUCTION:**

Inflammation is defined by pathologists as a normal protective response of living body cells to injury or injury, manifested as a limited and localized way of irritation, infection, and other adverse effects. disease-causing agent. The living organism in an inflammatory state has many signs including rubor (red), calor (hot), pain (pain), tumor (swelling) in addition to lack of function [1]. Lysosomal enzymes released during inflammation induce a variety of disorders that lead to tissue damage by damaging macromolecules, and membrane lipid peroxidation is thought to be responsible for a number of disease conditions. such as heart attack, septic shock and rheumatoid arthritis, etc. This oxidative stress induces inflammatory cascades that damage cellular components.[2] The humoral and cellular mechanisms of inflammation are many and complex. They are involved in gene regulatory factors such as nuclear factor kappa B (NFκB) and signal transmitters synthesized by cells of the immune system such as cytokines and prostaglandins.[3] Many factors can cause out inflammatory process; Infectious agents, ischemia, antigen-antibody interactions, heat or physical shock.[4] Steroids, non-steroidal anti-inflammatory drugs (NSAIDs), and immunosuppressants, commonly used to reduce symptoms inflammatory diseases, require long-term treatment, and their use is often associated with serious side effects. such as gastrointestinal bleeding and peptic ulcer.[5]

This has led to the search for alternative treatments. In this regard, the secondary metabolites of various herbal medicines have been shown to be effective in the treatment of inflammation and pain.[6] The use of herbal medicines is gaining popularity due to Harm and toxicity of some synthetic drugs [7]. Senna singueana (Del.) Lock (Syn: Cassia singueana; legume) has many medicinal uses in Africa [8], including its traditional use in the fight against malaria. In Tanzania, its leaf sap is taken orally against malaria [9], and in Kenya [10] and Burkina Faso [10,11] it has been reported that oral hot powdered leaf soup can prevent malaria. and illness. fever. [9,11] Previous studies have shown that methanol root bark extract has significant anti-Plasmodium activity against Plasmodium berghei [12]. The root bark is also believed to contain atriterpene lupeol [8], which has many biological activities, including antimalarial effects in P. falciparum [13]. Although S. Singueana has many medicinal uses, there is little research on its medicinal properties and it is limited to the root bark. Because of the many medicinal uses, it is necessary to study the characteristics of leaves because they are more stable than root bark or stem bark. In addition, scientific claims have shown that various leaf extracts have antioxidant activity in vitro and in vivo [14-16].

**MATERIALS AND METHODS**

**Plant Collection:** The roots of Senna singueana (Del.) Lock were harvested in August 2019 from the hills of Tirumala, Andhra Pradesh, India. It was approved by GS.TS.K. Madhava Chetty, Department. Of Botany,

University, Tirupati, Andhra Pradesh, India. The voucher sample (Voucher NO.: 0631) has been kept in our laboratory for future reference.

**Extract preparation:** The roots of Senna singueana are dried in the shade, separated and ground into a dry powder. A sufficient amount of powder was continuously hot extracted in a Soxhlet apparatus using ethanol as solvent over a temperature range of 60- 70 °C. The extract was evaporated by simple evaporation until the solvent was removed from the given extract.

**Methodology:**
**Assessment of In vitro anti-inflammatory activity**
In vitro Evaluation of anti-inflammatory activity

**1.Albumin denaturation inhibition:** Anti-inflammatory activity of ethanolic root extracts of Senna singueana was studied according to the procedure of Mizushima et al. and Sakat et al. [17, 18] with some modifications. The inhibition of albumin denaturation was performed according to the protocol. The reaction mixture consisted of an equal volume of test extract of different concentrations (100–500 μg/ml) of bovine albumin. The pH of the reaction mixture was adjusted using a small amount of 1N HCl. The sample extract was incubated at 37 °C for 20 min and then heated at 51 °C for 20 min. The absorbance is measured after cooling the sample to room temperature. The turbidity formed was measured at 660 nm using an ultraviolet (UV) visible spectrometer (Model: Shimadzu UV1800). The percentage inhibition of protein denaturation was calculated as follows

**%inhibition** = [ Abs control -Abs sample]/Abs control×100

**2.    Membrane stabilization:**
Prepare a red blood cell (RB) suspension [18,19]. Blood was obtained from a healthy volunteer who had not taken nonsteroidal anti-inflammatory drugs for 2 weeks prior to the test. Blood samples were centrifuged at 3000 rpm for 10 min and washed 3 times with an equal amount of normal saline. Blood volume is measured and mixed at 10% v/v in normal saline

**a.Heat-induced haemolysis:**
The activity was carried out according to the procedure of Sakat et al. and Shinde et al. [18,20] with some modifications. The reaction mixture (2 ml) consisted of 1 ml of test sample at various concentrations (100–500 μg/ml) and a 10% red blood cell suspension (1 ml). For control, only saline solution was added to the test tube. Aspirin as a reference was used. The reaction mixture was incubated in a water bath for 30 min at 56 °C. The reaction was stopped by cooling the reaction mixture under running water. The reaction mixture was then centrifuged at 2500 rpm for 5 min. The supernatant obtained was used to measure the absorbance at 560 nm. The experiment was performed three times. The rate of hemolysis was calculated as follows

%inhibition =[ Abs control -Abs sample]/Abs control×100

**b.Hypotonicity-induced haemolysis:**
Hemolysis due to hypotonicity was performed according to the protocol of Azeem et al. [21] with some modifications. Extracts of different concentrations (100–500 μg/ml), controls (diclofenac sodium 100 μg/ml) and controls were mixed separately with pH 7.0 phosphate buffer (1 ml), hyposaline (2 ml) and a suspension of RBC (0.5 ml). The reactions were incubated at 37 °C for 30 min. It was then centrifuged at 3000 rpm. The supernatant was transferred and the absorbance was performed at 560 nm. Percent hemolysis was calculated assuming 100% control.

**%protection** = 100-[OD sample / OD control] ×100

**RESULTS AND DISCUSSION**
The percentage yield of ethanol extract of root of *Senna singueana* was found to be **2.94% w/w** respectively.

**Table 1: Summary of Phytochemical constituents**

| S.No | TEST | INFERENCE |
|------|------|-----------|
| 1. | Drangendroff's test | Presence of alkaloids |
| 2. | Mayer's test | Presence of alkaloids |
| 3. | Wagner's test | Presence of alkaloids |
| 4. | Hager's test | Presence of alkaloids |
| 5. | Shinoda test | Presence of flavonoids |
| 6. | Alkaline test | Presence of flavonoids |
| 7. | Ferric chloride test | Presence of tannins |

| 8. | Test for catechin | Presence of tannins |
|---|---|---|

## Inhibition of Protein denaturation

Protein denaturation is known to cause inflammation. In thermal albumin denaturation, inhibition is very effective. Mechanism of anti-inflammatory activity investigated the ability of plant extracts to inhibit protein denaturation assay. The inhibitory efficacy of the sample is presented in Table 2. The maximum inhibition of protein denaturation for the sample and standard (diclofenac sodium) at 500 µg/mL was found to be 78.06% and 81.14, respectively. %. The $IC_{50}$ values of the sample and the standard were observed at 330 µg/mL and 360 µg/mL, respectively. From the above results, we found that the sample has less protein denaturation expression. Protein denaturation is a biochemical reaction that occurs during a chronic inflammatory response leading to loss of function in tissues. The ethanolic extract of Senna singueana root (500 µg/mL) showed higher inhibition of protein denaturation compared with other concentrations [22].

**Table 2 : Inhibition of protein denaturation assay of Ethanolic root extract of *Senna singueana***

| S.NO | Concentration (µg/mL) | % Inhibition of standard * (Diclofenac sodium) | % Inhibition of sample* (EESS) |
|---|---|---|---|
| 1 | 100 | 39.90±0.26 | 37.11±0.38 |
| 2 | 200 | 48.26±0.46 | 46.20±0.53 |
| 3 | 300 | 57.85±0.54 | 52.79±0.25 |
| 4 | 400 | 67.05±0.65 | 63.90±0.48 |
| 5 | 500 | 81.14±0.44 | 78.06±0.51 |

(*Average value of 3 replicates)

## Membrane Stabilization –
### a.Heat Induced Haemolysis:

Human erythrocytes were used to study anti-inflammatory activity in vitro by membrane stabilization method HRBC. An investigation of the stability of the HRBC membrane was performed as it is similar to the lysosomal membrane. Due to the similarity of human erythrocytes to lysosome membranes, a possible effect of the ethanolic extract of Senna singueana root might be inhibition of the release of lysosome content in neutrophils during inflammation. Hemolysis of the ethanolic extract of Senna singueana root showed significant protection at 74.09% at 500 µg/mL and $IC_{50}$ 440 µg/mL (Table 3). Aspirin was used as standard drug with a maximum inhibition of 91.05% at 500 µg/mL and $IC_{50}$ µg/mL. During lysosome stabilization, it is important to limit the inflammatory response. After restraining the inflammatory response, the release of the formed lysosomes is prevented. The ethanolic extract of Senna singueana root showed significant protection in erythrocyte membranes against heat-induced hemolysis [22].

**Table 3 : Heat induced haemolysis of Ethanolic root extract of Senna singueana**

| S.NO | Concentration (µg/mL) | % Inhibition of standard * ( Aspirin ) | % Inhibition of sample* ( EESS) |
|---|---|---|---|
| 1 | 100 | 62.90±0.34 | 45.19±0.37 |
| 2 | 200 | 85.23±0.33 | 64.35±0.45 |
| 3 | 300 | 87.59±0.36 | 67.83±0.48 |
| 4 | 400 | 89.64±0.48 | 71.83±0.43 |
| 5 | 500 | 91.05±0.38 | 74.09±0.33 |

(*Average value of 3 replicates)

## Hypotoncity Induced Haemolysis

The phenomenon based on the protective effect in hypotonic saline induced in erythrocytes is well known and good for anti-inflammatory activity. Significant protection was shown at 69.34% at a concentration of 500 µg/mL in the ethanolic extract of Senna singueana root and an $IC_{50}$ of 400 µg/mL (Table 4). Diclofenac is used as the standard drug. It showed remarkably high protection at 85.80% at a concentration of 500 µg/mL and $IC_{50}$ at a concentration of 410 µg/mL. (Table 4). [22].

**Table 4 : Hypotonicity induced haemolysis of Ethanolic root extract of Senna singueana**

| S.NO | Concentration (µg/mL) | % Inhibition of standard * (Diclofenac) | % Inhibition of sample* ( EESS) |
|---|---|---|---|
| 1 | 100 | 36.75±0.55 | 16.50±0.46 |

| 2 | 200 | 48.99±0.27 | 28.00±0.54 |
| 3 | 300 | 69.41±0.45 | 48.94±0.52 |
| 4 | 400 | 71.98±0.46 | 57.74±0.45 |
| 5 | 500 | 85.20±0.36 | 69.34±0.38 |

(*Average value of 3 replicates)

## CONCLUSION

The phytochemicals (polyphenol, alkaloid and flavonoid content) present in the ethanolic extract of Senna singueana root show potential in the formulation of anti-inflammatory drugs. EESS inhibits various inflammatory parameters such as inhibition of albumin denaturation, proteinase activity, heat hemolysis, and hypotonicity. In vitro testing for the anti-inflammatory activity of ethanolic root extracts from the Senna singueana studies provided moderate activity. This study demonstrates that the ethanolic root extract of Senna singueana has significant anti-inflammatory activity. Therefore, the sample can be suggested for the preparation of anti-inflammatory drugs. The current study gives rise to the idea that the sample could be used to discover a new anti-inflammatory drug. Further work is required to isolate, purify and characterize samples that can be used for future research.

## REFERENCES

1. Stankov, S.V. (2012 ). Definition of Inflammation, Causes ofInflammation and Possible Anti-inflammatory Strategies. The Open Inflammation Journal. 5: 1-9.

2. Seril DN, Liao J, Yang G-Y, Yang CS. Oxidative stress and ulcerative colitis-associated carcinogenesis: studies in humans and animal models. Carcinogenesis. 2003;24(3):353-62.

3. Ahmed AU. An overview of inflammation: mechanism and consequences. Frontiers in Biology. 2011;6(4):274.

4. Osadebe PO, Okoye FBC. Anti-inflammatory effects of crude methanolic extract and fractions of Alchornea cordifolia leaves. Journal of Ethnopharmacology. 2003;89(1):19-24.

5. Corley DA, Kerlikowske K, Verma R, Buffler P. Protective association of aspirin/ NSAIDs and esophageal cancer: a systematic review and meta-analysis. Gastroenterology. 2003;124(1):47-56.

6. Sheir Z, Nasr AA, Massoud A, Salama O, Badra GA, El-Shennawy H, *et al*. A safe, effective, herbal antischistosomal therapy derived from myrrh. The American Journal of Tropical Medicine and Hygiene. 2001;65(6):700-4.

7. Kumar, S. ; Bajwa1, B.S. ; Kuldeep ,S. and Kalia ,A.N. ( 2013 ).Anti-Inflammatory Activity of Herbal Plants: A Review. IJAPBC.2 (2): 272 – 281.

8. Kawanga V, Bosch CH. Senna singueana (Delile) Lock; 2007.

9. Fowler DG. Traditional Fever Remedies: A List of Zambian Plants; 2006.

10. Nanyingi MO, Mbaria JM, Lanyasunya AL, et al. Ethnopharmacological survey of Samburu district, Kenya. J Ethnobiol Ethnomed. 2008;4:14.

11. Nadembega P, Boussim JI, Nikiema JB, Poli F, Antognoni F. Medicinal plants inBaskoure, Kourittenga Province, Burkina Faso: an ethnobotanical study. J Ethnopharmacol. 2011;133:378-395.

12. Adzu B, Abbah J, Vongtau H, Gamaniel K. Studies on the use of Cassia singueana in malaria ethnopharmacy. J Ethnopharmacol. 2003;88:261-267.

13. Srinivasan T, Srivastava GK, Pathak A, et al. Solid-phase synthesis and bioevaluation of Lupeol-based libraries as antimalarial agents. Bioorg Med Chem Lett. 2002;12:2803-2806.

14. Gebrelibanos M, Asres K, Veeresham C. In vitro radical scavenging activity of the leaf and bark extracts of Senna singueana (Del.) Lock. Ethiop Pharm J. 2007;25:77-84.

15. Madubunyi II, Ode OJ. In vitro and in vivo antioxidant potential of the meth- anolic extract of Cassia singueana Delile (Fabaceae) Lock leaves. Comp Clin Path. 2012;21:1565-1569.

16. Ibrahim MA, Koorbanally NA, Islam MS. In vitro anti-oxidative activities and GC-MS analysis of various solvent extracts of Cassia singueana parts. Acta Pol Pharm. 2013;70:709-719.

17. Mizushima Y, Kobayashi M. Interaction of anti-inflammatory drugs with serum preoteins, especially with some biologically active proteins. J Pharm Pharmacol 1968;20:169-73.

18. Sakat S, Juvekar AR, Gambhire MN. In vitro antioxidant and anti-inflammatory activity of methanol extract of Oxalis corniculata Linn. Int J Pharm Pharm Sci 2010; 2:146-55.

19. Sadique J, Al-Rqobahs WA, Bughaith, EI Gindi AR. The bioactivity of certain medicinal plants on the stabilization of RBS membrane system. Fitoterapia 1989;60:525-32.

20. Shinde UA, Kulkarni KR, Phadke AS, Nair AM, Mungantiwar AA, Dikshit VJ, et al. Mast cell stabilizing and lipoxygenase inhibitory activity of Cedrus deodara (Roxb.) loud. Wood oil. Indian J Exp Biol 1999; 37:258-61.

21. Azeem AK, Dilip C, Prasanth SS, Junise V, Hanan S. Anti-inflammatory activity of the glandular extracts of Thunnus alalunga. Asia Pac J Med 2010; 3:412-20.

22. Leela prakash G, Mohan Dass S. In vitro Anti-inflammatory activity of methanol extract of Enicostemma Axillare. International journal of Drug Development & Research. 2011; 3(3):189-196.

## ENVIRONMENTAL STRESSORS

**Dr. G. Latha**

Associate Professor, Department of Business Administration, Annamalai University, Annamalainagar, Tamilnadu, India

**ABSTRACT**

*Environment is important to all living beings because they depend on the environment for their existence. Environment can satisfy the needs of human beings on one hand can also cause stress on the other hand. Ivancevich and Matteson (1987) define stress as "the interaction of the individual with the environment". Environmental stressors refer to the stressors that are found in our surroundings. Everyday routine life is full of environmental stressors. The main objective of this paper is to analyse the various environmental stressors. An attempt is also made to identify the stress experienced by respondents due to these stressors and also the strategies adopted by them to manage these environmental stressors. Students studying post-graduation in management studies are the respondents of the study. Result reveal that all the respondents have experienced environmental stressors. Noise, Crowding, Air Quality, Colour and Light, Natural and Manmade disasters, Climate, Pollution and Biological stress are the environmental stressors experienced by the respondents. The respondents adapt two strategies to cope up with environmental stress. First strategy is problem focussed coping wherein the efforts taken by individuals or group tries to directly address the problem. The second strategy is emotion focussed coping where the individual takes efforts to control the psychological response to the stressor.*

*Key Words: Environmental Stressors, outcomes, environmental protection*

### INTRODUCTION

Stress is experienced by everyone invariably without any exception. The situation and response differs between individuals. Stress is the result of a lack of fit between a person (in terms of his personality, aptitudes and abilities) and his environment when he is unable to cope with the constraints or demands encountered (Harrison, 1976). There are many sources of stress. Stress can root from the individual himself. It can also root from the group in which the individual belongs to or from the work place where the individual is employed. There are extra organizational sources of stress where stress arises from factors that are beyond the organization. Research shows that environment can also be a source of stress. Everything that surrounds us is called as environment. It not only includes living and nonliving things around us but also the physical, chemical and other natural resources that constantly interact with us. Environment is important to all living beings because they depend on the environment for their existence. In the course of their existence, human beings, either knowingly or unknowingly harm the environment. This harm on the environment retaliates back on the lives of human beings. Environmental stress can be defined as the imbalance between what is demanded from individuals and what he or she can cope up with. There are different types of environmental stressors. These stressors create a number of symptoms among individuals.

### ENVIRONMENTAL STRESSORS

Environmental stressors refer to the stressors that are found in our surroundings. Everyday routine life is full of environmental stressors. These stressors can cause minor irritations or even affect the wellbeing of individuals. A number of environmental factors are identified to influence stress among individuals. They are

**Noise:** The Propagation of noise from machines, transport system, construction activities and even from generators or air conditioners can have a harmful impact on human activity.

**Crowding**: The physical environment wherein the amount of space available is less than desired can result in stress.

**Air quality:** It is the degree to which air in a particular place is pollution free. Quality of air can also induce stress.

**Colours & Light:** Different colours can raise or reduce stress levels. Research shows that green colour can reduce anxiety and tension and can bring peace to mind. Similarly darkness and intensity of light are associated with stress levels. Prolonged exposure to darkness, very high as well as very low intensity of light can create mood swings, tension and depression.

**Natural disasters:** Disasters like flood, storm, volcano eruptions, Tsunami are natural disasters that can induce stress.

**Manmade disasters:** The disasters that are manmade like war, explosions, terrorism and accidents are also stressors.

**Climate:** Extreme temperatures whether hot or cold affects human mind and body. Extreme weather conditions create physical demands of the body which results in poor concentration as well as performance.

**Pollution:** Pollution of any kind like water, land, air affect human life there by creating stress.

**Biological Stress:** Biological stress is associated with the diverse interactions that occur among organisms of the same or different species. Diseases are the important ones that cause stress.

## METHODOLOGY

The main objective of this paper is to analyse the various environmental stressors. An attempt is also made to identify the stress experienced by respondents due to these stressors and also the strategies adopted by them to manage these environmental stressors. Students studying post graduation in management studies are the respondents of the study. The total number of respondents is 50. A questionnaire was circulated among these respondents to collect all relevant data.

## RESULT AND DISCUSSION

Results show that all the respondents experience stress due to all environmental stressors. But the level of stress varies for different stressor. Some stressors induce high levels of stress because the respondents personally experience them. Other stressors induce stress because their friends or relatives or other individuals are affected by them, which is given in Table 1. The level of stress experienced due to environmental factors is given in Figure 1.

**Table 1.** Showing the stress experienced due to environmental stressors.

| S.no | Stressor | Experience | Example | Coping strategy |
|------|----------|-----------|---------|-----------------|
| 1. | Noise | Personal experience | Vehicles, Machinery | Emotion focussed coping |
| 2. | Crowding | Personal experience | Public transport systems, common assembly | Emotion focussed coping |
| 3. | Air quality | Personal experience & others experience | AQI during bursting of crackers, industrial smoke | Problem focussed coping |
| 4. | Colour & Light | Personal experience | Power cuts | Emotion focussed coping |
| 5. | Natural disaster | Personal experience & others experience | Flood in Cuddalore and Chennai, Tsunami | Both Problem and Emotion focussed coping |
| 6. | Manmade disaster | Personal experience & others experience | Industrial accidents, Road accidents, war at the country borders | Both Problem and Emotion focussed coping |
| 7. | Climate | Personal experience | Extreme heat and cold, change in climatic conditions | Problem focussed coping |
| 8. | Pollution | Personal experience | Land, water and air | Problem focussed coping |
| 9. | Biological stress | Personal experience & others experience | Diseases due to mosquitoes like dengue, corona virus threat | Problem focussed coping |

**Figure 1** Showing Level of Stress Experienced due to Environmental Stressors
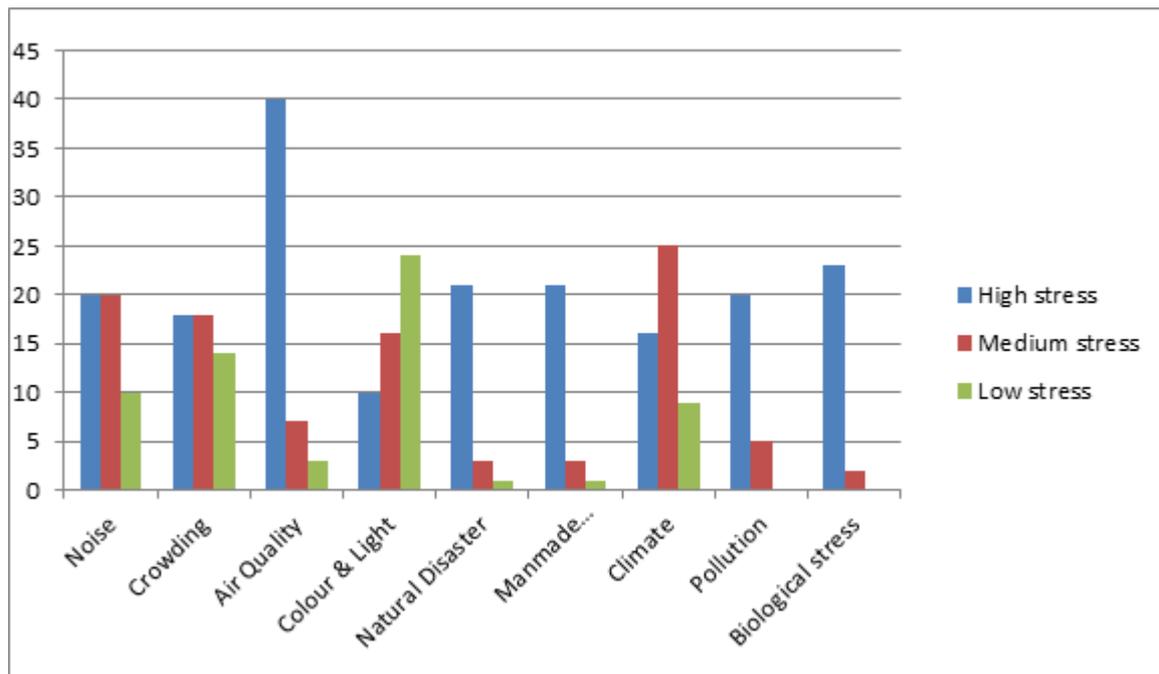
The table 1 and figure 1 clearly show that all the respondents are aware of all the environmental stressors and experience them in their life. They also experience varied levels of stress due to these stressors. Air quality, biological stress due to diseases, both natural and manmade disasters and pollution create high levels of stress for them. The respondents adapt two strategies to cope up with environmental stress. First strategy is problem focussed coping wherein the efforts taken by individuals or group tries to directly address the problem. The respondents feel that this strategy will be suitable for stress due to biological issues, climatic changes, pollution and air quality. Monitoring and regulating the use of crackers, plastics, management of waste, personal cleanliness are identified to be helpful. The second strategy is emotion focussed coping where the individual takes efforts to control the psychological response to the stressor. This strategy is helpful to cope up with noise, crowding, colour and light. Both problem and emotion focussed coping will be helpful to manage stress due to manmade and natural disasters in which directly addressing the problem will be helpful to some extent and controlling emotional response will help to cope up completely.

## CONCLUSION

Stress is inevitable in our everyday life. Environment could be a source of stress. Concern for the environment can help to reduce stress due to environmental stressors as prevention is better than cure. When an individual experiences stress due to environmental factors, problem focussed and emotional focussed coping strategies can be adapted to manage stress.

## REFERENCE

1. Harrison, 1976 In Srivastav A.K. "Role Stress in the Public Sector: An Empirical Study." Management & Change 10.1 (2006): 1-10.

2. Latha.G, 2019, Environmental Issues: Awareness and Strategies by Futuristic Generation, paper presented at UGC-SAP-DRS-II sponsored Two Day National Seminar on "Environmental Issues : Protection, Conversation and Management" on 22.03.19 & 23.03.19 organized by the Department of sociology and social Work, Annamalai University, Annamalainagar, Tamilnadu.

3. Latha G, "3 Cs of Effective Environmental Management", 7th International Istanbul Scientific Research Congress Proceedings Book, ISBN 978-605-71167-1-0, pp 664-668.

4. https://www.praxis-landgraf.de/2012/02/environmental-psychology-stress-stressors-and-its-management/

5. https://en.wikipedia.org/wiki/Environmental_issues_in_India

6. http://ssimple.wikipedia.orgwikiEnvironment

7. https://www.toppr.com/guides/biology/environmental-issues/types-of-environmental-issue

## A STUDY ON EFFECTIVENESS OF SUSTAINED NATURAL APOPHYSEAL GLIDES WITH LEMPERT MANEUVER IN BENIGN PAROXYSMAL POSITIONAL VERTIGO AMONG MIDDLE AGED WOMEN

**C. Nageswari[1], Dr. N. Meena[2] and Dr.T. Ramani Devi[3]**
[1]Research Scholar and [2]Senior Lecturer, Department of Physical Medicine and Rehabilitation, Annamalai University, Annamalainagar, Tamilnadu, India
[3]Director Ramakrishna Medical Centre

**ABSTRACT**
*Benign paroxysmal positional vertigo (BPPV) is one of the most common causes of vertigo or dizziness that is very uncomfortable. It is the sudden sensation that we are spinning or rotating and also the inside of our head is spinning. This occurs generally due to the debris called ear rocks or otoconia which has collected within a part of the inner ear. The symptoms are really distressing that is a feeling of spinning (vertigo), lightheadedness, trouble with balance, nystagmus, nausea and vomiting. Certain types of movement can bring on symptoms. Common triggers are rolling over in bed or looking up while standing. These symptoms can vary in how often they happen and how severe they are. In some people, these symptoms are so severe that they disrupt personal and work life. Very often, the symptoms go away and then come back weeks or months later. It is more common in middle-aged women. The ratio of females to males is 3:1. This study aimed to determine the efficacy of sustained natural apophyseal glides (SNAGs) with Lempert Maneuver in the treatment vertigo. Convenient samples of 30 subjects from the middle aged women who are diagnosed with Dix hall spike test and horizontal roll test positive are selected. The experimental group was treated with Sustained natural apophyseal glides with Lempert maneuver. The control group was treated with Conventional physiotherapy of vestibular exercises. After the six to eight weeks of the treatment session the scores on the Dizziness Handicap Inventory (DHI) and there is decreased frequency of dizziness or vertigo for the experimental group who undergone the SNAGS with Lempert Maneuver compared to the conventional vestibular exercises.*

*KEYWORDS: Middle aged women, BPPV,Vertigo, SNAGS, Lempert Manueuver, DHI*

**AIM OF THE STUDY**
This study is to aim the effect of sustained apophyseal glides with Lempert maneuvur in the treatment of Benign Paroxysmal Positional Vertigo.

**OBJECTIVE OF THE STUDY**
To determine to prove effect of sustained apophyseal glides with Lempert maneuvur in the treatment of benign paroxysmal positional vertigo.

**METHODOLOGY**
The convenient samples of 30 subjects from the middle aged women will take for this study will be selected based on inclusion and exclusion criteria. Detailed procedure will be explained in patient's words and informed consent will be obtained from all the participants. The subjects were then allocated into two groups group A (Experimental) and group B (Control).

Group A treated with Sustained natural apophyseal glides with Lempert maneuver. The control group were treated with Conventional physiotherapy of vestibular exercises Both groups are assessed by outcome measures pre and post interventions.

**OUTCOME MEASURES:** Dizziness Handicap Inventory (DHI)
**STATISTICAL ANALYSIS:**
The collected data will be tabulated and analyzed using descriptive & inferential statistics. To all the parameters mean and standard deviation (SD) will be used. Paired t-test will be used to analyze significant changes between pre-test & post-test measurements.

**RESULTS**
The two-tailed P value is less than 0.001 By conventional criteria, this difference is considered to be extremely statistically significant and 95% confidence interval of this difference form the both groups.

**CONCLUSION**
The aim of the study was to determine the effect of sustained apophyseal glides with Lempert maneuvur in the treatment of benign paroxysmal positional vertigo among middle aged women. After the treatment sessions the scores on the Dizziness Handicap Inventory (DHI) indicates that there is decreased frequency of dizziness or

vertigo for the experimental group who undergone the SNAGS with Lempert Maneuver compared to the conventional vestibular exercises.

## NEED OF THE STUDY:

The most common cause of BPPV in people under age 50 is head injury. The head injury need not be that direct even whiplash injuries have a substantial incidence of BPPV (Dispenza et al, 2011). Between 8% and 20% of BPPV is attributed to trauma. While one does not usually think of surgery as trauma, nevertheless BPPV can follow surgery, including dental work, where the cause is felt to be a combination of a prolonged period of supine positioning with vibration from drilling, or after surgery to the inner ear (Atacan et al 2001).The resolution rate of BPPV due to trauma and non-traumatic BPPV is similar (Aron et al, 2015, Luryi 2019), but the trauma group may require more maneuvers to cure and also are more likely to recur (Chen et al, 2019).There is also a strong association of BPPV with migraine (Ishiyama et al, 2000). Viruses affecting the ear such as those causing vestibular neuritis and Meniere's disease are significant causes (Batatsouras et al, 2012).This study prove the effect of physiotherapy intervention can relieve the symptoms of Benign paroxysmal positional vertigo.

## INTRODUCTION:

The most prevalent form of vertigo caused by peripheral vestibular abnormalities is benign paroxysmal positional vertigo (BPPV). It accounts for 20 to 30 percent of all vertigo patients examined in dizziness clinics. While the total frequency of BPPV is roughly 2.5 percent in the general population, it is more common in middle-aged women. The ratio of females to males is 3:1. This disorder is caused by problems in the inner ear. Its symptoms are repeated episodes of positional vertigo, that is, of a spinning sensation caused by changes in the position of the head. The recurrence rate for individuals at one year following initial bout of BPPV is 15% and at 5 years the recurrence rate is 37-50%.Individuals with a clinical diagnosis of anxiety are 2.7 times more likely to develop BPPV. Unilateral posterior canal is the most commonly affected canal in BPPV with 90% of all BPPV diagnosis; .Unilateral horizontal canal affects 5-15% of all BPPV diagnosis. Within a horizontal canal diagnosis, 2/3 of the cases are geotropic while 1/3 of the cases are apogeotropic. Anterior canal affects 1-2% of all BPPV diagnoses, which is the least common. The lifetime prevalence is 2.4 percent. BPPV is a biomechanical problem that occurs when there is displacement of calcium-carbonate crystals or otoconia from the utricle into one of the three fluid-filled semicircular canals of the inner ear. This causes the semi-circular canal (or canals) to be inappropriately excited, resulting in vertigo, nystagmus and occasionally nausea. The vestibular rehabilitation (VR) is a form of physical therapy using head and trunk movements and improves balance by developing vestibular system stimulation and central compensation, Sustained Natural Apophyseal Glides (SNAGs) and Lempert maneuvur is used clinically and is accepted in the Physiotherapy profession, there has been very little research to evaluate its efficacy for cervicogenic dizziness. This study focus on physiotherapy intervention can relieve symptoms of Benign paroxysmal positional vertigo.

## HYPOTHESIS OF THE STUDY
## NULL HYPOTHESIS

There will be no beneficial effect of Sustained Apophyseal glides with Lempert Maneuvur in the treatment of benign paroxysmal positional vertigo.

## ALTERNATE HYPOTHESIS

There will be beneficial effect of Sustained Apophyseal glides with Lempert Maneuvur in the treatment of benign paroxysmal positional vertigo.

## METHODOLOGY

**Study design:** Quasi Experimental Study

**Study Setting :** Shri Indra Ganesan Institute of Medical Science Physical Medicine and Rehabilitation, Trichirappalli

**Sampling method :** Convenient sampling – Odd Even method

**Sample size:** According to prevalence rate required sample size is 30 participants. Each group there are 15 participants.

The convenient samples of 30 subjects from the middle aged women will take from this study. The subjects are selection form the following criteria.

## INCLUSION CRITERIA

- Age group between 35 to 55

- Females

- Type of dizziness – posterier and lateral canal

- Imbalance with giddiness

- History of neck pain with vertigo

- History of neck movement or positions provoking the cervicogenic dizziness

- Dizziness symptoms for 3 months or longer.

- Dix hall pike test and horizontal roll test positive

- Dizziness inventory scale 0-60

## EXCLUSION CRITERIA

- Traumatic head  injury

- Light-headedness

- Psychogenic dizziness

- Vertebrobasilar insufficiency

- Migraines or other causes of poor balance

- Stroke, spinal cord pathology, cerebellar ataxia, Parkinson disease).

- Inflammatory joint disease,

- Cervical spine infection

- Marked osteoporosis, cervical spine cancer

- Pregnancy

- Ear surgery

- Brain surgery

**OUT COME MEASURES:** Dizziness Handicap Inventory (DHI)
**PROCEDURE**
A total 30 middle aged women  are included if they are diagnosis with  dix hall spike test and horizontal roll test positive, mild to moderate BPPV patients will be selected. The detailed purpose, procedure and benefits of the study will explain to the subjects after obtaining signed consent form before data collection and assured confidentiality. The recruited subjects are randomly divided into two groups.

**Group A: Sustained Natural Apophyseal glides with Lempert Maneuvur**
**SNAGS**

- Position of Patient: sitting

- Position of therapist: stands beside the patient, while his\her head is cradled between your body and your right forearm (when you stand at his\her right side)

Application:

- Start by placing your right index, middle and ring fingers at the base of the occiput. The middle phalanx of the same hand and the little finger lie over the spinous process of C2. Then place the lateral border of the left thenar eminence on top of your right little finger.

- Gentle pressure is now applied in a ventral direction on the spinous process of C2 while the skull remains still due to the control of your right forearm. (The really gentle moving force to do this comes from your left arm via the thenar eminence over the little finger on the spine of C2).

- The pressure applied by the index finger moves the lower vertebra forward under the first until the slack is taken up, then the first vertebra moves forward under the base of the skull. This is quickly taken forward until end range is felt and this position is maintained for at least 10 seconds.

Frequency of treatment: 5 glides per day continuously 10 days

**LEMPERT MANEUVUR**

1. Group Patient lie supine on examination table, affected ear down

2. Quickly turn the head 90 degrees towards unaffected side facing up

3. Wait 15-20 seconds between each head turn

4. Turn the head 90 degrees so affected ear is up

5. Have patient tuck arms to chest, roll patient into prone

6. Have patient turn on side as you roll their head 90 degrees ( return to original position, affected ear down)

7. Reposition patient so that they are facing up into sitting position

Frequency of treatment: 5 times per day for 10 days

**Group B**: **Conventional physiotherapy vestibular exercises**

- Step 1 - Have the patient sit on the edge of the bed and turn their head 45° to one side

- Step 2 - Quickly have the patient lie down on the opposite side that their head is facing

- Step 3 - Have the patient hold this position for 30 seconds

- Step 4 - Return to the sitting position

- Step 5 - Repeat steps 1-4 while facing the opposite direction, alternating until 6 repetitions have been completed.

Frequency of treatment:   5 times per day for 15 days.
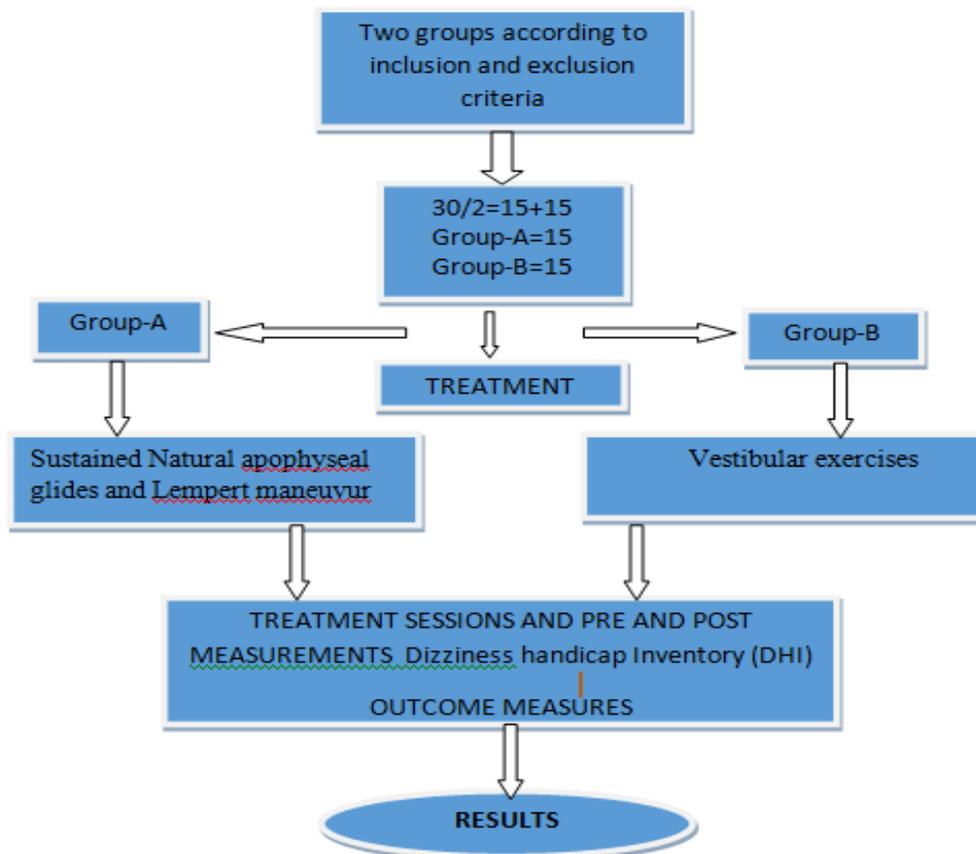


**Fig. : 1 Procedure for Data collection method**

## RESULTS

The collected data will be tabulated and analyzed using inferential statistics. To all parameters mean and standard deviation (sd) will be used. Paired t-test will be used to analyze significant changes between pre-test & post-test measurements. Unpaired t-test will be used to analyze significant changes between two groups.

### The Dizziness Handicap Inventory (DHI)

It is one of the most popular questionnaires for assessment of the dizziness handicap.The DHI was developed by Jacobson and Newman to assess disability grade The DHI consists of 25 items designed to determine dizziness-dependent changes grouped into three domains: Functional, emotional, and physical.

**Table –1. Pre test –Post test values of group –A**

| Group A | Pre- Value | | Post- value | | | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | P-Value | T –Value |
| DHI | 67.9 | 4.24 | 35.1 | 7.566 | < .001 | -13.917 |
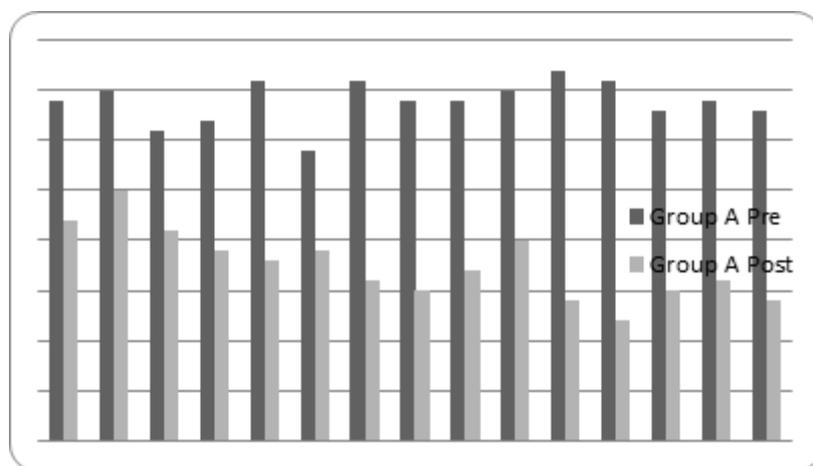


**Fig 2.GROUP A**

**Table -2 Pre test –Post test values of group –B**

| Group B | Pre- Value | | Post- value | | | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | P-Value | T –Value |
| DHI | 68.2 | 4.1 | 42.9 | 10.1 | <.001 | -12.86 |
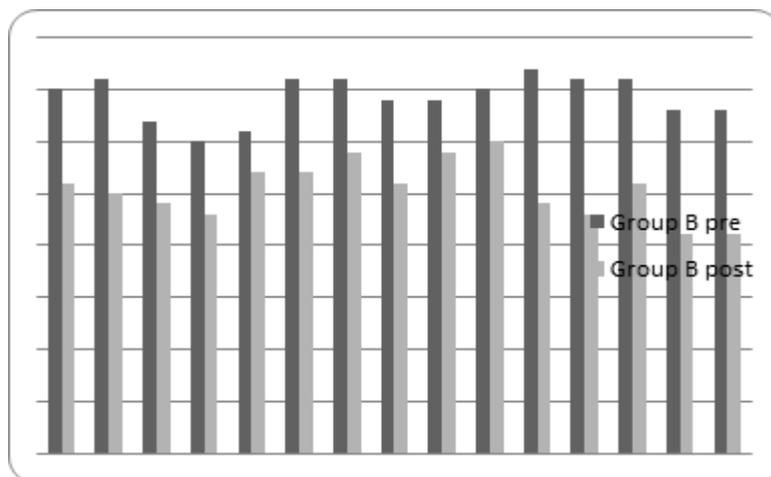


**Fig 3.GROUP B**

**Table – 3 Comparison between the post test values group A and group B.**

| | Group A | | Group B | | P-Value | T –Value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| DHI | 35.1 | 7.566 | 42.9 | 10.1 | 0.0236 | 2.3938 |
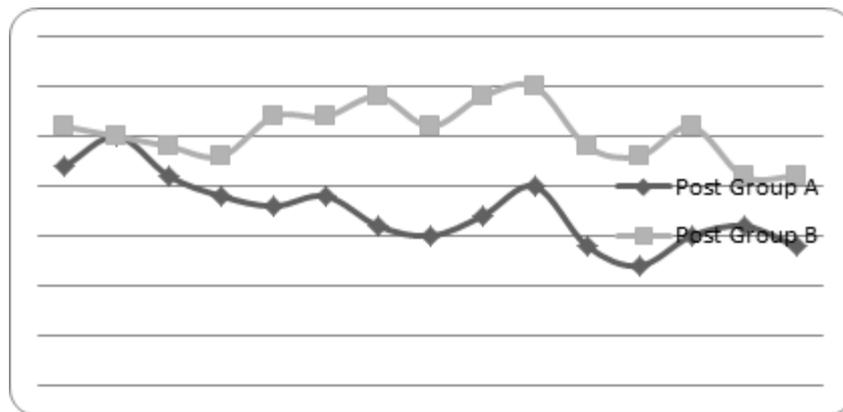
**Fig 4. Comparison of Post GROUP A and GROUP B**

## DISCUSSION
The results of this study demonstrated that SNAGS along with Lempert Maneuver can better manage the vertigo and dizziness compared to the conventional vestibular exercises. This study prove the effect of physiotherapy intervention can relieve the symptoms of Benign paroxysmal positional vertigo. Further in the comparison of pre and post values the two-tailed P value is 0.0236 , by conventional criteria, this difference is considered to be extremely statistically significant. A significance value of P value and the Confidence interval of the mean of Group One minus Group Two equals -7.800 , 95% confidence interval of this difference is from -14.47446 to -1.12554 and the value of t = 2.3938, df = 28, standard error of difference = 3.258.So the results states that SNAGS along with Lempert Maneuver can better manage the vertigo and dizziness compared to the conventional vestibular exercises by decreasing the discomfort and increasing the functional ability.

## LIMITATIONS AND FUTURE RECOMMENDATIONS
- Sample size
- Time constraints
- A study with large sample size is recommended
- Further studies shall be done with increased duration of treatment session
- A study shall be done with different outcome measures

## CONCLUSION
The aim of the study was to determine the effect of sustained apophyseal glides with Lempert maneuvur in the treatment of benign paroxysmal positional vertigo among middle aged women. After the treatment sessions the scores on the Dizziness Handicap Inventory (DHI) indicates that there is decreased frequency of dizziness or vertigo for the experimental group who undergone the SNAGS with Lempert Maneuver compared to the conventional vestibular exercises.

## REFERENCES
1. Bhattacharyya N, Baugh RF, Orvidas L, et al. Clinical practice guideline: benign paroxysmal positional vertigo. Otolaryngol Head Neck Surg. 2008;139:S47–S81.

2. Parnes LS, Agarwal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). CMAJ. 2003;169:681–693.

3. Halker RB, Barrs DM, Wellik KE, Wingerchuk DM, Demaerschalk BM. Establishing a diagnosis of benign paroxysmal positional vertigo through the Dix-Hallpike and side-lying maneuvers: a critically appraised topic. Neurologist. 2008;14:201–204.

4. Steiner WA, Ryser L, Huber E, Uebelhart D, Aeschlimann A, Stucki G. Use of the ICF model as a clinical problem-solving toll in physical therapy and rehabilitation medicine. PhysTher. 2002;82:1098–1107.

5. International Classification of Functioning, Disability, and Health (ICF). ICF Full Version. Geneva, Switzerland: World Health Organization; 2001.

6. Fife TD, Iverson DJ, Lempert T, et al. Practice parameter: therapies for benign paroxysmal positional vertigo (an evidenced-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology. Neurology. 2008;70:2067–2074.

7. Rundell SD, Davenport TE, Wagner T. Physical therapist management of acute and chronic low back pain using the World Health Organization's International Classification of Functioning, Disability and Health. PhysTher. 2009;89:82–90.

8. Treleaven J. Dizziness handicap inventory (DHI). Aust J Physiother. 2006;52:67.

9. Tamber AL, Wilhelmsen KT, Strand LI. Measurement properties of the dizziness handicap inventory by cross-sectional and longitudinal designs. Health Qual Life Outcomes. 2009;7:101.

10. Pereira AB, Santos JN, Volpe FM. Effect of Epley'smaneuver on the quality of life of paroxysmal positional benign vertigo patients. Braz J Otorhinolaryngol. 2010;76:704–708.

11. Binder,AI. Cervical spondylosis and neck pain. *BMJ.* 2007;334(7592) doi:10.1136/bmj.39127.608299.80.

12. Reid SA, Rivett DA, Katekar MG, Callister R. Sustained natural apophyseal glides (SNAGs) are an effective treatment for cervicogenic dizziness. *Manual Therapy.* 2008;13(4):357–366. doi:10.1016/j.math.2007.03.006.

13. Kazmi SAM, Iqbal S, Rafi MS, Hamidi K. Immediate Effects of Spinal Manipulation Compared to Mulligan Sustained Natural Apophyseal Glide Mobilization Technique in Cervical Pain. *Pak J Rehabil.* 2012;1(2):1–8.

14. Susan A.ReidDarren A.RivettMichael G.KatekarRobinCallister Sustained natural apophyseal glides (SNAGs) are an effective treatment for cervicogenic dizziness https://doi.org/10.1016/j.math.2007.03.006

15. Hall T, Chan HT, Christensen L, Odenthal B, Wells C, Robinson K. Efficacy of a C1-C2 self-sustained natural apophyseal glide (SNAG) in the management of cervicogenic headache. *J Orthop Sports Phys Ther.* 2007;37(3):100–107. doi:10.2519/jospt.2007.2379

## STUDY ON PROBLEMS FACED BY FEMALE TEACHERS IN ONLINE TEACHING DURING LOCKDOWN IN MUMBAI

**Dr. Susmita Daxini[1] and Vikas Mishra[2]**
[1]Associate Professor, DTSS College, Mumbai
[2]Assistant Professor, K.E.S. Shroff College, Mumbai

**ABSTRACT**

*Change in method of teaching from time to time is not a new thing, but whenever we shift from one method of teaching to another, we did with proper plan and gradually. Due to COVID-19 pandemic all of sudden shift from class room teaching to online teaching really create challenge for all teachers. In this paper, researcher studied about the different problems faced by female teachers in online teaching, teaching at different levels in Mumbai district. Through this paper an attempt is made study the relation between problems of online teaching and subject taught by teachers, perception of teachers about online teaching and also whether female teachers able to maintain balance between online teaching and their domestic work at home.*

*Keywords: Online teaching, COVID-19, Female teachers.*

## INTRODUCTION

COVID-19 which is caused by coronavirus has shaken the whole world. Wuhan city was the source of this outbreak or played a role in the initial amplification of the outbreak. In December 2019 the first patient was found in Wuhan city of China and then very rapidly it spreads in entire world and stood as a challenge in front of all human civilisation. It became very difficult for all countries to control it. As it is a contagious disease which is transferred from one human being to other, therefore it becomes essential to restrict the movement of people. To avoid gathering and crowd of people lockdown was only measure available to the government.

Indian prime minister Shri Narendra Modi declares first lockdown of 21 days in country starting from 25 March 2020. During lockdown market, malls, industries, companies, transport system all were stopped, only essential services were permitted. But lockdown was not a full proof solution because it was not a matter of 21 days or two three months. As per WHO Director-General Dr Tedros, while presenting Coronavirus disease 2019 (COVID-19) Situation Report – 94, in his regular media, cautioned that "we have a long way to go. This virus will be with us for a long time". He added that "the world cannot go back to the way things were. It became true today after one year also we are living with COVID-19.

During lockdown entire education system get disturbed, from K.G. to P.G. all lectures cancelled, schools and colleges shut down. But no one can cancel lectures and studies for so many days, so online lectures and digital teaching is the only one source available. Through online teaching or digital class, it became possible to conduct lecture of students. Online teaching is a method of teaching to others using internet. Various methods of online teaching are one-on-one video calls, group video calls and webinars. Online teaching has increased flexibility of time and location but it has several disadvantages also. It is not possible for students from financially backward families to pace with online teaching. Availability of smart phone, availability of internet service, environment at home etc are the barriers for online lectures. As online became the only mode of learning during the lockdown months of 2020, the stark inequalities of class, caste and gender became visible, as thousands of children were forced out of the education system, and thousands more faced learning setbacks. According to a UNESCO report, about 40% of low-and lower middle- income countries have not supported learners at risk of exclusion during this crisis, such as the poor, linguistic minorities and learners with disabilities. The 2020 Global Education Monitoring Report noted that efforts to maintain learning continuity during the pandemic may have actually worsened exclusion trends. During the heights of school closures in April 2020, almost 91% of students around the world were out of school. Report also says that many poorer countries opted for radio and television lessons, 55% of low-income, 73% of lower-middle-income and 93% of upper-middle-income countries adopted for online learning platforms for primary and secondary education. (The Hindu June 24, 2020)

Online teaching is not only a problem for students but also for teachers. In India where classroom teaching is going on from so many years, where teachers are not trained enough to take online class, all of sudden it was really challenging to engage student through online lectures. It was further more challenging for female teachers who have to fulfil the responsibility of home makers also. It is really difficult for female teachers to maintain balance between both.

**REVIEW OF LITERATURE:**

**Gillet-Swan (2017)** studied about challenges of online learning and emphasised the importance of providing considered and focused support for isolated students from a lecturer's perspective, a number of insights can be gained. The reflections throughout this paper potentiate the ability for the perception of difference between internal and external student.

**Gupta (2020)** studied about effect of COVID-19 on education system and food security in India, found that 0.32 billion students in India have been affected by school closures due to the Covid-19 pandemic, of these 84% resides in rural area. Dropout rates are likely to be even more severe for girls as girls may also be required to undertake additional household responsibilities as parents increase their own labour hours to cope with economic distress.

**Nangia (2020)**, studied the attitude and challenges faced by school teacher in online teaching during COVID-19, found that 82.1% of teachers are conducting online teaching without any training. Lack of appropriate materials and resources, Technical problems, Lack of in-service training, difficulty in assembling all the students for the class, Lack of cooperation from the parents, Lack of internet facilities to the students, difficulty to follow up the learning of students are the problems faced by teachers in online teaching.

**Dr Babita Dube (2020)** studied about perception of teachers on online teaching in higher education during COVID-19 lockdown. In his study he found that teachers have positive perception towards online teaching. Difference is found when perception is compared with the designation. Teachers accepted that though online teaching enhance their technical knowledge and brought knowledge diversification but online teaching increase their working hours.

**Claudiu Coman et al. (2020)** studied about students' perspective about online teaching & learning in higher education. The study offers a perspective regarding the way the educational process took place in a period of sudden and multiple changes in the Romanian higher education system. Researchers also concluded that adoption of online system will be more fruitful and impressive in long run. Weak capacity of servers used in university creates hurdles during online lectures but university is making continuous attempt to overcome this problem.

**OBJECTIVES:**

1- To study the relation between training provided to teachers and problem faced by them in online teaching.

2- To analyse the relation between subject taught by female teachers and problem faced by them in online teaching.

3- To know whether female teachers are ready to teach online in future also.

**RESEARCH METHODOLOGY:**

Research is based on primary data. Data from female teachers teaching across Mumbai in schools and colleges, is collected through questionnaire. Questionnaire is sent through google form with the help of social media applications like WhatsApp and Telegram. T-test is applied on Microsoft excel to test the hypothesis.

**HYPOTHESIS:**

**$H_0$:** There is no significant difference in problems of female teachers on the basis of subject taught by them.

**$H_1$:** There is significant difference in problems of female teachers on the basis of subject taught by them.

**$H_0$:** There is no significant difference in problem faced by trained and untrained female teachers.

**$H_1$:** There is significant difference in problem faced by trained and untrained female teachers.

**DATA ANALYSIS & HYPOTHESIS TESTING:**

**$H_0$:** There is no significant difference in perception of female teachers on the basis of subject taught by them.

**$H_1$:** There is significant difference in perception of female teachers on the basis of subject taught by them.

| t-Test: Two-Sample Assuming Unequal Variances | | |
|---|---|---|
| | *13* | *10* |
| Mean | 27.46 | 27.68115942 |
| Variance | 46.04938776 | 56.36743393 |
| Observations | 50 | 69 |
| Hypothesized Mean Difference | 0 | |

| df | 111 | |
|---|---|---|
| t Stat | -0.167761448 | |
| P(T<=t) one-tail | 0.433538112 | |
| t Critical one-tail | 1.658697265 | |
| P(T<=t) two-tail | 0.867076225 | |
| t Critical two-tail | 1.981566757 | |

Above analysis shows that t stat value is less than critical two-tail value, therefore here we cannot reject the null hypothesis. It means that there is no significant difference in perception of teachers towards online teaching on the basis of subject taught by them.

**H$_0$:** There is no significant difference in problem faced by trained and untrained female teachers.

**H$_1$:** There is significant difference in problem faced by trained and untrained female teachers.

| t-Test: Two-Sample Assuming Unequal Variances | | |
|---|---|---|
| | *10* | *14* |
| Mean | 25.48333333 | 29.71186441 |
| Variance | 65.84717514 | 29.34658095 |
| Observations | 60 | 59 |
| Hypothesized Mean Difference | 0 | |
| df | 103 | |
| t Stat | -3.348337691 | |
| P(T<=t) one-tail | 0.00056818 | |
| t Critical one-tail | 1.659782273 | |
| P(T<=t) two-tail | 0.001136359 | |
| t Critical two-tail | 1.983264145 | |

The above analysis also shows that there is no significant difference in problems faced by female teachers, during online lectures, on the basis of pre-training provided to them. It means pre training are not so effective to solve the problems of online lectures.
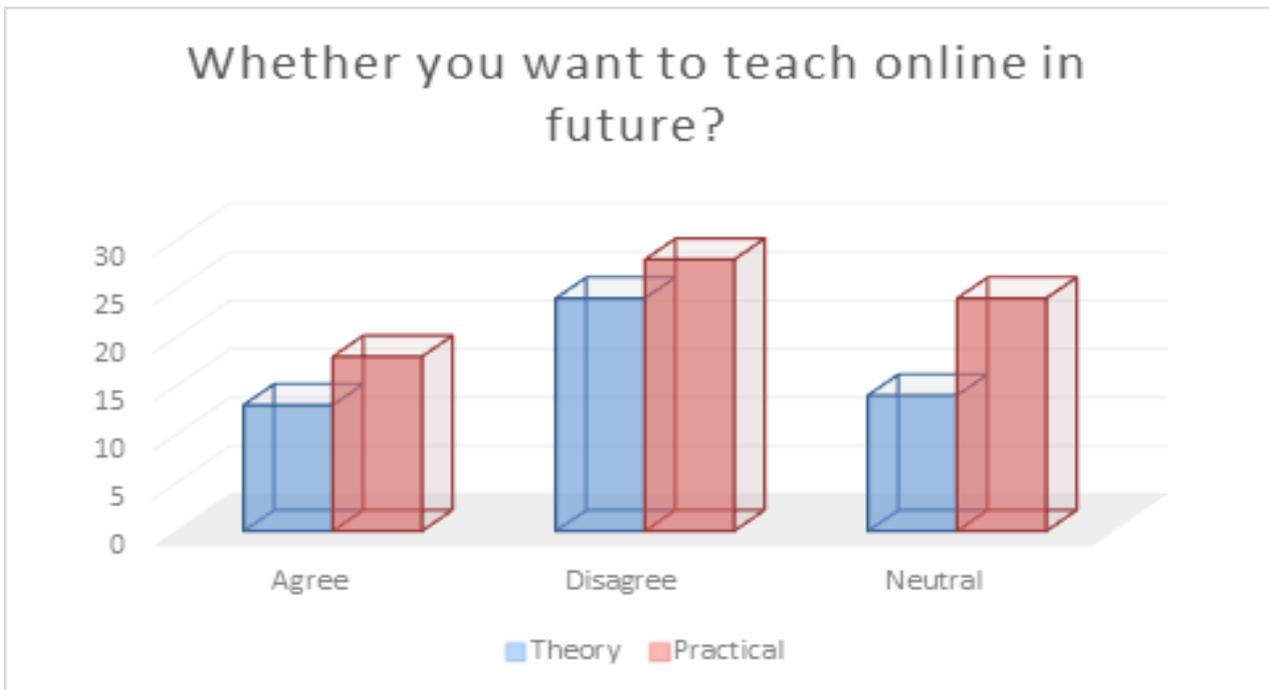


From the above bar diagram, it is clear that maximum number of female teachers are not ready to teach online in future.

**FINDINGS:**
1- From the selected respondents, 57.9% of selected teachers are teaching theory subjects, and 42.1% teachers are teaching practical subjects.

2- From the selected respondents 86.8% teachers accepted that they had not taught online before the lockdown.

3- 47.1% of teachers accepted that they are comfortable with online teaching, while 10% of teachers accepted that they feel difficulty in online teaching and rest are ok with online teaching.

4- 90% of teachers accepted that classroom teaching is a better method of teaching than online teaching.

5- 55% of teachers teaching practical subjects and 50% of teachers theory subjects accepted that they do not get proper teaching environment at home.

6- Majority of female teachers accepted that they are able to maintain balance between domestic work and online teaching.

**CONCLUSION**

All of sudden shifting from classroom teaching to online teaching was really a challenge for female teachers and specially for them who do not have any previous experience of online teaching and also, they had not acquired any training. Different subjects require different method and technique to explain concepts, which was not possible with online teaching. No face-to-face contact with students is another problem of online teaching, which is one of the main reasons of increasing disinterest of students in learning. From the research it is found that majority of teachers are not satisfied with online teaching. Female teachers teaching at different levels are able to maintain balance between domestic work and online teaching but majority of respondents accepted that they do not proper teaching environment at home.

**REFERENCES**

- al., C. C. (2020). Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. Sustainability, 1-24.

- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. Wiley Periodicals LLC, 113-115.

- Dr Babita Dubey, D. S. (2020, May). PERCEPTION OF TEACHERS ON ONLINE TEACHING IN HIGHER EDUCATION DURING COVID-19 LOCKDOWN. International Journal of Creative Research Thoughts (IJCRT), 8(5), 1017-1022.

- Gillett-Swan, J. (2017, March). The Challenges of Online Learning Supporting and Engaging the Isolated Learner. Journal of Learning Design, 10(1), 20-30.

- Gillett-Swan, J. (2017, January). The Challenges of Online Learning Supporting and Engaging the Isolated Learner. Journal of Learning Design, 10(1), 20-30.

- Gupta, M. A. (2020). Learning in times of lockdown: how Covid-19 is affecting education and food security in India. International Society for Plant Pathology and Springer Nature B.V. 2020, 793-796.

- Ip, M.-j. W. (n.d.). Tasks and Challenges Faced by Teachers in Handling an Online Project. Asian EFL Journal, 12(4).

- Jacobs, P. (n.d.). The challenges of online courses for the instructor. Research in Higher Education Journal, 1-18.

- Loknath Mishra, T. G. (2020, september). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. International Journal of Educational Research Open.

- Mansureh Kebritchi, A. L. (2017, September). Issues and Challenges for Teaching Successful Online Courses in Higher Education: A Literature Review. Journal of Educational Technology Systems, 46(1), 4-29.

- Nangia, D. S. (2020). Online Teaching during COVID 19 : Attitude and Challenges faced by School Teachers. International Journal of Disaster Recovery and Business Continuity, 11(1), 3012-3018.

- Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. (2020). Sustainability, 1-24.

- https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf

- https://academic.oup.com/cid/article/71/15/882/5721420

- https://www.labmanager.com/lab-health-and-safety/covid-19-a-history-of-coronavirus-22021

- https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf

- https://www.thehindu.com/education/coronavirus-lockdown-covid-19-widened-educational-divide-unesco-report/article31907857.ece

- https://www.hindustantimes.com/cities/mumbai-news/one-year-of-covid-19-online-mode-a-big-lesson-for-education-system-101615145414568.html

# EFFECT OF BIO ORGANIC FERTILIZER WITH REDUCED USE OF CHEMICAL FERTILIZER ENHANCED THE PRODUCTIVITY OF CROP: A REVIEW

**[1]Dr. Neelam Tripathi and [2]Swati Shakya**
[1]Department of Botany, Jai Narayan Vyas University, Jodhpur, Rajasthan, India
[2]Department of Biotechnology, Sri Satya Sai University of technology and Medical Science, Sehore (M.P.) India

**ABSTRACT**
*Extreme use of chemical fertilizers presents prospective threats to soil quality as well as Extending use of chemical manures has detrimentally impacted the atmosphere as well as natural microbial variety in the soil as well as consequently reduced soil fertility as well as plant quality. The use of chemical Manure is the most commonly accepted rule in the expansion of intensive farming nowadays. Nevertheless, the continued prolonged usage of chemical fertilizers has actually led to numerousunpredictedproperties. Additionally, countless lots of synthetic nutrients that are packed into dirt annually are not captivated by plant life. Regarding 50 percent N, as well as 90 percent P, have been reported as runoff from crop fields as well as an escape into the environment or water resources, resulting in the production of greenhouse gas in water systems. Eutrophication and salinization in the soil. The application of bio fertilizers having a mix of useful microbes in a formula with a minimized amount of chemical plant food was believed to be a lot more reliable compared to the stand-alone application of bio fertilizers or chemicals. Application of natural modifications as well as decrease of not natural fertilizer is economically possible and environmentally audio approaches to developing sustainable agriculture. Chemical/Synthetic plant foods use high temperatures, high pressure, as well as stimulants to 'fix' or change molecular nitrogen right into responsive nitrogen which is the type that can be readily made use of by plants. Organic fertilizer on the other hand as implied in their name usage biomaterials as the source of micro as well as macronutrients called for by the plants. Hence while chemical fertilizer are more concerning the addition of brand-new responsive nitrogen from the ambiance, natural fertilizer count greatly on recycling the nitrogen in the atmosphere as well as the addition of new reactive nitrogen by plants. This research checked the impacts of bio-organic manure addition, with the reduced application of chemical manure, on physical as well as soil hydraulic buildings. The use of bio-organic manure with reduced chemical manure can enhance the physical as well as hydraulic residential properties of harvested soils.*

*Keywords: Organic fertilizers, Microorganisms, Micro nutrients, synthetic fertilizers, nutrients, crop, atmosphere,*

## INTRODUCTION
### Organic fertilizer
Organic farming needs to maintain as well as boost the wellness of soil, plant, pet, humans, as well as the earth as one as well as indivisible. Health is the honesty life systems as well as integrity. It is not merely the non appearance of health problems, but the care of physical, psychological, social as well as environmental well-being. Resistance, durability, as well as rebirth are key characteristics of well-being. The duty of natural farming, whether in cultivation, processing, circulation, or ingestion is to promote the well-being of the environment as well as microorganisms from soil to human's. Particularly, organic farming is planned to produce top-notch, healthy food that adds to preventative wellbeing care as well as health. In view of this, it ought to evade the use of fertilizers, chemicals, tranquilizers, as well as artificial additives that might have adverse wellness impacts. (TNAU AGRITECH PORTAL).

Organic plant foods are manures that are made naturally as well as contain carbon (**Christian et al., 2016**). Manures are resources that can contribute to soil or plant to supply nutrients as well as to maintain development.Common organic fertilizers include mineral processing, meat processing, compost, slurry, as well as compost, plant-based manures, such as garden compost, as well as bio solids (**Guertel, & Green, 2012).**

The major natural fertilizer isanimal wastes,peat, plant wastes from farming, as well as treated sewage sludge (**Dittmar *et al*., 2009).**

### Minerals
Domestic work minerals can be extracted or fossilized, such as greensand (anaerobic marine credits), some limestone (fossil shell deposits), (**Barker, 2012**), as well as some rock phosphates (fossilized guano). (**Hillel, 2008)** Adding sedimentary rock or "liming" soil is one of method forlevitation of the pH. By raising soil pH,

microbial growth can be encouraged, which subsequently enhances biological procedures, making it possible for nutrients to flow through the soil even more easily **(Ahmed, 2013**).

## Peat

Peat, or turf, is a plant material that only partly decomposes. It gives organic material. Soils with high levels of organic material are much less possible to be portable, which aids in maintaining soil microbial well-being as well as enhances soil oxygenation as well as drainage. **(Sato, & Seckler, 2014; Beef Cattle Study Council, 2021)**

## Manure Basics

Manure is some material of natural or artificial cause (other than lime resources) which is added to the soil to provide nutrients to single or further plants important for plant growth or to relieve plant nutrient deficiencies. Many resources of manure exist, both natural as well as scientificallycreated. Any natural or factory-made product that comprises at least five percent of the 3 main nutrients—nitrogen, phosphorus, or potassium —can be measured a manure. In some cases, scientifically produced manures are called "mineral" fertilizers.Fertilizers have differing percentages of other non-essential constituents of plant vital (nitrogen, phosphorous, potassium, etc.) as well as smaller (Zn, Mn, Fe, and so on) aspects as well as impurities. This definition includes both natural (mineral) as well as organic fertilizers as well as soil conditioners, such as gypsum as well as lime, which can promote plant development by growing the access to nutrients present in the soil. Manures usually supply nutrients in inconsistentamounts:

## Primary Macronutrients

- Nitrogen, is a significant component of numerous of the furthermost vital plantlife compounds similarto pigment, for this reason, triggering fallen leave development.

- Phosphorus is associated with numerous important plant procedures like power transfer, Growth of origins, flowers, seeds, and fruit.

- Potassium: Acts as an activator of enzymes utilized in photosynthesis as well as breathing, massy stem development, the motion of water in plants, promoting flourishing as well as fruiting.

## Three Secondary Macronutrients

- Calcium, manages the plant to transfer the various nutrients in addition to be associated with the instigation of certain plant enzymes, in addition to photosynthesis as well as being associated with plant framework.

- Magnesium, in-plant nourishment, is a component of the chlorophyll radical. Such as a service provider, it is involved in countless enzyme responses as an efficient catalyst.

- Sulfur, along with some amino acids, is a structural part of vitamins, as well as a characteristic vital for the development of chloroplasts; it is essential for nitrogen uptake by pulses, as well as the conversion of nitrates directly into amino acids as well as afterward into proteins.

## Fertilizers Classification

Fertilizers are classified on the basis of the nature of nutritional elements such as N, P, and Kcurrent chemically in the substances. There are various nitrogenous chemical plant foods such as ammonium sulfate ($(NH_4)_2SO_4$), calcium ammonium nitrate, calcium cyanamide ($CaCN_2$), standard calcium nitrate, urea, and so on. Clearly, these manures supply N to the soil. Likewise, there are many phosphatic chemical types of manure such as lime superphosphate, triple superphosphate, and so on, as well as potash chemical fertilizers such as potassium nitrate, potassium sulfate, potassium chloride, and so on. Hence phosphatic as well as potash chemical fertilizers specially supply phosphorus as well as potassium to the soil.

## Alternatives other than the use of chemical manures

Extreme use of chemical fertilizer on the same soil for too long can lead to soil erosion, loss of beneficial soil microbes, as well as many other damages **(Vitusek *et al*, 1997)** As a result, some variety of nutrients such as chemical fertilizers, organic fertilizers, biofertilizers, as well as other slow-release or regulated-release fertilizers, to both promote as well as ensure sustainable farming production as well as protect the environment. **Pandiselvi *et al*., (2017)** Using organic manures with chemical manures, in contrast to the increase of natural manures alone, had a more favorable outcome on bacterial biomass as well as soil wellness **(Osman *et al*., 2015)**.

a) **Bio manure:** Bio-fertilizers differ from chemical as well as organic manures in the intellect that they don't supply any nutrients directly to plants as well specialized microbes as well as cultures of fungi. The

manufacturing technology for organic fertilizers is relatively simple as well as the fitting cost is precise low in contrast to chemical manure plants **(Martin, 1997).**

b) **Nano fertilizers:** : "Nano fertilizers are manufactured or converted types of traditional manures, majority items of fertilizers or from dissimilar vegetative or generative parts of the plant by changed physical, biochemical, automatic or organic approaches to retouch the fertility of soils with the help of nanotechnology used in efficiency in addition to the top class of agricultural yield. Nanoparticles can be completed totally from mass products.E.g., Nano-$TiO_2$ recorded a formation of much higher dry weight, higher photosynthetic value, in contrast to chlorophyll-control to deal with a seed-producing plant **(Singh et al., 2017)**

c) **Efficiency of Application:** The claim of any manure must be done at a financial price apart from the optimal price. Moreoverclaim from the right source, appointment, price&period will certainly minimize the negative result on together the plant as well as the environment. Different methods that preserve as well as enrich fertility of soil & the soil humus web content need to be utilized like utilizing agro-forestry, compost , manure, green manure,mulch manure,  and so on.

## REVIEW AND LITERATURE

Management of Soil Nutrition is necessary for maintainable biomass output as well as maintenance of quality of soil. Carbon-based manure improved soil power of hydrogen, phosphorus, attentions, nitrogen as well as significant cations. Before using livestock byproduct-derived natural manure, dissimilar nutrients of organic manure by type of animal byproducts, soil formation of application land, nutrient requirements of target tree species as well as the environment in border locations.The sanitary conditions should be taken into thought.This study verified that livestock byproducts as well as natural manure from sawdust not only promoted the growth of yellow poplar but also improved soil conditions **(Han et al., 2015).**

Agricultural bio-fortification of food crops can be used as avitalfarming tool to enhance the human nutrition of individuals in rising countries. A widely known example of bio fortification of grain crops using SE manures comes from Europe. Agronomic bio fortification is the fastest as well as an economical way to promote the contented of certain molecules along with minerals in food crops **(Prasad and Singh, 2020).**

This research study considers the various natural modifications to the exotic conditions of Hawaii rather than a review of extensive literary works. Plant growth for meat as well as bone dish by-products (tankage), batch-to-batch variability, vitamins, as well as mineral content/release patterns, as well as high quality, as well as liquid manure created from tankage feedback were assessed. For cattle livestock, dairy manure as well as chicken manure were high quality, soil amendments in residential or commercial properties, as well as plant biomass formation as well as root distribution, were evaluated. **(Ahmad, et al., 2016).**

Hence, the current research study disclosed that the unification of bio-organic fertilizer + fifty percent chemical fertilizer can serve as an effective as well as an alternative plant food in order to lower the consumption of chemical plant foods for lasting farming **(Gao et al., 2020).**

Therefore, the outcomes recommend that Trichoderma Bio-organic manure can be active in mixture with reasonable rates of chemical manures to achieve maximum profits related to returns, high quality, as well as fertilizer savings **(Ye et al., 2020).**

### Bio-based fertilizer

On the other hand, bio fertilizers are living cells of micro-organisms such as germs, algae, as well as fungi alone or microbial inoculants in a mixture that can help enhancing crop performance. Organic functions are significantly improved by bacterial communication in the root microbiome. In contradiction, natural plant foods are derived from animal resources such as pet manure or plant resources such as green manure. **(Judy, 2016)** include that organic fertilizer contains a range of beneficial microbes, however, all microbes in organic fertilizer have failed to survive after high-temperature treatment, which makes it difficult to supply beneficial soil microbes.

### New Approach
### Liquid vs carrier-based biofertilizer

If a researcher can unite microorganisms as a federation bundle with recently developed modern machinery, it would be an encouraging modern technology for sustainable farming. Preparations for preserving microorganisms, to supply them to mark areas, to recover the organicaction of an association of microbes, to provide an ideal tool, to maintain their stability for a certain period.This will help promote biological activity at the goal. **(Pindi and Satyanarayana, 2012)** Evaluation of services on the basis of bit or build-up dimension,

the composition of inoculum in semi-dry issues containing clay, granules, other than briquettes. The team makes wet table powders that turn completely dry powder. Clay generally varies from 5–20 mm in dimension with calls for a low absorption inert diluent as a carrier. Around 30 percent of the completely dry mass of the dust comprises bacteria in the form of a deferment. They are usually organized by nourishing bacteria into an airstream for mixing with a mixer or food processor. Piece dimensions, mass density, as well as flow capacity are incredibly important. Pindi, along with Satyanarayana, also reported the advantages and disadvantages of liquid bio fertilizers as well as carrier-based bio fertilizers.The LBF formula is enticing alongside the advanced modern innovation of traditional carrier-based manufacturing innovation, which, despite countless advantages over agricultural chemicals, has left substantial disagreements in farmer neighborhoods regarding the key factors of the organism's usefulness.

## Encapsulation method

Crop fertilizer action research must be carefully performed to represent the economics of the grower as well as the defense of the atmosphere from nutrient losses because of too much fertilizing. There are a number of mathematical versions to describe crop return response to plant food, as well as these designs, should be utilized with caution. Making use of a solitary model to discuss crop response may not account for business economics and possible environmental influence together. This trouble is evident with the quadratic as well as linear-plateau versions. Including both versions in the information feedback analysis as well as calculating the axis as we have actually shown over will consider both objectives.The logistic version seems the best single version at considering both economics as well as environmental objectives. There is an enhancing buildup of studies documenting the effects of over-fertilization on yield as well as quality, therefore lowering earnings. Added to these reasons is the requirement to protect the atmosphere from nutrient pollution related to farming tasks. It ends up being apparent that just how the study is performed as well as how the data are evaluated as well as analyzed is crucial to creating a notified fertilizer referral **(Hochmuth, *et al*. 2018).**

## Advantages Of Using Organic Fertilizer

According to the Organic Profession Association, with natural products found in 82 percent of United States households, natural fertilizers are likely to be an essential tool for fertilizer customers thinking about building programs. Here are the benefits to consider when using natural fertilizers in your program **(Ersek, 2021).**

Organic manure is usually made from plant or pet waste – compost or composted manure. They can also be extremely sophisticated items with a compost or compost base.

### 1.  **Structure of Soil**

Due to the biological matter present in natural manure, the structure of Soil is enhanced, as well as hence the capability of soil to hold water, as well as nutrients.

### 2.  **Microorganisms Thrive**

Synthetic manure comprises of biochemical particles without carbon. These particles can often be disruptive as well as at the same time not accessible to microorganisms. Natural fertilizers, on the other hand, are abundant in biological matter, which aids microbes grow.

### 3.  **Environmentally Friendlyand Sustainable**

Synthetic manures drainage directly into our rivers which harms aquatic life as well as water quality. Organic manure does not escape as quickly (if any) as well as attach to soil structures. According to the Organization for the Organic Profession, organic manure increases the biodiversity of the type by thirty percent compared to synthetic manure.

### 4.  **ReducedManuresas well as Pesticides**

Though natural manure can be more expensive than synthetic, it can reduce the requirement for chemicals as well as the need for total NPK. As a result of depletion, organic fertilizer can neutralize you as well as sometimes set you back savings.

## DISCUSSION

The lowered tons of manures right into crop fields deprived of triggering efficiency loss is a possible but tough experiment **(Da Costa, et al, 2013).**

Biofertilizers include living microorganisms in an appropriate carrier which can be made use of to enhance the plant nutrients, improve plant development as well as boost organic matter decomposition. No, chemical fertilizers are confirming unsafe not only to humans however to entire farming land. Once you begin pouring

chemical fertilizers in the land you obtain a good plant in the initial year (however not so helpful for health), yet the top quality of land degrades and nitrogen-fixing germs, as well as the best good friend of farmer "earthworm", will certainly suffer most, in the following year the land need's more fertilizer as well as the cycle go on till the land ended up being total barren/ sterile.

Main advantages of bio fertilizers are: They are environmentally friendly, improve the soil properties, decontaminate the contaminants existing in the soil, assists in plant nutrient schedule, as well as boost plant return.

Emerging demand for food manufacturing made rice farming depend on artificial plant food along with improving ecological pollution. Bio-organic manure that presented different potentials, such as vitamins also mineral procurement along with plant advancement promo of rice, is an organic-based bio fertilizer which comprises RP (5 percent), biochar (15 percent), as well as the living cells of PGPB, mainly Bacillus, Proteus, in addition to Paenibacillus spp., which were separated from the floodplain, veranda, as well as saline dirts. The organic matter, as well as biochar, enhanced soil nutrients along with carbon product too. The consolidated impact of living active components and also the raw material of the bio-organic plant food saved 30% urea-N, got rid of 100% TSP manure usage in rice manufacturing, along with all at once enhanced nutrient uptake, N, P usage effectiveness, rice yield, in addition to soil wellness. **(Naher, 2021).**

## CONCLUSION

Manures presentation is very important for today's farming plant manufacturing system as it brings back the soil nutrient as well as encourages plant development & yield (Sharma et al, 2017). Fertilizers are an important as well as an identical piece of the current farming sector. That is clear given that high-yielding item assortments simply perform well when they are offered an excellent measurement of plant supplements, as well as composts, are a basic as well as a straight source of it. The fertilizers raise the resistance power of plant cells as well as safeguard the plant from different diseases so the plants can grow up to be healthy. However, it does not suggest that the application of too much quantity of fertilizers is great. It may damage the plants. In simple words, fertilizers are protection for plants if being utilized in a balanced amount, however are unsafe if are being excessively made use of. All things taken into consideration, there is a remarkable technique to managing the circumstance with the application of mixed plant foods. The end results have actually been for all intents and purposes experienced in Fiji country where a household manure handling plant was developed which provided combined fertilizers. Blended fertilizers dealt with the situation well, along with increased harvest generation also. The fact to be told, such a modification is needed in the gardening industry where agriculturists have actually ended up being accustomed to the criteria of an appropriate supplement change for their harvests.

Organic fertilizers consist of only plant or animal-based products that are either a by-product of the final result of normally happening procedures, such as manures, leaves as well as garden compost. The largest advantage of natural manure is that the threat of over-fertilization is lowered as the nutrients are released slowly as well as therefore they are readily available over a longer duration and just a couple of applications are called for.

## REFERENCES

1. "Manure and Nutrient Management - Beef Cattle Research Council". *Manure and Nutrient Management - Beef Cattle Research Council*. Retrieved 2021-04-09.

2. "Nitrogen-Phosphorus-Potassium Values of Organic Fertilizers". *extension.oregonstate.edu*. Retrieved 2021-05-16.

3. Ahmad, Waqar; Singh, Balwant; Dijkstra, Feike A.; Dalal, R.C. (2013). "Inorganic and organic carbon dynamics in a limed acid soil are mediated by plants". Soil Biology and Biochemistry. 57: 549–555. doi:10.1016/j.soilbio.2012.10.013

4. Amjad A. Ahmad, Theodore J.K. Radovich, Hue V. Nguyen, Jensen Uyeda, Alton Arakaki, JeanaCadby, Robert Paull, Jari Sugano and Glenn Teves (2016) "Use of Organic Fertilizers to Enhance Soil Fertility, Plant Growth, and Yield in a Tropical Environment" INTECH. 85-108 .doi.org/ 10.5772/62529

5. Barker, Allen V. (2012). "Plant Growth in Response to Phosphorus Fertilizers in Acidic Soil Amended with Limestone or Organic Matter". Communications in Soil Science and Plant Analysis. 43 (13): 1800–1810. doi:10.1080/00103624.2012.684829. ISSN 0010-3624

6. *Barker, Allen V. (2012).* "Plant Growth in Response to Phosphorus Fertilizers in Acidic Soil Amended with Limestone or Organic Matter". *Communications in Soil Science and Plant Analysis. 43 (13): 1800–1810.* doi*:*10.1080/00103624.2012.684829. ISSN 0010-362

7. *Christians, Nick E.; Patton, Aaron J.; Law, Quincy D. (2016-11-21).* Fundamentals of Turfgrass Management, Fifth Edition. *Hoboken, NJ, USA: John Wiley & Sons, Inc.* doi:10.1002/9781119308867. ISBN 978-1-119-30886-7.

8. da Costa, P. B. et al. the effects of different fertilization conditions on bacterial plant growth promoting traits: guidelines for directed bacterial prospection and testing. Plant and Soil 368, 267–280 (2013).

9. Ersek, K., (2021) "8 Advantages And Disadvantages Of Using Organic Fertilizer" HOLOGANIX Soil Nourishing Root Stimulating

10. Gao, C., El-Sawah, A.M., Ali,D.E.F.I., Hamoud, Y.A., Shaghaleh, H., Sheteiwy, M.S.,(2020) "The Integration of Bio and Organic Fertilizers Improve Plant Growth, Grain Yield, Quality and Metabolism of Hybrid Maize (Zea mays L.)" Agronomy. *10*(3), 319; https://doi.org/10.3390/agronomy10030319

11. Guertal, E. A.; Green, B. D. (2012). "Evaluation of organic fertilizer sources for south-eastern (USA) turfgrass maintenance". *ActaAgriculturaeScandinavica, Section B*. 62 (sup1): 130–138. doi:10.1080/09064710.2012.683201. ISSN 0906-4710

12. Han, S.H., An, J.Y., Hwang, J., Kim, S.B., Park, B.B., (2016) "The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow poplar (*Liriodendron tulipifera* Lin.) in a nursery system" 12(3) 137-143 https://doi.org/10.1080/21580103.2015.1135827

13. Heinrich Dittmar, Manfred Drach, Ralf Vosskamp, Martin E. Trenkel, Reinhold Gutser, Günter Steffens "Fertilizers, 2. Types" in Ullmann's Encyclopedia of Industrial Chemistry, 2009, Wiley-VCH, Weinheim. doi:10.1002/14356007.n10_n01

14. Hillel, Daniel (2008), "SOIL FERTILITY AND PLANT NUTRITION", Soil in the Environment, Elsevier, pp. 151–162, doi:10.1016/b978-0-12-348536-6.50016-2, ISBN 978-0-12-348536-6, retrieved 2021-04-08

15. Hochmuth, G., Hanlon, E., Overman,A., (2018) "fertilizer experimentation, data analyses, and interpretation for developing fertilization recommendations—examples with vegetable crop research"uf ifas Extension University of Florida

16. Judy, F. (2016) What is the difference between organic fertilizer and bio fertilizer? https://www.linkedin.com/pulse/what-difference-between-organic-fertilizer-bio-frady-judy/

17. Naher, U.A., Biswas, J.C., Maniruzzaman, M. D., Khan, F.H., Sarkar, M.I.U., Jahan, A., Hera, Md. H. R.H.,Hossain, Md. B., Islam, A., Islam, Md. R., Kabir. Md. S., (2021) "Bio-Organic Fertilizer: A Green Technology to Reduce Synthetic N and P Fertilizer for Rice Production" frontiers in plant science. 12; 1-14 .https://doi.org/10.3389/fpls.2021.602052

18. Pandiselvi T, Jeyajothiand R, Kandeshwari M. Organic nutrient management a way to improve soil fertility and Sustainable AgricultureA review. International Journal of Advanced Life Sciences. 2017; 10(2):175-181.

19. Pindi P K and Satyanarayana S D V 2012 J. Biofertil. Biopest. 124 1

20. Prasad, R., & Singh, Y., (2020) "Agronomic biofortification of plant foods with minerals, vitamins and metabolites with chemical fertilizers and liming" Journal of Plant Nutrition. 1-21, DOI: 10.1080/01904167.2020.1738464

21. Saito, B.; Seckler, M. M. (2014). "Alkaline extraction of humic substances from peat applied to organic-mineral fertilizer production". Brazilian Journal of Chemical Engineering. 31 (3): 675–682. doi:10.1590/0104-6632.20140313s00002512. ISSN 0104-6632

22. Sharma A, Chetani R. A Review on the Effect of Organic and Chemical Fertilizers on Plants. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 2017, 677.

23. Singh MD, Chirag G, Prakash PO, Mohan MH, PrakashaVishawajith G. Nano-Fertilizers is a New Way to Increase Nutrients Use Efficiency in Crop Production. International Journal of Agriculture Sciences. 2017; 9(7):3831-3833.

24. TNAU AGRITECH PORTAL Organic Farming (2016)

25. Trenkel Martin E. Controlled-release and stabilized fertilizers in agriculture. Paris: International fertilizer industry association, 11, 1997.

26. Usman M, VU Madu, Alkali G. The combined use of organic and inorganic fertilizers for improving maize crop productivity in Nigeria. International Journal of Scientific and Research Publication. 2015; 5:1-7

27. Vitousek PM, Aber JD, Howarth RW, Likens GE, Matson PA, Schindkerm DW et al. Human Alterations of the Global Nitrogen Cycle: Sources and Consequences: Ecological Applications, 1997.

28. Ye, L., Zhao, X., Bao, E., Li, J., Zou, Z., Cao, K., (2020) "Bio-organic fertilizer with reduced rates of chemical fertilization improves soil fertility and enhances tomato yield and quality"

## BRAIN TARGETING THROUGH INTRANASAL DELIVERY

**Amisha Chauhan[1], Shikha Baghel Chauhan[2] and Sakshi Nainwani[3]**

[1,3]Research Scholar and [2]Assistant Professor, Amity Institute of Pharmacy, Amity University, Noida, Uttar Pradesh, India

## ABSTRACT

*Delivery of therapeutics to central nervous system in the treatment of psychiatric and neurodegenerative disorder like Parkinson's disease, Alzheimer's disease is a rigorous task due to presence of blood brain barrier and cerebrospinal fluid barrier. Most of the drug do not pass through BBB that's why different delivery system have been developed among them intranasal delivery has gained emerging interest as nasal cavity is in close proximity with the brain and it also contain nerves which provide direct delivery to the brain, it is a non - invasive method with better patient compliance, no first pass metabolism, high absorption and permeability. The objective behind this study is to provide better understanding of the anatomy and physiology of the nose, mechanism responsible for nose to brain delivery, factors, and strategies to overcome the blood brain barrier, formulation approaches.*

*Keywords: Nasal cavity, Mechanism, factors, Strategies for enhancing nasal permeation*

## INTRODUCTION

Delivery of therapeutics to Central nervous system is difficult because of blood brain barrier (BBB). The Blood brain barrier consist of endothelial cells lining the blood capillaries combined with perivascular cells like astrocytes, pericytes, microcytes which form tight junction[1]. These tight junction results in high electric resistance as compared to other organs. The drug which have low molecular weight and are nonpolar easily cross the blood brain barrier as compared to macromolecules and polar molecules such as proteins and peptides[2]. The permeability across BBB is one of the major problems, different strategies have been developed to bypass brain which include invasive and non-invasive method. Invasive method can achieve high concentration but it also has many problems like pain at the site of injection, trauma, and noncompliance with patients while non-invasive method such as intranasal delivery is safe and effective[3].

The intranasal delivery has gained emerging interest it shows non –invasive local and systemic administration. Nasal mucosa is potential sites which show fast absorption as well as good permeability of drug and biopharmaceuticals[4]. The intranasal delivery is one of the best strategies to bypass cerebrospinal fluid barrier and BBB as the root of nasal cavity is in close proximity to brain and contain nerve that projects into the brain[5]. Nasal to brain delivery have several advantages better patient compliance in comparison to other parenteral route, needle free delivery, self-administered, no first pass metabolism and degradation, delivery of large molecules such as proteins, peptides, nucleotides , viruses and cell can be achieved by the use of penetration enhancers ,the drug compound which show poor oral absorption and are unstable in gastrointestinal fluid can be administered by this route[6]. It is a non-invasive method for targeting the CNS in neurological condition such as Parkinson's disease, Alzimer disease and other conditions like cancer and viral infection[7]. It is used for the delivery of steroidal agent, antihistamines and corticosteroids; the best example of intranasal administration is insulin and oxytocin. Insulin administered by intranasal route is use to reduce insulin level in Type I Diabetes mellitus as well it act as cognitive enhancer in Alzimer disease[8]. Although nasal route is one of the potential route for delivery of drugs to brain but it also have some problems like less absorption area when compared with gastrointestinal tract, chances of side effects and damage of cilia and tissue, irritation due to addition of penetration enhancers, it may also leads to leakage of drugs to other parts of respiratory tracts. Some of the surfactant added in the preparation causes damage to the mucous membrane[9,10].

## ANATOMY OF THE NASAL CAVITY

For better understanding of nasal to brain delivery it is necessary to know the anatomy and physiology of nasal cavity. The nasal cavity is located above the oral cavity and hard palate**.** The function of nasal cavity is respiration, olfaction and filtration of inhaled air. The total surface area of nasal cavity is 150 cm$^2$. The nasal cavity is divided into two parts through nasal septum (a cartilage which separates the olfactory and respiratory region and shapes the nasal cavity). These cavities are further divided into three regions, Vestibular region, Respiratory region and olfactory region[11]. The first portion is called vestibular region, it is anterior portion of the nasal cavity which opens through the nostril. Surface area of this portion is very less about 0.6 cm$^2$ and presence of hair in this area helps in filtering the inhaled particles. This part contains stratified squamous epithelium and absorption of the drug from this area is very less[12].

The second part is called respiratory region through which air travels. The region covers lateral walls including three turbinates' (superior, median and inferior). This region is highly vascular and has large surface area. It contains four types of cells – goblet cell, ciliated and non-ciliated cell and basal cells. Goblet cells secrete mucous which delivers the drug molecule to their targeted side by trapping them. It has low clearance due to high viscosity and allow passage of large portion of drug. The large surface area of this region is due to presence of cilia, it is also highly vascular and show maximum absorption[13,18]. Vomer nasal terminalis muscle, this is generally present in neonates if it is present in adults it shows direct absorption and delivers the drug to brain[14,15]. The third Region is called olfactory region which contain receptors for smell sensation and Bow man's gland unlike other region the epithelium does not contain cilia. The transportation of drug from nasal cavity to brain takes place by both the nerves (trigeminal and olfactory)[16,17,19].

## FACTORS INFLUENCING NASAL TO BRAIN DELIVERY
### Physiochemical factors:
### Molecular size :
The drug having molecular weight less than 300 dalton can easily pass through the nasal mucosa through aqueous channel while the lipid soluble drug permeation and availability directly depends on the molecular weight but it is opposite in the case of hydrophillic drugs.Permeation is not affectedby physiochemical properties but it is highly sensitive in case of hydrophillic drugs[21].

### Solubility:
If the drug is not soluble in the vehicle then it is difficult to formulate the preparation as well it hinder the absorption .It become important to understand the relationship between solubility,saturation and absorption[20]. As we know lipophillic drugs are not soluble in aqueous secretion that's why they absorbed through aqueous secretion that's why they absorbed through active transport[19].

### pKa and Partition co-efficient:
According to pH partition theory we know that ioniosed drug are not absorbed properly in comparision to unionised . This is also true in case of nasal absorption.There is constant relationship between partition coefficient and nasal absorption constant.The nasal absorption of weak electrolyte such as salicylic acid and aminopyrine is highly dependent the degree of ionisation[21]. It was concluded that the quantity of uncharged drug as well hydrophillicity lipophillicity will affect the drug delivery through the membrane[22].

### Hydrophilicity and lipophilicity of drug:
There should be proper balance between the lipophilicity and hydrophilicity. If the drug is highly lipophillicity than it will not be soluble in the nasal fluid and the penetration of drug from through nasal mucosa will not take place. Non polar drugs show better absorption as compared to hydrophillic drugs and they show 100% bioavailabity. Examples of drug which are completely absorbed from nasal mucosa are naloxone and buprenorphine[23]

## FORMULATION FACTORS
### pH of Formulation:
It plays important role important role in permeation across nasal cavity[24]. Lysozyme is the enzyme which prevent microbial growth in the nasal cavity is generally active at acidic pH and inactive at alkaline condition. To prevent any kind of irritation the pH of nasal formulation is adjusted between the 4.5 to 6.5[25].

### Osmoralirity:
It was observed generally isotonic formulation are prefered for administration due to decreased influence of secretion[26]. It was found in the experiment conducted in rat that absorption of secretin reaches maximum at concentration of 0.45 M sodium chloride due to shrinkage of epithelial cell as a result increase permeation.This not increases bioavailabity but also leads to nasal epithelial toxicity. Sorbitol as an osmoregulatory agent show enhanced absorption[27.]

### Viscosity of Formulation :
The contact time between the nasal mucosa and drug increases with increase in viscosity of formulation but highly viscous solution affect normal functioning such as mucocilliary clearance and finally alter the passage of the drug[28].

### Drug distribution and deposition:
The drug absorption from nasal cavity depends on the distribution of drug in nasal cavity and drug distribution depends on the mode of drug administration. The drug administered to anterior part of nasal cavity show extended residental time which in turn produces better absorption while drug administered to posterior portion

of nasal cavity show poor absorption and bioavailabity due to elimnation of drug by mucocilliary clearance[29]. The site of drug administered also affected by mode of administration,dosage form and physiochemical characterstics of drug[30,31].

## Biological Factors
### Membrane permeability:
The membrane permeation of drugs mainly depends on the type and ,density, arrangement and number of cells present for the absorption. Due to presence of microvili on the cells , the surface area of the cells increases , blood supply also increases hence show better absorption[33].

### Enzymatic Degradation:
Nasal cavity have different types of enzymes ( exopeptidase and endopeptidase.Exopeptidase cleave the molecule from terminal end and endopeptidase cleave the molecule from inside that's why presence of enzyme in nasal mucosa causes degradation thus affect stability. Peptides also form complex with the immunoglobulins which show law absorption across nasal mucosa[34,35].

## STRATEGIES FOR ENHANCING NASAL PERMEATION
### By Increasing Nasal Residence Time:
Mucocilliary clearance is responsible for removing the foreign substance and drug from nasal mucosa hence decreases the nasal residence time .To enhance the residence time the formulation can be prepared using different polymers such as Methyl cellulose, polyacrylic acids ,chitosans,pectins, hydroxy propyl methyl cellulose[36,37] .Another method to increase residence time is use of bioadhesive microsphere which swell in the presence of water[38].

### Enhancemenrt of nasal absorption:
The nasal absorption can be improved by addition of permeation enhancers. These work by decreasing the viscosity of the solution which in turn decreases the mucocilliary clearance, opens the tight junction and solubalise thr drug. Schipper in the experiment show that bioavailabity of insulin increases with the use of dimethyl beta cyclodextreins[39].

### Structural modification:
Alteration of drug structure without changing its pharmacological activity is one of the best way to enhance the drug absorption. The change in chemical structure to change physiochemical properties such as solubility, molecular size and molecular weight. In Salmon calcitonin by changing the C-N bond with S-N bond show better bioavailabity[40,41].

## DELIVERY SYSTEM FOR NASAL TO BRAIN TARGET
### Novel delivery systems:
### Nanoparticles:
These are colloidal delivery systems consist of biodegradable polymers in which either drug is enclosed within colloidal matrix or adsorbed on the surface They have several advantages due to their size (10-200 nm) they can easily penetrate through the membrane and show enhanced nasal to brain delivery[42]. These nanoparticles only cross the blood brain barrier when they are coated with polyethylene glycol[43]. Other polymers which are used include polylactic acid, polyglycolic acid, polycaprolactone[44]. The exact mechanism for delivery of nanoparticle across blood brain barrier is not known but they cross the blood brain barrier either by endocytosis, transcytosis through endothelial cell, by surfactant effect which is due to solubilization of lipid in endothelial cell membrane and causes fluidization and transport of drug through endothelial cell due to concentration gradient[45]. Example-Olanzapine polylactide co-glycolic nanoparticles in the treatment of schizophrenia through nose to brain delivery[44].

### Liposomes:
Liposomes are colloidal vesicles having hydrophilic core enclosed in a lipid bilayer membrane. Due to their unique nature they are used for the delivery of both hydrophilic drug as well as lipophilic drug[45]. They are nontoxic, nonimmunogenic vesicles which show enhance penetration of calcitonin and insulin through nasal mucosa and show better bioavailabity. They provide protection to peptides from enzyme and provide sustained release. They are also helpful in delivery of non-peptide drug to the brain[46].

### Microspheres:
This is one of the strategies which increase nasal residence time of the drug by increasing the contact time with the nasal mucosa[48]. The microsphere are in the range of 10-50u.m. Microspheres of met chlorpropamide containing chitosan and alginate act as potential carrier[49]. Alginate microsphere show hypoglycaemic effect

after administration into rat in powder form. The advantages of microsphere include prolong residence time in nasal cavity for 3to 5 hours, they can be used for the delivery of low molecular weight substances and increases the bioavailabity of protein and peptides[50].

## Chitosan Hydrogels and Insitu gel:
Chitosan is a natural polysaccharide which is nonimmunogenic biocompatible and specific. Chitosan based insitugel gel system show sol to gel conversion at the site they are administered[51]. They are in liquid form when they are formulated and undergo phase conversion at the site of administration due to pH, temperature and ion exchange[52]. They are compatible with most of the drugs whether they are soluble or insoluble. These reduce the side effects and provide prolong action. Insitu gels are used in the treatment of Parkinson's disease, Alzheimer's disease and migraine[53].

## Liquid Nasal Formulation:
These are one of the commonly used formulations. They are aqueous formulation hence require preservatives and present in the solution or suspension form. These formulations are used because of higher accuracy and precision. These can be delivered in accurate amount through metered dose pump and their formulation depends on the surface tension and viscosity[54].

## Olfactory Drug delivery devices:
### Opti nose:
It is also known as Breath powered and Bidirectional Technology. It is novel drug delivery devices which are reliable non-invasive, efficient for local, systemic nose to brain delivery and vaccine delivery and produces rapid onset of action and increase bioavailabity and minimizes side effects. I t is used for the delivery of both liquid dosage form and solid dosage form. This device has mouthpiece and a nosepiece[55]. The nosepiece is introduced into nose trills and it forms seal over the soft palate and isolate nasal cavity with the oral cavity and creates a positive or pharyngeal pressure. The user then exhales from the mouthpiece[56]. This device prevent lung deposition and provide bidirectional flow as entered air first passes through posterior chamber and then exit from the anterior chamber of opposite nostril. By optimizing the particle size, flow rate and nose piece it is possible to target the delivery to brain[57].

## Vianase Pump :
It is vertical flow atomizer is another drug delivery device which consist of nosepiece and a device which generate vortex of small particles. It is capable of delivering the drug in entire nasal cavity involving olfactory region. It produces droplet in the range of 9-11u.m. It has many advantages as improves residence time, delivers solution and suspension of varied viscosity, prevent deposition in lungs. The device has been used to deliver noninsulin and is show beneficial effect in the Alzheimer's disease[58].

## CONCLUSION
Many effective techniques have been developed to target brain but intranasal delivery has great ability to directly deliver the therapeutics via olfactory and trigeminal pathway across blood brain barrier. It offers many advantages like rapid absorption, less or no side effects due to less dose requirement, avoid first pass metabolism and provide long duration of action. Different physiochemical, biological and formulation factor should be considered during intranasal delivery of drugs. For better absorption and bioavailabity of drug it should have sufficient contact time with nasal mucosa and to achieve the same, polymers, permeation enhancers and enzyme inhibitors are added in the preparation. Present review manifest the fact that colloidal delivery carriers such as nanoparticles, liposomes, microspheres, Microemulsion and olfactory device are potential delivery system that bypass the brain and find wide application in treatment of epilepsy, migraine, brain tumour, Parkinson's disease and Alzheimer's disease.

## REFERENCES
1. Wang X, Yu X, Vaughan W, Liu M, Guan Y. Novel drug delivery approaches to the blood brain barrier. Neurosci Bull 2015; 31(2):257-64

2. Tayebati SK, Nwankwo IE, Amenta F. Intranasal drug delivery to the central nervous system: present status and future outlook. Curer Pharm Des.2013;19(3):510-526

3. Ganger S, Schindowski K. Tailouring formulation for nose to brain delivery: A Review on Architecture, Physiochemical Characteristics and Mucocilliary clearance of the nasal olfactory mucosa. Pharmaceutics. 2018;10(3):3-28

4. Lochhead JJ, Thorne RG. International delivery of biologics to central nervous system. Adv Drug Deliv Rev.2012;64(7):614-28

5.  Chapman CD, Frey W.H. Craft S, Danielyan L, Hallschmid M, Schioth HB, Benedict C. Intranasal treatment of central nervous system dysfunction in human. Pharm Res.2013;30(10):2475-84

6.  Crowe T, P. Greenlee MHW, Kanthas may AG, Hsu WH. Mechanism of intranasal drug delivery directly to brain. Life Sci. 2018; 195:44-52

7.  Kamie N, Tanaka M, Choi H, Okada N, Ikeda T, Itokazu R , Takeda –Morishita. Effect of an enhanced Nose to Brain delivery of Insulin on mild and Progressive In senescence Accelerated Mouser. Mol Pharm. 2017; 14(3)916-927.

8.  Henkin RI. Intranasal Insulin: from nose to brain. Nutrition.2010;26(6):624-33

9.  Chirag P, et.al. A recent review on alternative system of Parentral delivery: Nasal drug delivery system. J Drug Discov Ther. 2013;1;12-18

10. Singh A, Nasal cavity: a promising trans mucosal platform platform for drug delivery and research approaches from nasal to brain targeting. Journal of drug delivery  & Therapeutics 2012;2(3):22-33

11. Erdo F, Bors LA , Farkas D, Bajza A, Gizurasons S. Evaluation of Intranasal delivery route of drug administration for brain targeting . Brain Res Bull.2018 ;143:155-170

12. Mygind N, Dahl R. Anatomy, physiology and function of the nasal cavities in health and disease. Adv Drug deliv. Rev1998, 29(1-2):3-12

13. Pertuson B, HanssenHA, Karlsson G. Structural and functional aspect of cells in nasal mucocoilliary system. Arch Orolarengeal,1984;110(9):576-581

14. Illum L. Transport of drugs from the nasal cavity to central nervous system. Eur J Pharm Sci. 2000;11(1):1-18

15. Pardeshi CV, Belgamwar VS. Direct nose to brain drug delivery via integrated nerve pathways bypassing the blood-brain barrier; an excellent platform for brain targeting. Expert Opin Drug Deliv.2013;10(7):957-72

16. Sivilotti L, Nistri A, GABA Receptor mechanism in central nervous system. Prog  Neurobiol,1991;2(1):35-92

17. Dodane V, Khan MA, Merwin JR. Effect of chitosan and epithelial permeability and structure. Int J Pharm. 1999;182:21-32

18. Authora J. Development of Nasal Delivery Sytem: A Review. Drug Deliv Technol.2002;2(7):1-8

19. Jyothi SL, Gowda DV, Gupta NV , Osmani RAM. Nose to brain drug delivery: New Prospective for old problems- An enlightening review. Journal of Chemical and Pharmaceutical Research.2017;9(7):111-122

20. Parvathi M. Intranasal drug delivery to brain: An Overview. International Journal of Research in Pharmacy and Chemistry.2012;2(3):889-895

21. Kushwaha K.S, Koshare R.K, Rai A.K. Advances in trans mucosal drug delivery. Journal of applied pharmaceutical Science.2011;1(7):21-28

22. Huang CH, Kimura R, Nassar RB, Hussain A. Mechanism of Nasal absorption of drugs: Physiochemical parameters influencing the rate of insitu nasal absorption of drugs in rats. J Pharm Sci. 1985;74(6):608-11

23. Shabana P, et.al. Nasal Drug Delivery: A Potential Route for Brain Targeting. I J Adv Sci Res..2015;1(2):65-70

24. Romeo VD, de Mireles J, Sileno AP, Pimplaskar HK, Behl CR. Effect of physiochemical properties and other factors on systemic Nasal Delivery. Adv Drug Deliv Rev. 1998;29(1-2):89-116

25. Mackey JA, Deen DF, Szoka Jr. FC. Distribution in brain liposomes after convection enhanced delivery modulation by particle charge, partial diameter and presence of stearic coating. Brain Res.2005:129-135.

26. Vyas T.K, Tiwari SB, Amiji MM. Formulation and Physiological factors influencing CNS Delivery upon intranasal administration. Crit Rev Ther Drug Carrier Syst. 2006;23(4):319-47

27. Ohwaki T , Ando H , Kakimato F , Uesugi K , Watanabe S, Miyake Y, Kayano M . Effect of dose pH and osmolality on nasal absorption of secretin in rat. J pharm Sci. 1987;76(9):695-698

28. Dhakar RC, Maurya SD, Tilak VK, Gupta AK. A Review on the factors affecting the design of nasal drug delivery system. International system of drug delivery.2011; 3(2):194-198

29. Upadhay S, Parikh A , Joshi P, Upadhaya UM, Chatai NP. Intranasal drug delivery system-A glimpse to become mestro. Journal of applied Pharmaceutical Sciences2011;1(3): 34-44

30. Majgainya S, Soni S, Bhat P. Novel approaches for nose to brain drug delivery bypassing Blood brain barrier by pressurized olfactory delivery devices. J App Pharm.2015;7(3):148-163

31. Patel RS, Mcgurry GW. Most patient overdose on topical nasal corticosteroid drops: an accurate device is required. J Larayngeal Otol.2001;115(8):633-35

32. Ishikawa F, Kastura M, Tamai J, Tsuji A. Improved Nasal Bioavailabity of Electonin insoluble Powder formulation. Int Pharm;224:105-114.

33. Chaudhary R, Goswami L, Nasal Route: A Novelistic approach for Targeted Drug Delivery to CNS. International Research journal of pharmacy.2013;4(3):59-62

34. Lee VH. Enzymatic barrier to peptide and protein absorption. Crit Rev Ther Drug Carrier Sys.1988;5(2):69-97

35. Ugwoke MI, Agu RU, Verbake N, Kinget R. Nasal mucoadhesive drug delivery: background applications, trends and future perspective. Adv Drug Deliv Rev.2005;57(11):1640-65

36. Patel J. Intranasal Route for CNS Delivery: Overview and Recent Advancement. European journal of pharmaceutical and medical research.2017;4(06):281-292

37. Ghori MU, Mahdi MH, Smith AM, Canway BR. Nasal drug delivery system: An overview. American Journal of Pharmacological Science.2015;3(5):110-119

38. Alnasser S. A Review on nasal drug delivery System and its contribution in therapeutic management. Asian Journal of Pharmaceutical and Clinical Research 2019;12(1):40-45

39. Telangakar S , Mishra PR. International delivery: An approach to bypass the blood brain barrier. Indian J Pharm 2004;36:140-5

40. Chein YW. Novel drug delivery system. 1st edition. New york Marcel Dekker Inc;1992:229-262

41. Hussain MA, Koval CA,  Shenvi AB, Aungst BJ. Recovery of rat nasal mucosa  from the effect of amino peptidase inhibitors. J Pharm Sci. 1990;79(5):398-400

42. Pathan A., et.al. CNS drug delivery system: novel approaches. Recent Pat Drug Deliv Formul.2009;3(1):71-89

43. Rempe R, Cramper S, Qiab R, Galla HJ. Strategies to overcome the barrier, use of nanoparticle as carrier and modulators of barrier properties. 2014;355(3):717-26

44. Seju U, Kumar A, Sawant KK. Development and evaluation of olanzapine –loaded PLGA nanoparticles for nose to brain delivery, invitro and invivvo studies. Acta Biomatria.2011;7:4168-4179

45. Patel Z, Patel B, Patel S, Pardeshi C. Nose to brain targeted Drug Delivery bypassing the blood brain barrier: An Overview. Drug Invention Today.2012,4(12):610-615

46. Savale S, Mahajan H. Nose to brain: A versatile mode of drug delivery system. Asian journal of Biomaterial Research. 2017;3(1):16-38

47. Jaiswal PL, Darekar AB, SaudagarRB. A Recent review on nasal Microemulsion for the treatment of CNS disorder. Int  J Curr Pharm Res.2017;9(4):513

48. Vyas T.K, Babbar AR, Sharma RK, Singh S, Mishra A. Intranasal mucoadhesive Microemulsion of clonazepam: preliminary studies on brain targeting. J Pharm Sci.2006;95(3):570-580

49. Kayani V, Dedankia A, Mathaliya C , Patel P. Microsphere for Intranasal Delivery System: As Review. Bioinfo Drug targets.2014;2(1):14-19

50. Kumar A, Pandey AN, Jain S.K. Nasal Nanotechnology revolution for efficient therapeutics delivery. Drug Delivery.2016;23(3):671-683

51. Shaji A, Podder A, Iyer S. Brain Targeted Nasal Clonazepam Microspheres. Indian J Pharm Sci 2009;71(6):715-718

52. Aderbigbe B. Insitu –Based gels for Nose to Brain Delivery for the treatment of neurological Diseases. Pharmaceutics 2018;10(40):2-17

53. Dinnath G, Padmini K, Dipak M, Namdeo J Development of particulate Mucoadhesive gel for intranasal delivery. Asian J Pharm Clin Research. 2017;10:222

54. Alagusundaram M, Chengaih B, Gnanprakash K, Ramkanth, Chetty CM, Dhachinamoothi D. Nasal Drug Delivery System –An Overview. Int J Res. Pharm Sci. 2010;1:454-65

55. Hoekman JD , Ho RJV. Enhanced Analgesic Responses after preferential delivery of morphine and fentanyl to olfactory epithelium in rats. Anesth Analg.2011,113(3):641-51

56. Yadavali STV. Bidirectional Nasal Drug Delivery. (Optimose Technology) A Review. International Journal of Pharmacy and Pharmaceutical Research.2018;13(4):164-176

57. Pardeshi CV, Vanjari YH, Kulkarni AD. Novel Nasal Devices for the efficient Drug Delivery: A Systemic Review. Indian Journal of Novel Drug Delivery.2015;7(1):1-9

58. Moharil S, Niranjane K Nastare L.  Nagadevie A, Bhupale N. Nasal Dosage form and device for Intranasal delivery. World J Pharm Pharm.2014;3(4):554-557.

## REVIEW ON BRAIN GATE - AN EXPERT TO CURE THE INABILITY

**Surya Prathapan V. R, Krishna Veni R and [*]Brindha Devi P**

Department of Bio-Engineering, School of Engineering, Vels Institute of Science, Technology and Advanced Studies

**ABSTRACT**

*Brain gate is a neuroprosthetic device which is a mind to movement system that allows a quadriplegic man to control a computer using his thoughts. This system helps mainly to those who have lost the control of their limbs and other bodily functions such as patients with spinal cord injury. Thus by this method they can able to move their arms by commanding the computer using their thoughts. Here a neuro chip is used which collects the signal from the brain and analyse it through the computer. Its main role is, it converts the intention of a user into computer command and it also used to control a robot arm. It is one of the innovative inventions of biotechnology combined with neuroscience. It is based on brain computer inter face technology. The principle behind is, neural interface system is that which intact with brain functions. It has wide range of applications and has an important advantage of controlling remote devices and to operate motorised wheel chair.*

*KEYWORDS: Braingate, Mind to movement, Robot arm, Neural Interface system, Neuro chip.*

## 1. INTRODUCTION

Brain is the centre of the nervous system in all vertebrate and invertebrates. It is the most complex organ of the body. The Physiological function of the brain is to exert centralized motion and control over the other organs of the body.It also does other bodily function like generating muscle activity in a controlled pattern and driving the secretion of hormones also called as complex chemicals. Reflexes mediated by the spinal cord are the basic types of responsiveness [1].

One of the growing fields in recent years of research and development is Man machine interface. Here the dedication of the work and effort is to design the model, a user friendly system or ergonomic systems. These are designed with a base of an innovative interface which includes recognition, virtual, voice and reality. A new dimension of man-machine interaction can be created by direct brain-computer interface.

The brain implant system also called as the braingate system, now currently working under the development of the brain gate and in clinical trials. This system mainly designed to help those who have lost control of their limbs and other bodily functions, such as patients with spinal cord injury or Amyotrophic lateral sclerosis (ALS). The goal of brain gate system is to make the users or the patients with severe disabilities to have a significant quality of life. To the brain a microchip is implanted, which monitors the brain activity of the patient and it is converted into computer commands based on the intention of the user. In reality, braingate allows a person to use his mind which plays a major role in handling the objects. Furthermore in real-time analysis, the neuron patterns to relay movement. Thus the braingate array is capable of recording electrical data which can be used for later analysis. A neurologist can study the seizure patterns of epilepsy patient this feature would also be one of the potential use [2].

This review gives the promising solutions to these challenges by considering recent research in brain–computer interfaces (BCIs). Reconstruction of upper limb is possible after those experiments done with animals which resulted in that intentional goal directed movements and is transmitted to robotic devices or external manipulation. This is complete when the Implantation of small number of microelectrodes in movement-relevant brain areas.[3]

### 1.2. Braingate

It enables a quadriplegic to use and control a system or a computer by the mode of mind to movement system, thus a patient can operate the computer using his thoughts. This system is mainly helps to those who have lost some bodily functions or control of their limbs. This includes patients with spinal cord injury to make them able to operate various gadgets such as TV, computer, fan, light etc. This system plays a major role in converting the intention or thought of the user into computer commands. This is also used to control a motorized wheelchair, a robot arm and a cursor on the screen. The application of these tools is on the basis of neurophysiologic studies. It helps to demonstrate the inter hemispheric interactions and its imbalance. Recovery process is done only with results of this over mentioned process [4]. The patients with chronic stroke were found to have improved motor functions by combining the peripheral sensorimotor activities and bi-hemispheric TDCS(transcranial direct current stimulation) that outlived the period of intervention. The cerebral adaptive process for motor recovery after stroke is initiated by this novel approach [5]. The overall schematic function of a braingate function from

how a signal is been acquired to how its is transferred to a device and The implementation of braingate to a human brain and a human body representation is shown (figure 1).

### 1.2.1. PRINCIPLE:-
The principle behind brain gate is a neural interface system. It is defined as that it intact with brain function and the neural signals are interpreted which are generated from brain these are done by the systems. A braingate pathway is created in an alternative way by a cursor on the screen. It is the same as we use the mouse to control the system the user can control the computer by using the cursor [6].
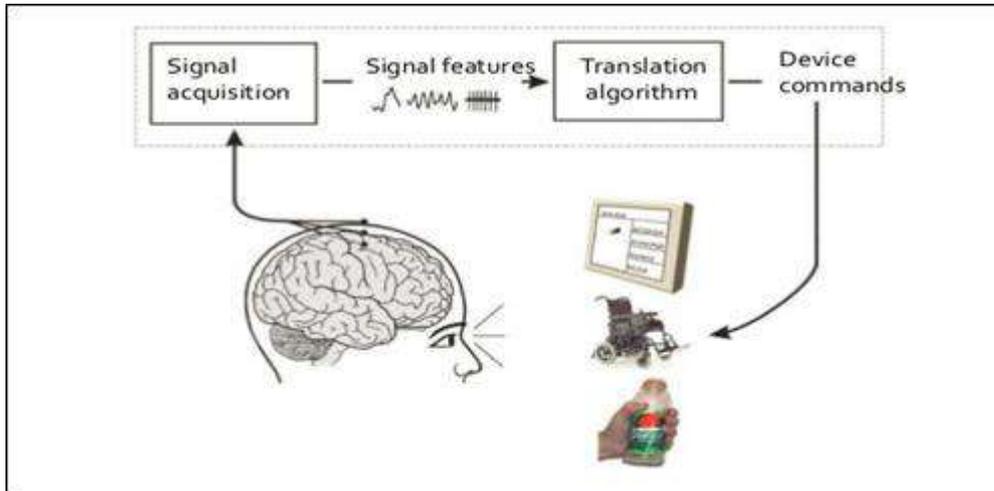


**Figure 1: computational representation of braingate**

**TABLE 1: Components and its characteristics of a braingate.**

| S.NO | COMPONENTS | CHARACTERISTICS |
|---|---|---|
| 1 | Sensor | A neurochip with hundreds of micro hairs, Whole in the size of a contact lens. |
| 2 | Connector | A small length cable with pedestal that connects the microchip to the converter. |
| 3 | Converter | A small signal processing unit used to convert the neural signals into computer language. |
| 4 | Computer | A central processing unit used to display the output command and also helps to send respond command to the brain. |

### 2.1. Neuro Chip
Achip designed to interact with the neurons or nerve cells are called as neurochip. They are majorly made up of silicon and they play major role in sensing the electrical activity of the brain. They are still in experimental phase but believed to be a good source of sensors that has major application in retinal implants and brain implants. A chip with hundreds of micro hair which is used as a sensor in brain gate.

### 2.2. Connector
The device which act as a platform for a sensor and converter is pedestal the connector system is represented in the Figure 1.3.2. They are named as pedestal with connector pins and reference wireconnections connected towards converter. They hold the neurochip at their end and serve as supporter during positioning the chip and prevent it from movements due to fluidity.

### 2.3 Convertor
Converter is a device placed on the wheel chair of the patients helps in collecting the signals from the pedestal and it converts it into computer language by which a computer can understand and output the mode of action. And also helps in converting the commands from the computer as signals by which a brain can understand the mode of command. This is the major part of the brain gate system where the actual mind of a patient is been read by the computer [7].

### 3. MECHANISM OF BRAIN GATE SYSYTEM
The whole process of brain gate system involves four major stages such as sensing , transmitting, analysing, training and controlling. Each step uses different components to perform their role in brain gate system. The flow diagram of braingate mechanism in mentioned in figure 2.
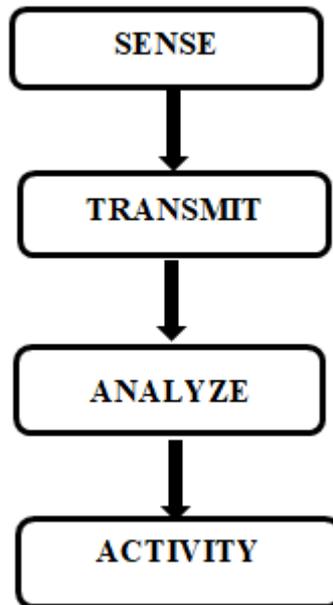
**Figure 2: A simple flow diagram of brain gate science**

### 3.1 SENSING THE BRAIN ACTIVITY:-
Braingate is uniquely designed technology which is able to do simultaneously functions such as to sense the electrical activity of numerous individual neurons. Our sensor contains one hundred electrodes of a silicon array which is about the size of a baby aspirin. Each is thinner than a human hair. On the surface of the brain the array is implanted, that the neural interface system is placed over the area which is responsible for limb movement. In other experiments the array can also be placed in the surface of the brain which is responsible for other bodily function this based on their need of application [8].

### 3.2 TRANSMITING AND ANALYZING THE BRAIN ACTIVITY:-
The world's best computer is human brain, so called because it can handle a vast amount of activities simultaneously and has the ability to process instantaneously. For analysis technology is made which has a large amount of information like electrical activity data in brain from neurons to computer system. In currently using brain gate system a group of hundred micro wires made of gold connects the pedestal with the array that is extended through the scalp. Then by the use of an external cable the pedestal is made to interact or connect to a set of computer system where the data is saved which can be analysed in real time. It is stored for future use and also offline analysis. The electrical activity of neurons are analysed and translated by signal processing software. It is translated in to control signals to make use of many computer based application [9].

### 3.3 RESPONSE AND CONTROL TO THE BRAIN ACTIVITY:-
A way to evolve multiplex clinical products was invented which encouraged a capability to produce control signals and to create computer application interfaces. In ideal a person can use his thoughts to move or control a cursor on the monitor screen and may also mirror the keystrokes on the screen. Another application was, in patients with epilepsy a doctor can be able to study the brain electrical activity at the time of before, during, and after seizure[10].

### 3.4. DETECTING THE INTENTION OF THE BRAIN ACTIVITY:-
**It involves four steps:-**
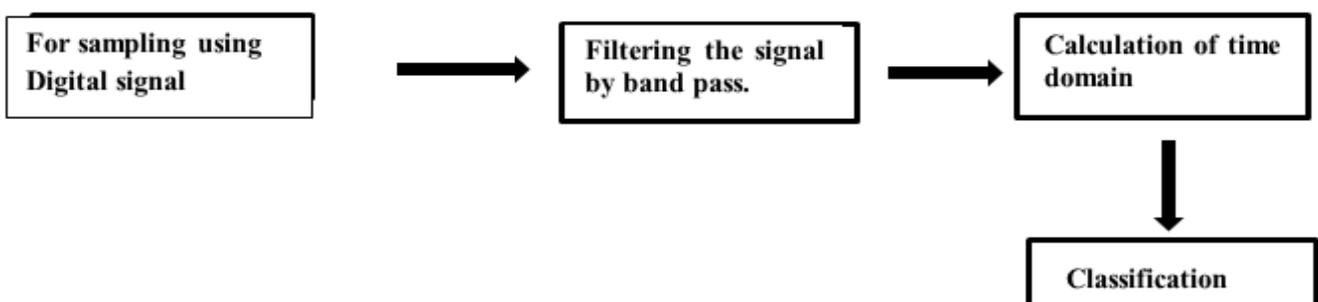


**Figure 3:** Steps involved in detecting Brain activity.

The classification involves in comparing the extent of non-linear, linear, and artificial neural network. The overall performance is enhanced by both the patterns when they learn from each other with a constant result from the user[11].

## 4. SOFTWARE BEHIND BRAINGATE:-

The custom decoding software is used for the translation of brain activity and also it forms a communicating pathway. To smooth the communication between the computer and the human the computer uses techniques called pattern-matching and adaptive algorithm[12].The computer languages used to translate algorithm are C, JAVA and MATLAB.

### 4.1. BCI TECHNOLOGY :-

BCI stands for Brain Computer Interface. BCI normally relates the brain with a computerscience. It is also called as direct neural interface. It is defined as a pathway that directly forms a communication pathway between a external device and human brain. There are two types of BCI based on the computer pathway. They are one way and two way BCI. Most of the BCI research application lies on the oral history of biofeedback and neuro feedback both are called as a result of technological achievements, in continuous survey of EEG patterns which gives a many kinds of neuro electrical activity. The aim was to rebuild the movements moreover built in originally by tuning the sensory-motor of neurons which represents the different types of movements[6].

### 4.2. WORKING OF BRAIN GATE SYSYTEM:-

The brain gate system is considered as a neural interface device thus it is whole reasonably accepted as conventionally used brain computer interface. It mainly consists of two divisions such as internal neural signal sensor and external processors [13].

### 4.3. INTERNAL NEURAL SIGNAL SENSOR:-

The sensor consists of a tiny chip containing 100 microscopic electrodes that detect brain cell electrical activity. The chip is implanted on the surface of brain in the motor cortex area that controls movement[14].The scan view of the brain with the chip used to transfer the brain activity is shown in figure 3.1.1.
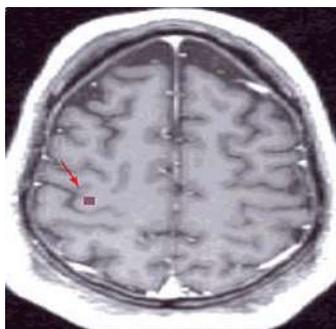


**Figure 4: Scan view after the placement of brain gate.**

### 4.4. EXTERNAL PROCESSORS:-

Convert neural signals into an output signal under the users own control. In the pilot versionof the device, a cable connects the sensor to an external processor in a cart that contains computers. The computers translate brain activity and create the communication output using custom decoding software.Patients implanted with a chip are advised to move the cursor immediately using their thought andintending their mind only. This is advised because a single movement is controlled by millions of neurons which contains varies components such as direction, acceleration and velocity these information are collected and given as a command.

### 4.5 LIMB AND DIGIT MOVEMENT SYSTEM:-

This FES or exoskeleton device used for joint movements and this system uses biological interface apparatus. It includes a normal BCI set up. Information from the device for the joint movements is transmitted for resulting a value of a system with configuration parameters to a processing unit. Disclosed is also a joint movement device which is easy with flexible design, this is used for force application to one or more than one patients.

## 5. METHODOLOGY FOLLOWED IN BRAIN GATE SYSYTEM:-
### 5.1 ELECTROCORTICOGRAPHY (ECoG):-

ECoG is a device which uses non-invasive type of technology, a small difference in this is the thin plastic covering covers the electrodes that is placed on the motor cortex areas which is beneath the dura meter. Light reactive BCI systems are under study till now, this technique involve laser the skull implantation. These lasers are specified to single neurons and the measurement of the reflective power of the neurons is done by separate

sensor. There would be some slight change in the patterns of the laser and their reflected wavelength when neuron impulse signals. This help's the scientist to follow the single neuron and also it reduces the build-up of scar tissue because it requires only small amount of contact with the tissue[15].

## 5.2 ELECTROENCEPHALOGRAPHY (EEG):-
EEG is one of the widely studied non-invasive method. It is mostly used for its accurate temporal resolution, portability, easy to use and cost efficient. Since this technology is attracted toward noise lies as barrier for using EEG as BCI, thus a qualified training is required to operate EEG before using it in humans. It is also used to operate a robot arm with 7 seconds delay in between the thought and movement [16].

## 5.3 MIRROR IMAGINED MOVEMENT TRAINING:-
Most of the paralysed patients about 50-80% feel the paining sensation over their amputated limbs this is called as phantom limb pain (PLP).. The usage of mirror box for the movement of amputated limb (the robot arm or an whole arm was tried to understand the movements of amputated arm), this was reported as the change in PLP. This training also resulted in reducing the potential pain by reversing the changes in cortical reorganization which was related to PLP, this may also find a solution to the disagreement between sensory feedback and motor intention. The mirror and movement executed imagining of intact hand with amputees and the dominant hand in control. These are tested by self-report and fMRI. To fight PLP they tested the thesis of the mirrored movements of the intact hand which may give some inputs to the cortical representation zone which is received before from amputated limb[17,18].

## 5.4 TRANSCRANIAL DOPPLER ULTRASONOGRAPHY:-
Transcranial Doppler (TDC) is one of the non-invasive method used to measure the velocity cerebral blood flow. It is mostly adopted in neuro critical care including traumatic brain injury. The specificity and sensitivity of TDC in conforming the brain death is 985 and 75%-885 respectively. Even though TDC has many application in monitoring ICP/CPP in neurocritical care it is still lacking in regular use for severe TBI patients.

## 5.5 CHECKING BRAIN TEMPERATURE OF THE PATIENTS:-
A temperature gradient of a brain temperature is compared with temperature of the body up to $3^{\circ}C$ more in the brain have been reported after a head trauma. To a harmed brain common secondary abuse is found to be an elevated temperature. To measure the brain temperature both non-invasive, invasive and continuous cerebral temperature monitoring devices are used and they were sold at concerned price making available for use. But still it is not mostly used in order with care for severe TBI patients [19,20].

## 6. PROMINENT RESEARCH SUCCESS AND CURRENT PROGRESS:-
## 6.1 ANIMAL BCI RESEARCH:-
To operate BCI using thoughts and bring it into an action or movements many laboratories have arranged monkeys and rat to record the signals of their cerebral cortex. Monkeys are allowed to think and move the cursors on the computer screen and also they were able command and operate the robot arm to do small activities. Some other researches have also done with cats by decoding their visual signals. In thalamus there is a geniculate nucleus area which is responsible for all brain sensory input integration a team of researchers aimed 177 brain cells over that area and there they implanted an array of electrodes this will decodes the signals produced at the retina. Monkeys have special abilities which make them as an ideal subject for advanced research, they were preferred here for their best hand manipulating movements.

## 6.2. APPLICATIONS OF BRAIN COMPUTER INTERFACE:
It is used in classification of EEG signal and in multimedia communication. Its play's as an a.ctuated control of mobile robot by human EEG and also as a brain controlled switch for asynchronous control [21].

## 6.2.1 APPLICATION IN HUMAN:-
Those patients with diseases like ALS, traumatic brain damage, Guillain-Bare syndrome, progressive motor neuron disease, subcortical stroke may get suffer from locked-in syndrome (LIS). It is defined as a whole body paralyze sometimes with few voluntary movements or functions left. TLIS- total locked-in syndrome is defined as complete ending of all voluntary functions, thus it is also called as cessation of somatic-motor function.

## 7. CONCLUSION:-
Thus this device is a boon to paralysed patients and it has wide applications. By this method a second way of giving life to a paralysed patient is possible. A patient with this defect will also be mentally down thus an encouragement for them to fight against this disability to make it as ability can be done. Patients and peoples all over the world are same and by this finding a way to change the mentality of the society form the tone of disabled peoples to differently able people.

## 8. FUTURE SCOPE:-

In research near future it aims at a low cost, low risk surgeries to the severely paralyzed patients, which can be used by them in their day to day life. The future development mainly focussed on the feature extraction, algorithms and in signal acquisition. Still some patients feel difficulty in learning and adapting BCI because of unknown reasons but others can easily learn and adapt BCI. All thepatients and participants will be clearly provided with approved ethical review from the board of medical faculty of University of Tubingen.. It is also expected to be a smaller and wireless device that is wireless interface between computer and implanted server.

## 9. REFERENCES:-

1. He BJ, Zempel JM, Snyder AZ, Raichle ME. The temporal structures and functional significance of scale-free brain activity. Neuron. 2010 May 13;66(3):353-69.

2. Münßinger JI, Halder S, Kleih SC, Furdea A, Raco V, Hösle A, Kübler A. Brain painting: first evaluation of a new brain–computer interface application with ALS-patients and healthy volunteers. Frontiers in neuroscience. 2010;4

3. Kumar N. Brain computer interface. 2011 Apr 2.

4. Arafat I. Brain-Computer Interface: Past, Present & Future. International Islamic University Chittagong (IIUC), Chittagong, Bangladesh. 2013.

5. Simeral JD, Bacher D, Sarma AA, Schmansky NJ, Stavisky SD, Jarosiewicz B, Milekovic T, Rosler DM, Gilja V, Pandarinath C, Cornwell AS. Evolution of the braingate real-time brain-computer interface (bci) platform for individuals with tetraplegia or limb loss. InNeuroscience Meeting Planner 2013 Nov 9.

6. Birbaumer N, Murguialday AR, Wildgruber M, Cohen LG. Brain-computer-interface (BCI) in paralysis. InThe European Image of God and Man 2010 Oct 7 (pp. 483-492).

7. BrainGate PDF PPT. (n.d.). Retrieved from http://www.seminarsonly.com/Labels/Brain-Gate-PDF-PPT.php.

8. Skoglund K. *The Neurological Wake-up Test in Neurocritical Care* (Doctoral dissertation, Acta Universitatis Upsaliensis).

9. Teper R, Inzlicht M. Meditation, mindfulness and executive control: the importance of emotional acceptance and brain-based performance monitoring. Social cognitive and affective neuroscience. 2012 May 12;8(1):85-92

10. Flaherty JC, Serruya MD, inventors; Braingate Co., Llc, assignee. Neurally controlled patient ambulation system. United States patent US 7,901,368. 2011 Mar 8

11. Kuhn J, Gründler TO, Bauer R, Huff W, Fischer AG, Lenartz D, Maarouf M, Bührle C, Klosterkötter J, Ullsperger M, Sturm V. Successful deep brain stimulation of the nucleus accumbens in severe alcohol dependence is associated with changed performance monitoring. Addiction biology. 2011 Oct 1;16(4):620-3.

12. Dobkin BH, Dorsch A. The promise of mHealth: daily activity monitoring and outcome assessments by wearable sensors. Neurorehabilitation and neural repair. 2011 Nov;25(9):788-98.

13. Birbaumer N, Murguialday AR, Wildgruber M, Cohen LG. Brain-computer-interface (BCI) in paralysis. InThe European Image of God and Man 2010 Oct 7 (pp. 483-492).

14. Arafat I. Brain-Computer Interface: Past, Present & Future. International Islamic University Chittagong (IIUC), Chittagong, Bangladesh. 2013

15. Himes DM, inventor; NEUROVISTA CORP, assignee. Universal Electrode Array for Monitoring Brain Activity. United States patent application US 12/630,300. 2010 Jun 10.

16. Sporns O, Betzel RF. Modular brain networks. Annual review of psychology. 2016 Jan 4;67:613-40.

17. Bassett DS, Yang M, Wymbs NF, Grafton ST. Learning-induced autonomy of sensorimotor systems. Nature neuroscience. 2015 May;18(5):744.

18. Brooker RJ, Buss KA, Dennis TA. Error-monitoring brain activity is associated with affective behaviors in young children. Developmental Cognitive Neuroscience. 2011 Apr 1;1(2):141-52.

19. Kassab A, Le Lan J, Vannasing P, Sawan M. Functional near-infrared spectroscopy caps for brain activity monitoring: a review. Applied Optics. 2015 Jan 20;54(3):576-86.

20. Simeral JD, Perge JA, Masse NY, Jarosiewicz B, Bacher D, Donoghue J, Hochberg LR. Some preliminary longitudinal findings from five trial participants using the BrainGate neural interface system. InSoc. Neurosci. Abstr 2011 (Vol. 142).

21. Flaherty JC, Serruya MD, inventors; Braingate Co., Llc, assignee. Neurally controlled patient ambulation system. United States patent US 7,901,368. 2011 Mar 8

22. Lindenberg R, Renga V, Zhu LL, Nair D, Schlaug GM. Bihemispheric brain stimulation facilitates motor recovery in chronic stroke patients. Neurology. 2010 Dec 14;75(24):2176-84.

## APPRAISAL AND IMITATION OF SURFACE PROFILES DOWN STREAM OF A HEAD SLUICE

**Prasanna S. V. S. N. D. L**

Department of Civil Engineering, College of Engineering (A), Osmania University, Hyderabad, India

**ABSTRACT**

*The flow rate in a natural stream may vary considerably during different periods of the year. Therefore, it becomes essential to create a reservoir to retain the surplus water during the periods of floods and/or high flows in the river. The water thus conserved may be diverted for constructive purposes through head works. Hence, a canal head regulator is needed not only for diverting water but also for regulating the water supplies into an off taking canal whenever required. The primary objective of the present investigation is to simulate the water surface profile under different flow conditions. The waterway of the head regulator should be sufficient to pass the required discharge into the canal with designed pond level. Moreover, studies were even carried out for half supply depth in the canal with liquid level condition. The hydraulic calculations were performed under various flow conditions viz., High Flood Conditions and Pond Level conditions will enable the level of jump formation. Accordingly, the cistern dimensions were arrived. In the present investigations, the simulation methodology was carried out using two different turbulence models viz., k-ε and k-ω. The simulation results were observed to have good agreement with the analytical estimations.*

*Keywords: head regulator, high flood level, pond level, turbulence models, UDF*

## I. INTRODUCTION

The state-of-art technologies in the area of water resources engineering have gained lot of importance these days. These technologies play a vital role with the advancement followed in solving various real-life problems. One such initiation is the simulation analysis. The major advantage of this approach is the reduction in the utilization of natural resources adopted for physical modeling. It helps in elaborative understanding of various perspectives involved in any water resources engineering applications. The present investigation is aimed at application of this methodology for analyzing the flow over a canal head regulator.

A head regulator is a structure constructed at the head of a canal taking off from a reservoir behind a weir or a dam. A head regulator may consist of a number of spans separated by piers and operated by gates similar to that provided in a barrage [1]. The manual operated gates having a span of 6 to 8 m are adopted. Further, the modern tendency is to use bigger span and mechanically operated gates controlled by Stoney gates or Sector gates [2]. The stilling basin is a structure in which a hydraulic jump is generated and has been designed economically in terms of length, tail water level and scour [3].

The present study focuses on the following objectives for elaborate understanding of the flow through canal head regulator

- To estimate analytically the pre jump, post jump and length of the jump on the downstream side of the canal head regulator and compare the hydraulic jump parameters using ANSYS–CFD

- To plot the water surface profile over the canal head regulator using Simulation analysis through User Define Function (UDF)

As physical modeling is very expensive involving lot of resources, there is an utmost requirement for an alternative methodology. The main objective of the present study is to estimate the flow characteristics using simulation analysis. Further, it is also aimed to demonstrate and emphasize the utilization of simulation analysis as an alternative to the physical modeling studies.

## II. METHODOLOGY

The present investigation was carried out in two different phases in order to estimate various characteristics of hydraulic jump over the canal head regulator.

### A. Analytical Estimations:

The analytical estimations were performed based on the following equations for the definition sketch of a hypothetical data as shown in the Figure 1 for different flow conditions.
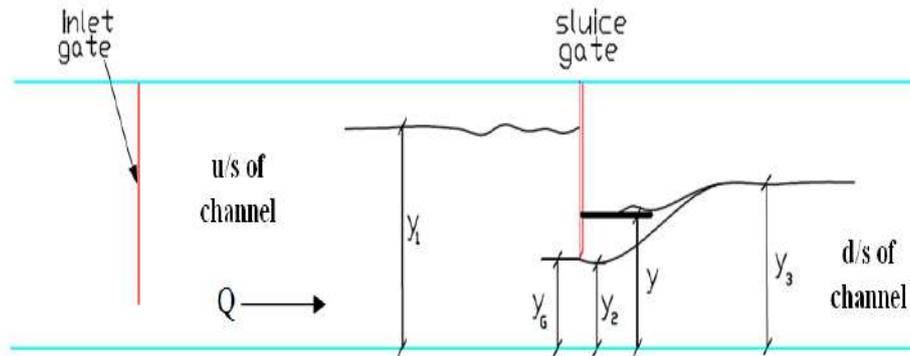
**Figure 1:** Definition Sketch

The nomenclature adopted is appended herewith. B = width of the channel, $y_n$ = normal depth, n = Manning's coefficient, $V_2$ = velocity at depth $y_2$, $Fr_2$ = Froude's number at section-2, $y_1$ = approach flow depth, $y_G$ = sluice gate opening, y = depth of flow just d/s of gate; $y_2$ = flow depth before formation of hydraulic jump (initial depth), $y_3$ = flow depth after the formation of hydraulic jump (sequent depth) (Suresh 2018). The normal depth was calculated by trial and error from Manning's Eq. (1) detailed below.

$$Q = \left(\frac{By_n}{n}\right)\left(\frac{By_n}{B+2y_n}\right)^{2/3} (S)^{1/2} \ \dots\dots\dots\dots\dots\dots\ (1)$$

From the specific energy as detailed in Eq. (2) between section-1 and section-2, the value of 'y' was estimated [4].

$$y_1 + \frac{Q^2}{2g\left(By_1\right)^2} = y + \frac{Q^2}{2g\left(By_2\right)^2} \ \dots\dots\dots\dots\dots\dots\ (2)$$

This value of 'y' was made use of in Eq. (3) for the conservation of momentum of the flow between section -2 and section-3.

$$\frac{Q^2}{gA_2} + A_2\overline{Z_2} = \frac{Q^2}{gA_3} + A_2\overline{Z_3} \ \dots\dots\dots\dots\dots\dots\dots\ (3)$$

In specific force equation across the jump in a rectangular channel, $\dfrac{Q^2}{gA}$ represents the momentum of the flow

passing through the channel per unit time per unit weight of water and $A\overline{Z}$ characterizes the force per unit weight of water [5].

The analytical results for the three different flow conditions from basic governing equations are highlighted in Table 1.

**Table 1:** Analytical Results of Gate operations

| Gate Opening (m) | Flow Condition | Discharge (cumec) | Flow velocity through the gate $V_2$ (m/s) | Normal depth, $y_n$ (m) | Sequent depth, $y_3$ (m) | Energy loss, $\Delta E$ (m) |
|---|---|---|---|---|---|---|
| 0.64 | High Flood Level | 180.0 | 10.081 | 2.681 | 2.676 | 0.8420 |
| 0.84 | Pond Level | 180.0 | 7.681 | | 2.256 | 0.4044 |
| 0.40 | Pond Level | 90.0 | 8.064 | 1.7421 | 1.694 | 0.1861 |

It is seen from the above Table 1 that, the height of gate opening required for different flow conditions was found to be in decreasing order, with the subsequent decrease in the flow rate. This is due to the fact that, the head causing the flow for larger flow rates is high. Hence, the flow velocity through the gate is also high. Moreover, the energy loss in the system is low for half supply discharge of pond level condition, as the values of normal depth is higher than the sequent depth. Therefore, the jump is getting submerged by the tail water conditions. As a result of this, the energy dissipation will not be complete and water continues to move with higher flow velocities. Consequently, the length of apron to be provided under energy dissipation arrangements

will be more than unsubmerged jump conditions. The jump and other flow characteristics are highlighted in Table 2.

**Table 2:** Jump Characteristics for various flow conditions

| Flow Condition | Discharge (cumec) | Pre-Jump Depth (m) | Post-Jump Depth (m) | Length of the Jump (m) | Turbulent Kinetic Energy (m²/s²) |
|---|---|---|---|---|---|
| High Flood Level | 180.0 | 0.397 | 2.676 | 11.395 | 50.813 |
| Pond Level | 180.0 | 0.521 | 2.256 | 8.675 | 29.498 |
| Pond Level | 90.0 | 0.248 | 1.694 | 7.230 | 32.514 |

### B. SIMULATION ANALYSIS:

The ANSYS-CFD software was adopted in the present study to estimate the height and length of the jump. The geometry was generated in design modeller of ANSYS as shown in Figure 2 and further, the mesh was generated as detailed in Figure 3. The boundary conditions adopted for the geometry created is depicted in Figure 4.
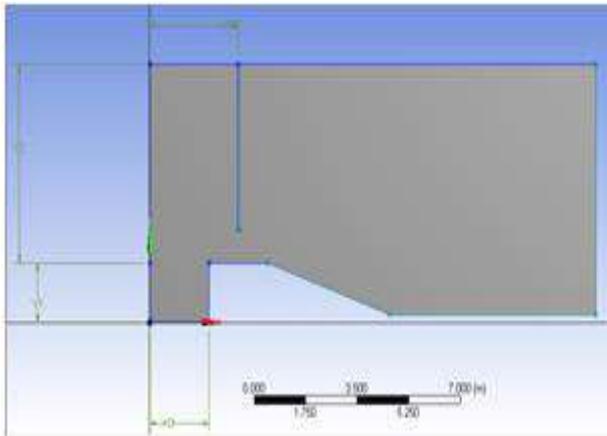


**Figure 2:** Geometry of Canal Head Regulator    **Figure 3:** Mesh of Canal Head Regulator
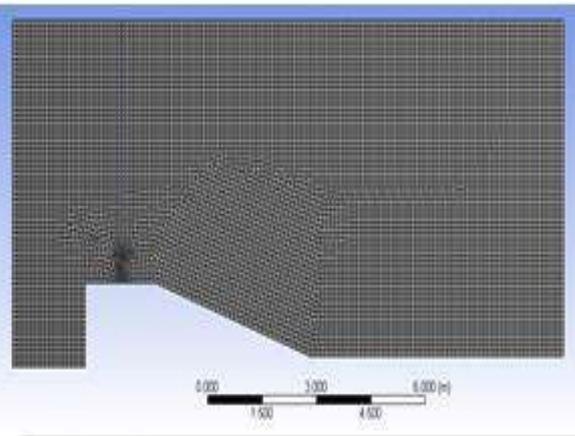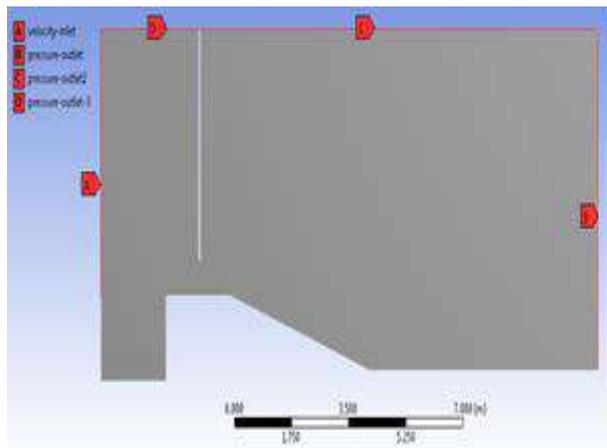


**Figure 4:** Assigned Boundary Conditions    **Figure 5:** Patched Water Level of CHR
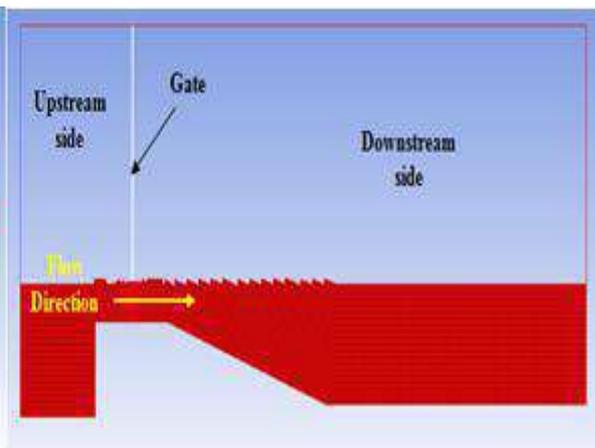
To evaluate the flow from upstream to downstream side in the canal head regulator, the geometry was patched initially with water level up to the gate opening. The details of the patched water level are illustrated in Figure 5 to evaluate the water surface profile [6]. The investigations were carried out for three different flow conditions viz., High Flood Level (HFL) and Pond Level (PL) for 180 cumec and Pond Level (PL) for 90 cumec. The contours of multiphases viz., water and air, velocity profiles are plotted using Graphics and Animations in fluent. The variations in multiphase analysis obtained from the simulations for two different phases were given a value of 1.0 for water and zero for air [7]. The contours of volume fraction for HFL condition obtained for k-ε and k-ω turbulence models is highlighted in Figure 6 (a) and (b).
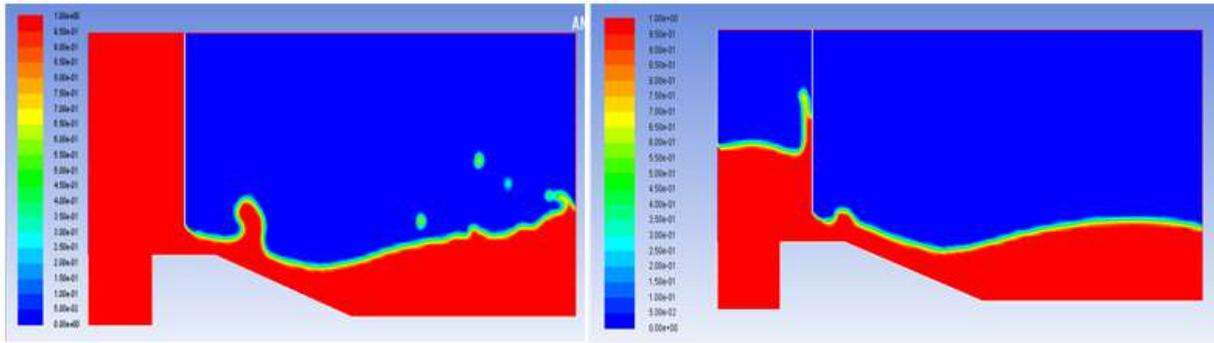
(a) HFL - 180 cumec                    (b) PL – 180 cumec

**Figure 6:** Contours of Volume Fraction Using k-Epsilon Turbulence Model

It is clearly seen from the Figure 6(b) that water is impinging against the breast wall. In order to prevent the spilling of water over the gates into the canal, a reinforced concrete breast wall is provided from pond level well above High Flood Level. When the gate is fully open, water rises above the pond level so that full supplies can be passed into the canal. When the gate is fully closed, it shuts the opening from the bottom of the breast wall to the crest. Thus, the portion above the top of the gate opening is permanently closed by the breast wall. Hence, in the absence of breast wall water might have splashed to the d/s side of the structure. It is evident from the contours that the height and length of the jump can't be read from the plots. Therefore, the simulations were extended to determine the length and height of the jump by adopting user defined functions.

The macros featuring the volume fractions at various cell points beginning from the entrance of the gate were programmed [8]. The programme was executed in the Fluent solver in order to obtain all the 'X', 'Y' and volume fraction values at all the cells upstream and downstream of the gate. The analysis of length (X), height (Y) corresponding to the volume fraction values enabled to determine the pre jump, and post jump depths as well as the length of the jump [9]. The water surface profile was also extracted from the UDF programme as represented in Figure 7. The results obtained from the simulation analysis for all the three flow scenarios are detailed in Table 2.
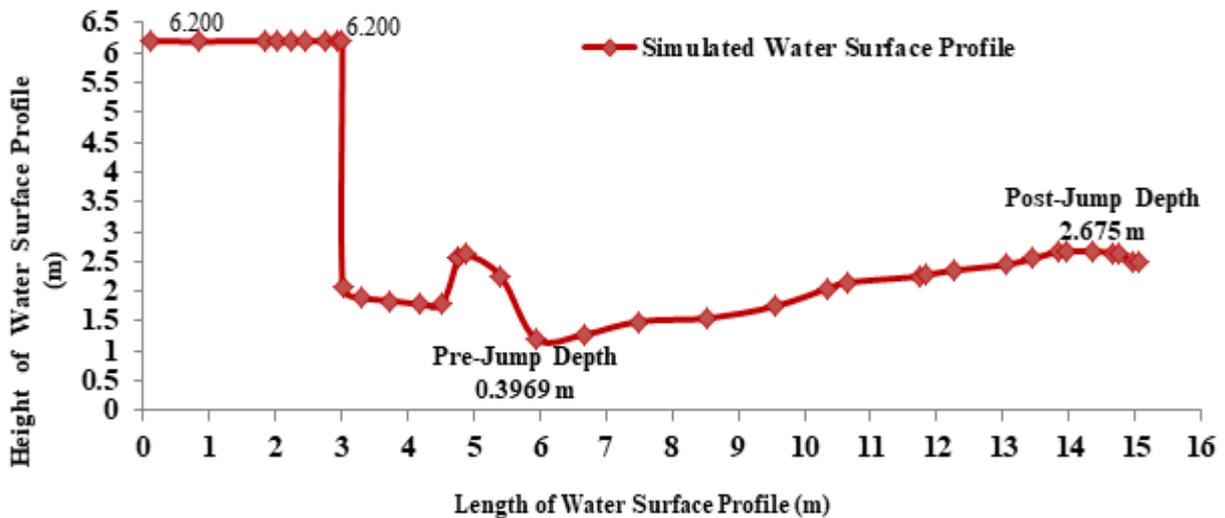


**Figure 7:** Simulated Water Surface Profile for HFL (180 cumec)

**Table 2:** UDF Analysis Results of k - ε and k - ω

| Flow Condition | Discharge (cumec) | Pre-Jump Depth (m) | | Post-Jump Depth (m) | | Length of the Jump (m) | |
|---|---|---|---|---|---|---|---|
| | | k - ε | k - ω | k - ε | k - ω | k - ε | k - ω |
| High Flood Level | 180.0 | 0.3969 | 0.3972 | 2.675 | 2.677 | 11.3905 | 11.399 |
| Pond Level | 180.0 | 0.5205 | 0.5212 | 2.2567 | 2.2562 | 8.681 | 8.675 |
| Pond Level | 90.0 | 0.2477 | 0.2475 | 1.6935 | 1.6934 | 7.229 | 7.2295 |

The contours of velocity magnitude as evaluated by two different turbulence models viz., k-ε and k-ω. It is apparent from the contours of velocity magnitude for simulated flow velocity using k-ε through the gate at vena contracta is quite close to the analytical estimate of 10.081 m/s. It is seen that, the flow lines on the d/s side of the gate are converging up to vena contracta. At vena contracta, the approaching stream lines are straight and practically parallel to each other. The area at this location is the least. Hence, velocity of flow at this section will be maximum i.e., (10.081 m/s) which can be clearly observed from the vectors of simulated velocity magnitude simulated as depicted in Figure 8 (b) for HFL – 180 cumec. The analytical dynamic pressure near the gate is 3.2 x10$^4$ Pa. It is quite close to the simulated dynamic pressure as detailed in Figure 9 for HFL carrying a discharge of 180 cumec.



(a) Contours                                    (b) Vectors
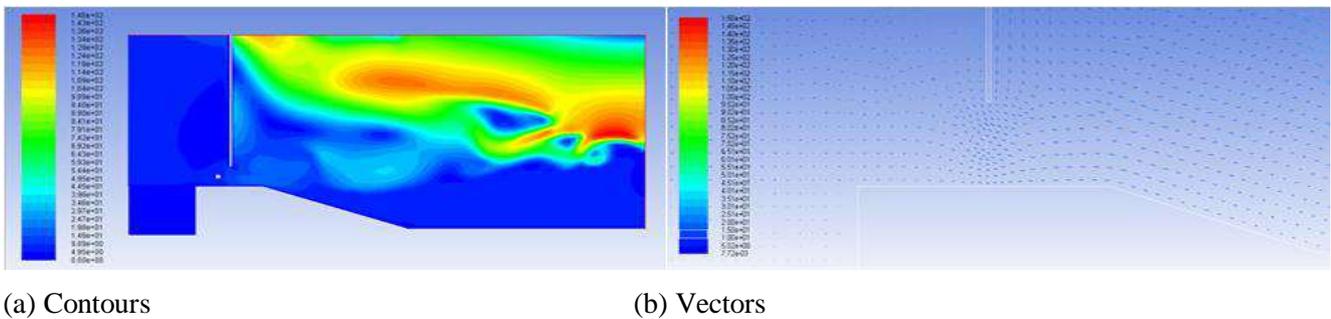
**Figure 8:** Velocity Magnitude Using k- ε Turbulence Model (HFL-180 cumec)
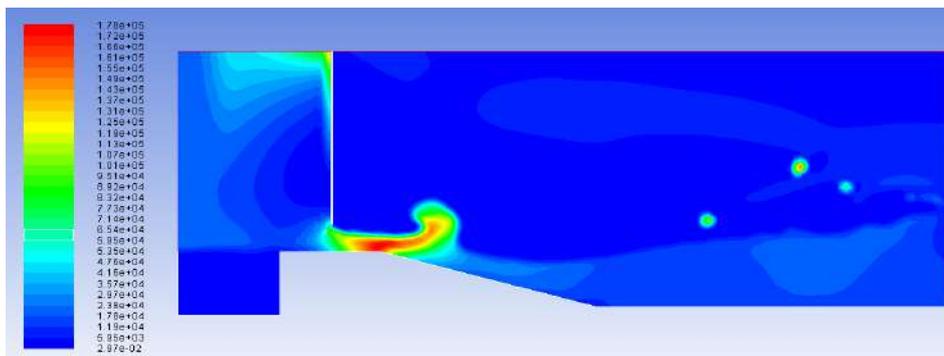


**Figure 9:** Contours of Dynamic Pressure by k-Epsilon Model

The simulation results of Turbulent Kinetic Energy for HFL are shown in the Figure 10. It is obvious from the figures of turbulent kinetic energy that, the values of 'k' is in full agreement with the analytical values detailed in Table 2.
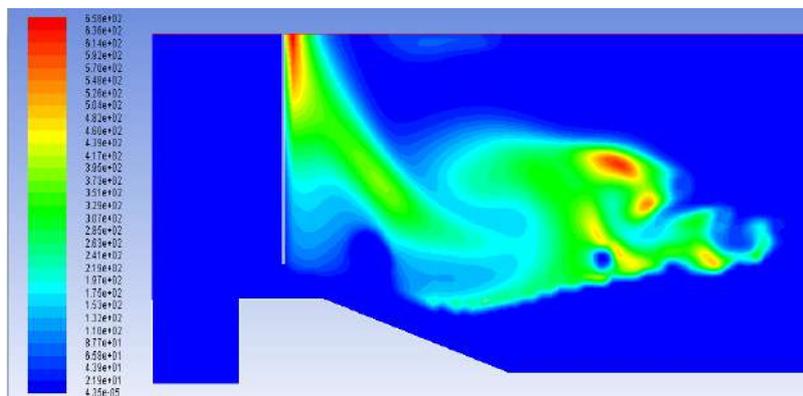


**Figure 10:** Contours of Turbulent Kinetic Energy by k-Epsilon Turbulence Model

## III.     RESULTS AND DISCUSSIONS

Based on the present investigations carried out in two different phases, the following results were deduced

- The pre-jump height, post-jump height and the length of the jump were analytically estimated for HFL condition at a discharge of 180 cumec and for PL at 180 cumec and 90cumec.

- The height of the pre-jump, post jump and the length of the jump for various flow scenarios were analyzed in Fluent with k-Epsilon and RNG k-Epsilon turbulence models.

- The pre-jump, post-jump height and the length of the jump values obtained using a User-Defined function, by the interpretation and execution of the macro generated based on the multiphase analysis were observed to have fair agreement with the analytical results as highlighted in Figure 11 to 13.
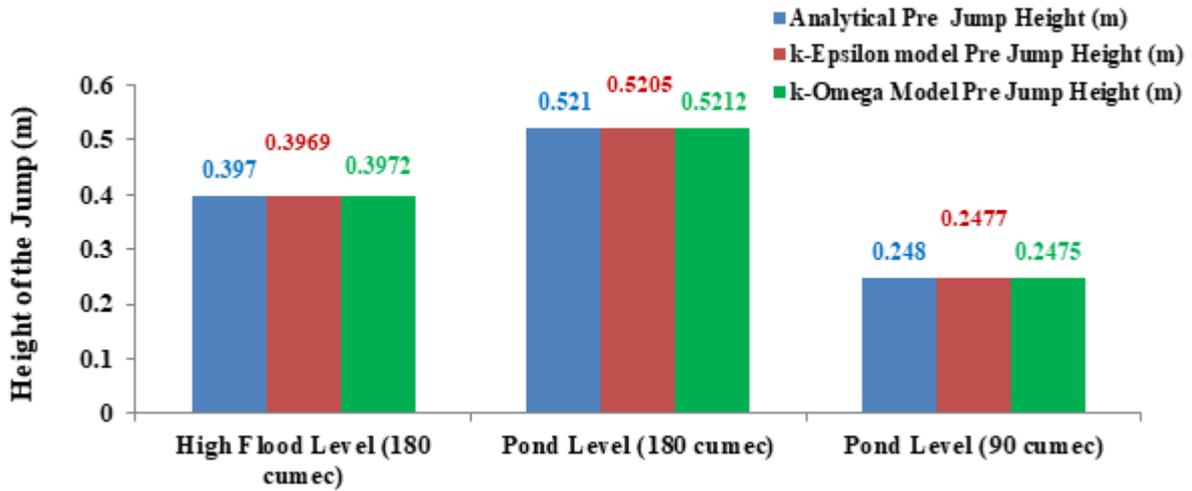


**Figure 11:** Comparative Pre-Jump Height Results
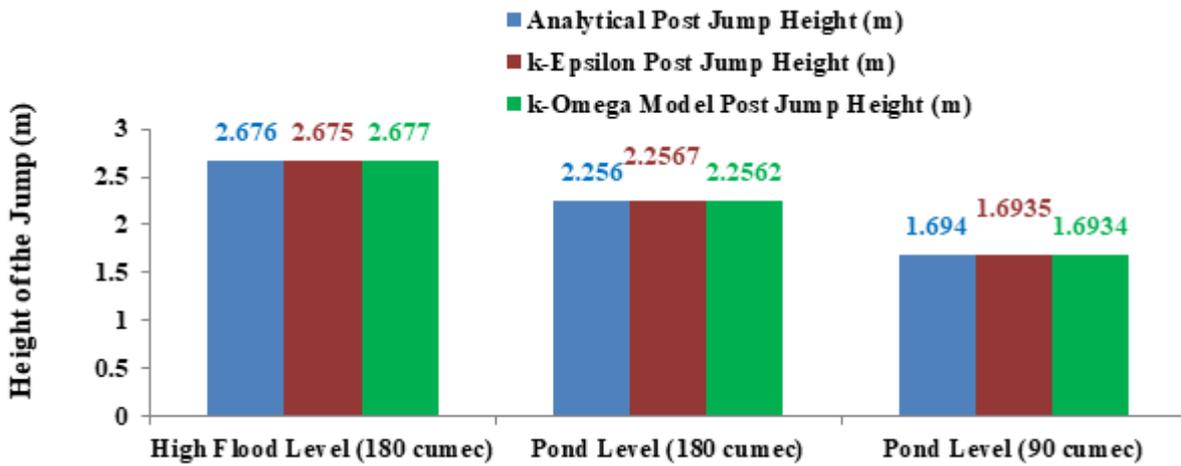


**Figure 12:** Comparative Post-Jump Height Results
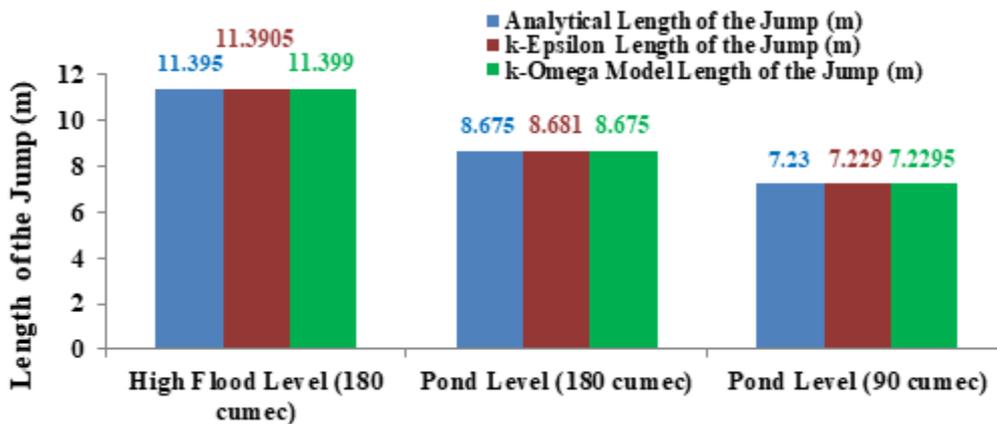


**Figure 13:** Comparative Results of Length of Jump

- The comparative results of pre-jump, post-jump and length of the jump are observed to have less than 1% error between the analytical and simulated results as shown in the Table 3.

**Table 3:** Percentage Error between Analytical and Simulated

| Flow Condition & Discharge | % Error in Pre-Jump Height | | % Error in Post-Jump Height | | % Error in Length of Jump | |
|---|---|---|---|---|---|---|
| | Analytical & k – Epsilon | Analytical & k - ω | Analytical & k – Epsilon | Analytical & k - ω | Analytical & k – Epsilon | Analytical & k - ω |
| High Flood Level (180 cumec) | 0.03 | 0.05 | 0.04 | -0.04 | 0.04 | -0.07 |
| Pond Level (180 cumec) | 0.10 | 0.04 | -0.03 | -0.01 | -0.07 | 0.07 |
| Pond Level (90 cumec) | 0.12 | -0.20 | 0.03 | 0.04 | 0.01 | -0.01 |

## IV. CONCLUSION

The pre-jump depth, post-jump depth and the length of the jump values obtained adopting a User-Defined function were detected to have fair agreement with the analytical analysis. The comparative results of jump characteristics were observed to have less than 1% error between the analytical and simulated results. Therefore, it is evident from the present investigation that, simulation studies can be an alternative to physical modelling studies in various hydraulic engineering applications. These studies can be taken up either in the planning stage or even for the modified flow scenarios subsequent for construction of a hydraulic structure.

## REFERENCES

[1]. Punmia B C., Lal B B Pande, Ashok Kumar Jain, Arun Kumar Jain; Irrigation and Water Power Engineering, *Laxmi publications Pvt. Ltd.*, 16th Edition, 2019, pp. 828-829.

[2]. Santosh Kumar Garg; "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, Delhi, 14th Edition, 1999, pp: 661.

[3]. Seungho Hong, Celio Biering, Terry W. Sturm, Kwang Seok Yoon and Juan A. Gonzalez-Castro; Effect of Submergence and Apron Length on Spillway Scour: Case Study, *Water,* 2015, 7, pp. 5378-5395; doi:10.3390/w7105378.

[4]. (Henderson FM. *Open Channel Flow,* Macmillan Publishing Co., Inc. New York, 1966)

[5]. Suresh Kumar N, Prasanna SVSNDL; Turbulence Modelling for Estimation of Hydraulic Jump Height, *Recent Trends in Fluid Mechanics.* 2018; 5(3): pp. 1–11.

[6]. Wilcox, David C. *Turbulence Modeling for CFD*, DCW Industries, Inc. California, 2006.

[7]. Prasanna S V S N D L, Suresh Kumar N; Simulation of flows over an Air-Regulated Siphon Spillway, *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)* , vol. 15, no. 4, 2018, pp. 19-25, DOI: 10.9790/1684-1504051925.

[8]. Abdulnaser Sayma, Computational Fluid Dynamics, Venus Publishing ApS (www.bookboon.com), 2009.

[9]. Prasanna, SVSNDL, Suresh Kumar N.; Simulation and Analytical Estimation of Spillway Flip Bucket Parameters, *International Journal of Innovative Technology and Exploring Engineering,* 8(12), 2019, pp. 4062 – 4066, *doi: 10.35940/ijitee.* L3632.*1081219.*

## EVALUATION OF WETTABILITY OF SELF ETCH ADHESIVE INCORPORATED WITH GREEN SYNTHESIZED TIO2 NANOPARTICLES-AN INVITRO STUDY

**[1*]Dr. M. Shamly and [2]Dr. Jayalakshmi**

[1]MDS, Postgraduate Student and [2]MDS, Senior Lecturer, Department of Conservative Dentistry & Endodontics, Saveetha Dental College, Chennai

**ABSTRACT**

*Background*

*The invention of universal adhesives has simplified adhesive protocols in dentistry. Self etch adhesives have decreased bond strength and also produces secondary caries due to microleakage. In an attempt to enhance wettability and antimicrobial property of self etch adhesives, $Tio_2$ nanoparticles were incorporated. The contact angle of adhesives is a predictor of bonding ability and the restoration's sustainability. Wettability is commonly determined using contact angle of solution.*

*Aim*

*The aim of the study was to evaluate wettability of self etch adhesive incorporated with Tio2 nanoparticles.*

*Materials and methods:*

*Green synthesized $TiO_2$ nanoparticles($n$-$TiO_2$) were prepared from Piper longum extract. Twenty extracted human teeth were taken. Labial enamel sections were prepared using hard tissue microtome. The Ossila goniometer was used to measure contact angle. Control and experimental $Tio_2$ incorporated self etch adhesives were dispensed using a micro-syringe over the sectioned tooth specimen and contact angle of bonding agent with tooth specimen was obtained. Statistical analysis was done using SPSS software version 23. Mean and standard deviation values were obtained and Student's independent t test was done for comparison between study groups.*

*Result*

*There is no statistical difference in wettability between conventional self etch adhesive and $TiO_2$ incorporated self etch adhesive. However the mean values of contact angle for experimental group is lower compared to the control group.*

*Conclusion*

*It can be concluded that incorporating $TiO_2$ nanoparticles into self etch bonding agent can be beneficial. Further invivo studies are needed to validate the findings for clinical relevance.*

*Keywords: Contact angle, Self etch adhesive, Titanium dioxide nanoparticles ,wettability.*

**INTRODUCTION:**

Long-lasting restorations are the hallmark of adhesive dentistry success. Adhesion necessitates close contact between the adhesive and the substrate. To achieve the optimal contact area between a liquid adhesive and a solid surface, the substrate must exhibit high wettability against that liquid, i.e. the adhesive must spontaneously spread on the substrate.[1] The physical–chemical characteristics of the adhesive blend namely the form of solvent and the hydrophilic/hydrophobic ratio of the monomers and environmental factors, such as the drying process, surrounding hygrometry, and temperature affects the wetting behaviour [2]. For total-etch adhesives, the effect of dentin wettability on adhesion efficiency has been demonstrated. Adhesion to dental substrates begins with an acid etching step, which results in surface demineralization of enamel or dentin. The prisms that make up enamel's highly mineralized structure will be extracted selectively, leaving a porous/micro-retentive surface that is conducive to resin penetration, resulting in stable resin-enamel bonds. Total etching uses a much more chemically reactive phosphoric acid than self-etching primers. As a consequence, the self-etching adhesives normally trigger a shallower etching depth.

Watanabe et al 1994 suggested the use of high concentrations of acidic resinous monomers that can release H+ ions and etch the dental structure while also penetrating the substrate in an aqueous solution[3]. Thus Self-etching adhesives were developed to address total-etch adhesives' water sensitivity during adhesive penetration into moist etched dentin. The resins are simultaneously infiltrated into the dentin as the self-etching adhesives strike it, decreasing water sensitivity[4]. The liquid acidity is the primary distinction between total-etch adhesives and self-etching primers. In addition, the wettability of self-etch adhesives is influenced by the smear layer. It is

slightly affected by the smear layer[5]. Total-etch adhesives will completely remove the smear layer during the etching process. Self-etching primers, on the other hand, partly remove the smear layer due to their lower acidity, and the resulting residues are mixed in with the remaining adhesive. Dentin bonding is affected by the contamination of the final adhesive substance and the partial removal of the smear layer. Self-etch primers and self-etch adhesive systems are made up of an aqueous solution of acidic functional monomers with a pH slightly higher than phosphoric acid etchants[6]. Water serves as a medium for the ionisation and action of these acidic resin monomers. Since most acidic monomers are water-insoluble, self-etch adhesive systems also use HEMA monomer to improve the wettability of the dentin surface[7]. To strengthen the cross-linking created by the monomeric matrix, bi- or multi-functional monomers are added[8]. Self-etch adhesive systems are called simpler adhesive materials because they do not need a separate acid conditioning step or a moist post-rinse control. They have some benefits over traditional etch and rinse systems, such as reduced postoperative sensitivity and less technique sensitive.[9]

The properties of a material and the substrate have an effect on how well it penetrates. The properties of surface tension and viscosity have an impact on penetration. When a liquid comes into contact with a solid, an angle is created between the solid and the air-liquid interface tangent, which is known as a contact angle[1]. Adhesives with lower surface tension and contact angles have more wetting potential and better diffusibility. The current research looked at a new proposal for lowering adhesive surface tension and increasing diffusivity. Nanoparticles have been integrated into dental adhesives after nanotechnology was introduced to the dental field in order to improve the adhesive's bond strength to the enamel [10]by penetrating into the demineralized surface, decreasing polymerization shrinkage, and increasing the elastic modulus of the adhesive layer. SiO2, Al2O3, Fe3O4, ZrO2, and TiO2 are among the nanoparticles that have been added. Because of its strong physical and chemical properties, availability and possible antifouling capacity, TiO2 has gotten the most attention. The TiO2 surface is a high-energy metal oxide surface and most liquids can fully wet it[11]. Also the hydroxy group in Tio2 helps to reduce contact angle and increase wettability. Till upto date no other studies have evaluated the property of wettability by incorporating Tio2 nanoparticles in self etch dentin adhesives. So the aim of this study is to evaluate wettability of self etch dentin adhesive incorporated with Green synthesized Tio2 nanoparticles using Piper longum. The null hypothesis is there is no significant difference in wettability of n-Tio2 incorporated self etch adhesives and conventional self etch adhesives.

## MATERIALS AND METHODS:

Piper longum 1gm was taken in 100ml distilled water and boiled for 5 minutes at 100 Cusing a heating mantle. The extracts were then filtered through Whatman N.1 filter paper before being processed and supernatant was used for further analysis.0.38gm of $Tio_2$ powder is added to 50ml of distilled water. Now 50ml of filtered piper longum extract is added with 50ml ofTio2 mixed distilled water. The solution is kept in orbital shaker and magnetic stirrer with hot plate for further mixing for 2 hours.

The absorption spectra of the produced nanoparticles in the range of 300 nm and 800 nm were measured using a UV-vis spectrophotometer. The solution is then mixed in magnetic stirrer for 2 days. This is followed by centrifugation at 8000 rpm for 10 minutes to remove supernatant and thus $TiO_2$ nanoparticles were isolated. Self etch adhesive used in this study was Restorite Bond 7G(PRIME Dental products Pvt Ltd).The prepared $TiO_2$ nanoparticles were measured and 1 wt% was directly incorporated into the bonding agent in the dark and mixed using vortex mixer for 10 minutes and then stored in a light proof bottle .Thus the experimental solution is prepared. Remaining bonding agent was left without any addition of nanoparticles that serves as control solution.

**Figure-1a:** Piper longum extract, 1b:Piper longum with $TiO_2$ ,1c:Centrifugation, 1d :Removal of supernatant solution, 1e:$TiO_2$ nanoparticles, 1f:$Tio_2$ incorporated self etch adhesive and Conventional self etch adhesive

Twenty extracted human teeth were taken in this study. They were randomly allotted into two study groups. Carious tooth or previously restored tooth are excluded.

Group 1- Conventional Self etch Adhesive

Group 2- $Tio_2$ nanoparticle incorporated Self etch Adhesive

Labial enamel sections were prepared using hard tissue microtome(Leica SP1600 saw microtome). Control and experimental $Tio2$ incorporated self etch adhesives were dispensed using a microsyringe and Ossila goniometer was used to measure contact angle. A specimen platform, a micro-syringe, and a camera linked to the software make up the goniometer. The camera was modified until a clear view was obtained after the small solid sectioned specimen was mounted in the centre of the platform. On the screen, the picture appears. After that, one drop of liquid was dispensed from the micro-syringe, but not allowing the needle to fall out. The specimen platform was raised to allow the drop to land on the specimen before being returned to its original position. This technique was used in a previous study to help prevent extra drops from falling on the specimen. Contact angle measurements were taken and a custom image processing programme was created to complement the goniometer measurements. A large contact angle denotes that the bonding agent solution is not wetting the tooth surface. Readings were taken and processed in excel sheet. Statistical analysis was done using SPSS software 23 version. Mean and standard deviation values were obtained and Independent t-test was done to promote comparison between study groups.
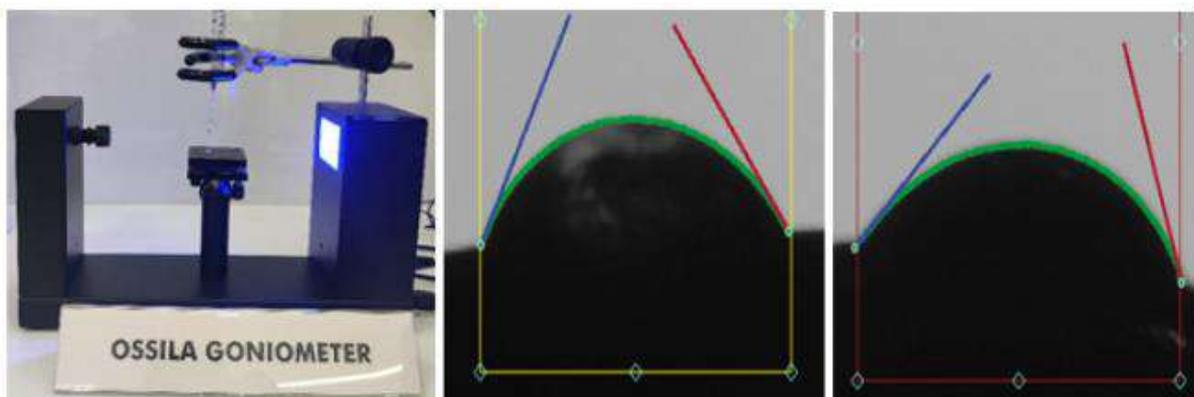


**Figure-2a:**Ossila Goniometer,2b:Experimental group ,2c:Control group

**RESULTS:**

The mean values of control group is 57.79 & standard deviation is 6.24 and experimental group is 56.53 & standard deviation is 9.91.

## Descriptive Statistics

| Group | | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| Control | contactangle | 10 | 48.48 | 68.75 | 57.7950 | 6.24000 |
| | Valid N (listwise) | 10 | | | | |
| Experimental | contactangle | 10 | 38.80 | 66.34 | 56.5360 | 9.91861 |
| | Valid N (listwise) | 10 | | | | |

| t | P value | Mean difference | Confidence interval of the difference |
|---|---|---|---|
| 0.340 | 0.73 | 1.25 | -6.52, 9.04 |

There is no statistical significance between control group and case group in relation to contact angle measurement. However the mean values of experimental group is lower compared to the control group.
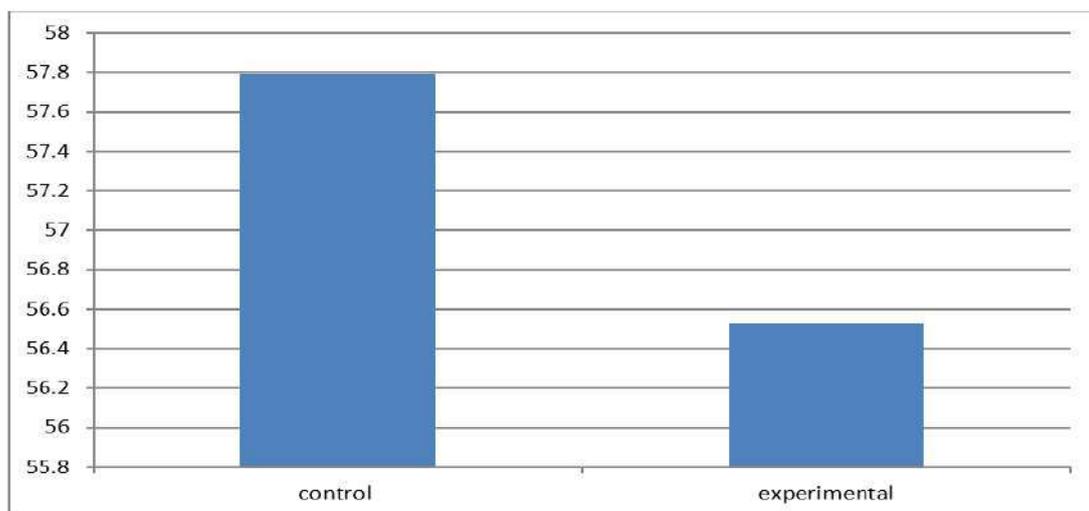


**DISCUSSION:**

Effective resin bonding on a dentin surface is well known to be dependent on two key factors: adhesive wetting and adhesive impregnation into the dentin substrates. The importance of wettability in dentin-resin composite material bonding stability cannot be overstated. The wettability of the dentin and the extent of adhesive penetration determine the consistency and longevity of the resin–dentin hybrid layer. The adhesive system's ability to adapt and spread is critical to achieve effective adhesion especially in case of self etch adhesives[7]. A change in microstructure can alter the properties of bonding agents. Therefore, this study investigated the wettability of $TiO_2$ nanoparticles incorporated self etch adhesive system.

The viscosity, surface roughness, and heterogeneity of a solution all influence the contact angle. Only when the substrate's surface free energy is maximised and the adhesive has a lower contact angle, ideal wettability can be achieved. The substrates with high wettability have higher surface energy than the liquid's surface tension[2].

It is well known that the inorganic hydroxyapatite phase of dentin has high wettability, while the organic collagen phase of dentin has low wettability. [12]The effect of tubule density on roughness and wettability has been studied because superficial and deep dentin have different characteristics.

On both superficial and deep dentin, Aguilera et al.2012 discovered a significant increase in wettability. There are two opposing viewpoints on the relationship of roughness and wettability. According to recent research,

lower dentin wettability is linked to higher surface roughness. According to these findings, open dentin tubules with larger diameters reduce dentin wettability due to tiny air pockets inside them. Liu et al.2015 on the other hand, looked at the relationship between roughness and wettability and came to the conclusion that the rougher the surface, the more wettable it is. So there is a contradictory between these findings.

The thickness of the smear layer has a greater effect on the wettability of the surface than surface roughness, according to a study by Pashley et al.2002. The smear layer blocks the dentinal tubules, stopping oral fluids and restorative materials from diffusing. As a result, some researchers advise acid etching of the dentin to remove the smear layer and promote perfect adhesion. The superficial portion of the dentin is also removed or dissolved by acid, which increases the microporosity of the intertubular dentin. As a result, the morphology and wettability of the dentin surface are significantly altered.

The majority of the smear layer is hydrophobic. The smear layer may dissolve and the intact dentin surface beneath the smear layer may be modified by functional monomers. Acid etching not only changes the adherent surface topology by raising tubule diameters and surface roughness, but it also exposes collagen fibres and raises the organic or mineral ratio portion, lowering surface energy. However, the literature does not agree on the efficacy of dentin wettability after acid etching. After acid etching, several researchers discovered that dentin wettability increases.

The effect of drying time and primer application on water infiltration on dentin was studied by Hitmi et al.2002, who found that air drying dentin after acid etching significantly reduced the wettability of dentin[13]. They also reported that HEMA-based primers reduced dentin's hydrophobicity, prevented collagen breakdown, and restored water content in air-dried dentin to some extent. Thus it increases hydrophilicity and thus wettability also increased. Gregoire et al.2011 on the other hand, discovered no connection between water contact angles and the use of HEMA-based primers. Since TiO2 is hydrophilic by nature, a textured surface on the TiO2 film has the potential to improve hydrophilicity. Some studies states that after being irradiated with ultraviolet light, the surface of TiO2 can become superhydrophilic. Another research investigated the hydrophilic properties of TiO2 coatings by fabricating a TiO2 film with a subwavelength surface structure using submicron-scale spherical aggregates of TiO2 nanoparticles. As compared to a plain surface, optical inspection revealed increased visible light transmittance. This was thought to be due to the air–TiO2 interface having a graded refractive index. In addition, the subwavelength-structure film often exhibited superhydrophilic activity without the use of ultraviolet light, as measured by the contact angle of a water drop. It was also determined that the proposed film's photocatalytic behaviour was comparable to that of a normal TiO2 film[14]. In our present study, seventh generation bonding agent was used.Clinical application has been streamlined with the implementation of single-application bonding systems that combine the Self etching primer(SEP) and the resin-bonding agent into a one-step formulation. They are called as sixth generation bonding agents. Due to the difficulty of achieving chemically stable concentrations of the components (acid, primer, and adhesive), the sixth-generation bonding systems are configured to store their components separately in two flasks before they are combined for clinical usage. Since initializers are acidity-sensitive, such component separation prevents changes in the initializers (Van Meerbeek et al., 2003). Seventh-generation SEPs were developed in an attempt to create a self-conditioning agent with all of its components mixed together in a single flask. It has a bond to enamel and dentine that is equivalent to that of traditional adhesive systems that have been treated with phosphoric acid (Nunes et al., 2009).However  the incidence of microleakage and secondary caries are more compared to total etch adhesives[15,16]. In order to minimise the problem encountered, proper wettability is needed. Thus the main aim of our research was to compare the wettability of conventional seventh generation bonding agent with TiO2 nanoparticle incorporated bonding agent. Also TiO2 has efficient antimicrobial property that can prevent incidence of secondary caries. The mean values of experimental group is lower compared to the control group. However  there is no statistical significance between control group and case group in relation to this contact angle measurement.The reason may be because of the small sample group taken. But according to the results obtained, it can be inferred that incorporating TiO2 nanoparticles into self etch bonding agent can be beneficial. Further invivo studies are needed to validate the findings for clinical relevance.

## CONCLUSION:
Within the limitations of the study it can be concluded that ,TiO2 incorporated self etch adhesives shows superior wettability compared to the  conventional self etch adhesives. However the results are statistically insignificant.

Further invivo studies are needed to properly extrapolate the study results in clinical situation.

**REFERENCES:**

1. Allen KW. Contact angle, wettability and adhesion [Internet]. Vol. 14, International Journal of Adhesion and Adhesives. 1994. p. 69. Available from: http://dx.doi.org/10.1016/0143-7496(94)90024-8

2. Aliofkhazraei M. Wetting and Wettability. BoD – Books on Demand; 2015. 384 p.

3. Watanabe I, Nakabayashi N, Pashley DH. Bonding to Ground Dentin by a Phenyl-P Self -etching Primer [Internet]. Vol. 73, Journal of Dental Research. 1994. p. 1212–20. Available from: http://dx.doi.org/10.1177/00220345940730061301

4. Toledano M, Osorio R, de Leonardi G, Rosales-Leal JI, Ceballos L, Cabrerizo-Vilchez MA. Influence of self-etching primer on the resin adhesion to enamel and dentin. Am J Dent. 2001 Aug;14(4):205–10.

5. Aguilar-Mendoza JA, Rosales-Leal JI, Rodríguez-Valverde MA, González-López S, Cabrerizo-Vílchez MA. Wettability and bonding of self-etching dental adhesives. Influence of the smear layer. Dent Mater. 2008 Jul;24(7):994–1000.

6. Kenshima S, Reis A, Uceda-Gomez N, Tancredo L de LF, Filho LER, Nogueira FN, et al. Effect of smear layer thickness and pH of self-etching adhesive systems on the bond strength and gap formation to dentin. J Adhes Dent. 2005 Summer;7(2):117–26.

7. Grégoire G, Dabsie F, Dieng-Sarr F, Akon B, Sharrock P. Solvent composition of one-step self-etch adhesives and dentine wettability. J Dent. 2011 Jan;39(1):30–9.

8. Malacarne-Zanon J, Pashley DH, Agee KA, Foulger S, Alves MC, Breschi L, et al. Effects of ethanol addition on the water sorption/solubility and percent conversion of comonomers in model dental adhesives. Dent Mater. 2009 Oct;25(10):1275–84.

9. Giannini M, Makishi P, Ayres APA, Vermelho PM, Fronza BM, Nikaido T, et al. Self-etch adhesive systems: a literature review. Braz Dent J. 2015 Jan;26(1):3–10.

10. Corona-Gomez J, Chen X, Yang Q. Effect of Nanoparticle Incorporation and Surface Coating on Mechanical Properties of Bone Scaffolds: A Brief Review. J Funct Biomater [Internet]. 2016 Jul 12;7(3). Available from: http://dx.doi.org/10.3390/jfb7030018

11. Huang J-Y, Lai Y-K. TiO2 -Based Surfaces with Special Wettability – From Nature to Biomimetic Application [Internet]. Wetting and Wettability. 2015. Available from: http://dx.doi.org/10.5772/60826

12. Rosenman G, Aronov D. Wettability Engineering and Bioactivation of Hydroxyapatite Nanoceramics [Internet]. Vol. 38, ChemInform. 2007. Available from: http://dx.doi.org/10.1002/chin.200730197

13. Hitmi L, Bouter D, Degrange M. Influence of drying and HEMA treatment on dentin wettability [Internet]. Vol. 18, Dental Materials. 2002. p. 503–11. Available from: http://dx.doi.org/10.1016/s0109-5641(01)00075-6

14. Zhou W, Zhong X. Corrigendum to "The effect of surface roughness and wettability of nanostructured TiO2 film on TCA-8113 epithelial-like cells" [Internet]. Vol. 201, Surface and Coatings Technology. 2006. p. 505. Available from: http://dx.doi.org/10.1016/j.surfcoat.2006.04.027

15. Prahasti A, Karnady J. Comparison of microleakage on Class V composite restoration: Study on total etch, self etch and selective etch technique [Internet]. Vol. 3, Scientific Dental Journal. 2019. p. 47. Available from: http://dx.doi.org/10.4103/sdj.sdj_7_19

16. Diansari V, Eriwati YK, Indrani DJ. Microleakage of Resin Composite Restoration with Total-Etch and Self-Etch Systems at Various Curing Distances [Internet]. Vol. 15, Journal of Dentistry Indonesia. 2008. Available from: http://dx.doi.org/10.14693/jdi.v15i2.68

## EFFECT OF YOGA PRACTICE ON HAPPINESS AMONG COLLEGE WOMEN POST COVID-19 PANDEMIC

[1]*I Sneha Ilayadarshini, [2]Dr. P. Yoga, and [3]Dr. K. Alaguraja

Research Scholar[1] and Assistant Professor[2], Alagappa University College of Physical Education, Karaikudi, Tamilnadu, India

Assistant Professor[3], V. P. M. M. College of Education for Women

**ABSTRACT**

*COVID-19 affected people of almost all ages, gender and area making us to live in a constant state of fear and loneliness confining us to our homes. The age considered as a stage where we want to experience freedom and independence; college life is such a platform to the youngsters. Everyone wants to enjoy this phase to their best and hold loads of hopes with the same. But pandemic and worldwide lock shattered this hope of the student. Therefore this study focused on the happiness level of women college students from Affiliated colleges of Alagappa University, Karaikudi area, who were subjected to Yoga for 8 weeks period and how yoga introduction changed the happiness level in the subjects was studied using Oxford Happiness Questionnaire. The pre-test and post-test scores were evaluated using t-ratio test and the score of 20.57\* was found in the experimental group post training which was greater than the required table value of 2.147 hence the study was found significant.*

*Keywords: Happiness, Oxford Happiness Questionnaire, pandemic and women.*

### INTRODUCTION

COVID-19 brought doom upon the planet earth and the whole humankind suffered a lot during the phase physically affecting our health to wide extend, our emotional stability took a ride; we suffered a lot in all aspect of physical, mental, emotional and social life. Humans known as the social animal had to live in isolation during this period, cutting all the physical bonds with their loved ones, this isolation made them to suffer a lot and college girls who dreamt about freedom, having fun filled life with friends and to just live it full; turned into disappointment with the world shutting down around the globe. In India, as the first step educational institutions were locked because student population have a whole share in the country's population count. Being in adolescence, the stage where the emotions are uncontrolled, most of the physiological, psychological and social changes occur, causing one to be insecure, helpless, isolated and they tend to suffer from pyscho-somatic problems such as anxiety, tension, frustration, instability, sadness and depression in their everyday life (Ram et al., 2014). Thus this study focused on the happiness level of college girls when yoga was introduced into their life post COVID-19.

### Yoga

Many studies showed that yoga have calming effect on mind. Participants in yoga studies shows higher level of happiness and mental balance compared to non-yoga practitioners (Gupta et al., 2016). Yoga practice increases the "release of serotonin, oxytocin and gamma-aminobutyric acid (GABA) levels in our body. Feeling happy is all about the chemical reactions that takes place in our body" (Shaw, *2015)*. While practicing yoga, there is an increase in the happiness hormones and thus we tend to get happy, relaxed and calm. How yoga influences the happiness of the students before and after inclusion of yoga in their life is what this study is all about.

### Happiness

India rank 144 in 2020 and 136 in 2021 in the happiness index with a happiness score of 3.819 according to the World Happiness Report 2021 published by United Nations Sustainable Development Solutions Network. The happiness is measured on 6 factors- levels of GDP, life expectancy, generosity, social support, freedom, and corruption. India's rank dropped with passing years. It was at the rank of 111 in 2013 to now a drastic drop of 139 among 149 countries (UNSDSN, 2021). Pandemic affected the happiness of Indian population in many ways as many went jobless, struggled to survive each passing day, fear of death, life expectancy dropped, freedom of moving was replaced by confined living involving isolation, etc. being the main reason.

### RESEARCH METHODOLOGY

### Research Subjects Selection

The subjects were selected from the affiliated colleges of Alagappa University. A pre-test was taken with the OHQ Questionnaire on the every women student of the affiliated colleges and the 30 students showing lower happiness scores were selected in random from the determined population after pre-test. The sample ranged between the ages of 17 to 23.

## SELECTION OF VARIABLE
**Independent Variable**
- Yoga

**Dependent Variable**
- Happiness

## Experimental design and implementation
The selected subjects were then divided into two equal groups of 15 subjects each the Experimental group named Yoga practice group underwent Yoga practice for 8 weeks and the control group was left out from any practice and were just performing their regular lifestyle. The psychological variable Happiness was selected as the criterion variable. All the subjects of both the groups were tested on the Happiness using Oxford Happiness Questionnaire (QHQ) prior to and immediately after the training period of 8 weeks [4]

## Statistical Technique
For analysing the significant difference between the two groups the 't' test was used as the statistical technique of measurement.

## Level of significance
For the study 0.05 was fixed as the level of significance as it was considered appropriate.

## STATISTICAL ANALYSIS
The significant difference existing among the groups were found out by the pre-test and post-test. The data was analysed and dependent t test was used with 0.05 as the significance.

**TABLE-I: Analysis of t-ratio for the pre-test and post-tests of experimental and control group on Happiness** (Scores in Points)

| Variables | Group | Mean | | SD | | SE | | Df | 't' ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | Pre | Post | Pre | Post | Pre | Post | | |
| Happiness | Control | 3.71 | 3.72 | 2.16 | 2.17 | 0.55 | 0.56 | 14 | 0.21 |
| | Experimental | 3.63 | 3.85 | 2.19 | 2.19 | 0.56 | 0.56 | | **20.57*** |

*\*Significance at 0.05 level of confidence for degree of freedom 14= 2.147*

According to the Table-I the mean values of pre-test and post-test scores of the control group on happiness were 3.71 and 3.72 respectively. The obtained 't' ratio was 0.21, which was less than the required table value of 2.147 for the significant level of 0.05 with 14 degrees of freedom it was found to be statistically insignificant. The mean values of pre-test and post-test of the experimental group on happiness were 3.63 and 3.85 respectively. The obtained 't' ratio was 20.57*, greater than the required table value of 2.147 for significance at 0.05 level with 14 degrees of freedom it was found to be statistically significant. The result of the study showed that there was a significant difference between control group and experimental group in happiness. It may be concluded from the result of the study that experimental group improved in happiness due to eight weeks of yoga practice.

**FIGURE-1: Bar diagram showing the pre-test and post-test mean values of experimental and control group on Happiness (Scores in Points)**

## DISCUSSIONS ON FINDINGS

The result of the study indicates that the experimental group that is the yoga practice group had significantly improved on the selected dependent variable happiness when compared to the control group. It was also found that the improvement was caused by yoga practice.

## CONCLUSION

On the basis of the results obtained the following conclusions were drawn,

1. There was a significant difference between experimental and control group happiness after the training period.

2. Happiness was a significantly improvement in favour of experimental group due to yoga practice for eight weeks.

**Conflict of Interest:** None

## REFERENCE

1. Ram, G. K., Jasoria, A., Singh, S., & Gautam, K. (2014). Parents Child Relationship A Predictor of locus of control in Adolescents. *Indian Journal of Psychosocial Sciences, 4*(2), 34-36

2. Gupta, R.K., Singh, S., & Singh, N. (2016). Does yoga influence happiness and mental balance: A comparison between yoga practitioners and non-yoga practitioners. *Online Journal of Multidisciplinary Research, 2*(3), 1-5.

3. Beth, Shaw. (*2015, May 25). How yoga makes you happy*. YogaFit Worldwide https://www.yogafit.com/news/tips-and-advice/HowYogaMakesYouHappy/

4. United Nations Sustainable Development Solutions Network. (**2021,** March 20**)** *World Happiness Report 2021*. World Happiness Report https://worldhappiness.report/ed/2021/

5. Hills, P., & Argyle, M. (2002). The Oxford Happiness Questionnaire: a compact scale for the measurement of psychological well-being. *Personality and individual differences, 33*(7), 1073-1082

6. Hadinezhad, H., & Zaree, F. (2009). Reliability, validity, and normalization of the Oxford Happiness Questionnaire. *Psychological research*

7. Steve, Wright. (2008, October 17). *Oxford Happiness Questionnaire.* Meaning and Happiness.com http://www.meaningandhappiness.com/oxford-happiness-questionnaire/214/

## A STUDY ON E-HRM TECHNIQUES IN IT COMPANIES

**M. M. Shanmugapriya**

Research Scholar, Department of Management studies, Bharath Institute of Higher Education and Research, Chennai-73

**ABSTRACT**

*The goal of the project was to assess current and new concepts of ELECTRONIC HUMAN RESOURCE MANAGEMENT (E-HRM) in the IT companies in chennai. It was determined to assess the effectiveness of the programme.Because of the Personnel Department's excellent foundation, E-HRM and HRIS are becoming more popular. The project was completed in four stages which comprised goal-setting, questionnaire design, data collection, and reporting. The project also includes an analysis and findings section. The information gathered was extremely useful because it provided deep understanding of the employee's expectations on how E-Human Resources Development should be implemented to put to use .It allowed employees to express their valuable suggestions more easily. The Questionnaire featured questions that were used to test and evaluate employee awareness of the Human Resources Development Department's various functions.*

*Key words: E-HRM, HRIS, Development, Effectiveness.*

**INTRODUCTION:**

Technological optimistic voices want us to believe that, from a technical perspective, the IT possibilities for HRM are endless: in principal all HR processes can be supported by IT. E-HRM is the relatively new term for this IT supported HRM, especially through the use of web technology. For many functions, HR transformation is currently one of their critical deliverables. As with all change, there are huge possibilities and exciting opportunities that lie at the end of the implementation journey. However, the obstacles stand in the way of effective implementation is considerable, and many HR functions lose their way or find that they have failed to deliver the outcomes that were initially anticipated.

**STATEMENT OF THE PROBLEM**

Although, like with other corporate activities, IT retailers began to provide more and more new solutions for HRM issues a bit later. IT has become a significant instrument for supporting the HR function's procedures, just as it has for other business functions, and the HR function is now closing the gap in terms of applying new IT capabilities to conventional functions. Distributors of e-HRM technology claim that employing these technologies will provide a business with a number of benefits. In practice, however, the aforementioned outcomes are rarely realized. Because the stakes are so high, scientific study can help discover the reasons why these promises aren't being met. Because it is a vital and future need of any business in terms of future and current E-HRM and management.

**OBJECTIVES OF THE STUDY E-HRM**

- The effectiveness of the present and emerging concepts of E-HRM and HRIS in IT Companies is taken up for study.

- To identify the underlying factors and prerequisites for the success of an e-HRM venture.

- To identify the challenges associated with the implementation and maintenance of e-HRM systems.

**SCOPE OF THE STUDY**

- A significant step toward a paperless office

- Increased data retrieval and processing speed

- Information/reports created are more consistent and accurate.

- Quick response to inquiries

- Cost reductions are possible as a result of process improvements and the elimination of duplication of effort.

- Productivity and employee happiness are all boosted by a more dynamic workflow in the company process.

- To keep an up-to-date personnel database.

- The HR Department must make a great judgement for the organization's benefit.

- To be able to quickly and easily obtain any data or information at any time.

- Using developing technologies to bring the organization to a higher level.

- To conduct and plan the interview in a systematic manner.

## RESEARCH METHODOLOGY
## RESEARCH DESIGN
A research design is the arrangement of condition for collection and analysis of data in a manner that to combine relevance to the research purpose with economy in procedure.

## DESCRIPTIVE RESEARCH
Descriptive research studies are those studies, which are concerned with describing the

Characteristics of a particular individual or of a group it is also includes surveys and fact findings enquire of different kinds.

## DATA COLLECTION
Primary Data

Primary data are those that are gathered for a specific purpose or for a specific research project.

The information was collected through a structured questionnaire.

Secondary Data

Secondary data means data that have already been collected and analyzed. The sources used to

collect these types of data are: Books , Journals and Websites.

## TOOLS FOR DATA COLLECTION
The various methods of data gathering involve the use of appropriate recording form, like

Mailed questionnaire

Rating scale

## SAMPLING DESIGN
Sampling design is the process of obtaining information about an entire population. The items selected are called the samples, their selection process or technique is called sample design and the survey conducted on the basis of sample is described as sample survey.

## SAMPLING TECHNIQUE
Simple random sampling is the simplest form of random sampling. It is the basic sampling technique where you select a group of subjects, a sample, for study from a larger group, a population. Each individual is chosen entirely by chance and each member of the population has an equal chance of being included in the sample.

## SAMPLE SIZE
The sample size should be optimum it should neither be too small nor be too large.

## PROPOSED STATISTICAL TOOLS FOR ANALYSIS
The data collected was analyzed by applying appropriate statistical tools or appropriate techniques. The techniques used for the analysis are: Chi-square method , ANOVA two –way method and Mann-Whitney U test.

## REVIEW OF LITERATURE:
The present work is to investigate the E-HRM modules, types and implementation process in the organization and how the HR professionals handle the up-gradation of E-HRM in current scenario. Earlier researchers find that E-HRM supports all HR activities and work much more in effective when comparing to existing HR activities. According to Martin et al., 2008 E-HRM is used for effective cost saving and reduces administration headcount in the organization. Operational cost will be reduced due to implementation of electronic HRM and it increases the company image and time management in the workplace (Panayotopoulou et al., 2007). The researcher says that, HRM and IT is a successful factor for E-HRM implementation and adoption. It improves the users to develop their skills effectively and efficiently (Ensher et al., 2002). The following research questions will elaborate the objectives of this study.

In his research, Maimuna Muhammad (2013) presents a literature review of employee performance training and development. His article revealed optimal returns from their investment for the organization. Education and growth are instruments that allow human capital to exploit its dexterity.Learning and growth is therefore important to the workers of the company[9]-[11]. In his study, Waqar Younas (2018) investigated the impact on employee performance of training and development.

## RESULTS, DISCUSSIONS AND CONCLUSION

### Findings

✓ 88 percent of employees agree that implementing E-HRM will aid in eliminating problems with decision-making replacement. While 12% of employees refuse to accept the offer.

✓ 73 percent of employees believe that using E-HRM will aid in the management of problems. While 27% of employees refuse to accept the offer.

✓ It is obvious that 76 percent of employees believe that implementing E-HRM will aid in the management of pressure in various areas. While 24% of employees refuse to accept the offer.

✓ It is obvious that 85 percent of employees believe that implementing E-HRM will assist in the prompt resolution of difficulties. While 15% of employees refuse to accept the offer.

✓ 38 percent of employees strongly feel that implementing E-HRM causes employees to be less willing to work,Whereas 36% of the employee —agree‖ and 26% of them have —neutral‖ suggestion.

✓ It is clear that 86% of the employee's accepts that for implementation of E-HRM provides High Standards and support to employee's. Where 14% of the employee do not accept.

✓ It is clear that 35% of the employees —strongly agree‖ those implementations of EHRM helps in improve Organization performance. Where 32% of the employee—agree‖ and 33% of them have —neutral‖ suggestion.

✓ It is clear that 61% of the employees —strongly agree‖ that implementation of E-HRM helps in Recruitment process. Whereas 29% of the employee —agree‖ and 11% of them have —neutral suggestion.

✓ 30% of the employees —strongly agree‖ those implementations of E-HRM helps in improve Admin Efficiency and productivity. Where 35% of the employee —agree‖ and 35% of them have —neutral suggestion.

✓ 53% of the employees —strongly agree‖ those implementations of E-HRM helps in making strategic decision for organization benefit. Where 35% of the employee —agree‖ and 12% of them have —neutral suggestion**.**

### Suggestions & Recommendations

The e-HRM technology should be modified as to increase efficiency of conducting e induction meetings via web technology in order to bring in high efficiency level of employees.

The pay structure defined currently is insufficient; therefore the HR department can give in more break ups or a more detailed description of what is being currently given.

The HR department has to given in a description on how assessment of the employee performance is made online in order to realize the payments calculated online.

E-HRM still has to be responsible to build high level performing teams. In that case the

HR department can conduct more reviews and training in order to pick out high performing teams.

E-HRM can also improve organizational performance through reframing the HR policies according to the preferences of the employees.

HR department has to implement policies that serve to benefit for all the employees in order to plan and develop their career.

The HR department has to bring in more options under e-HR technology for employees to enroll for flexible benefit administration.

The HR department can often make use of chat rooms, fairs, networking etc for recruiting in order to make them effective in the organization.

The HR department has to give in a detailed employment contract offer online in order to make it clear for employees.

The HR department should record and maintain all incoming applications online in order to make the applicant tracking system easily accessible.

The HR department should also give preferences to policies that change the nature of relationship with the employees and managers

## CONCLUSION

The study at IT Companies exposes the primary topics of cost, relative capacities of self-service, shared services, outsourcing, and, most importantly, the quality of the people in HR function. We may deduce from the research that recognize that the majority of IT companies' human resources functions have been automated and Employees are very comfortable using web-based technology to do these duties. In addition, it demonstrates how much interest people in the firm have for the function and the company. Effort expended in learning how to accomplish these activities. It's also clear that the system is broken. IT companies use a method that is both effective and user-friendly. But the software solution keeps up the promise to provide a useful, efficient and increased performance through this e-HRM and HRIS technology in spite of all barriers it has to face. Perhaps the ultimate determinant of the success of HR will be its own ability to source and develop human talent with the capability to share and lead HR into a preeminent position within the business, where its own value is then truly perceived to be creating value through people.

## REFERENCE

- E.W.T. NGAI, F.K.T. WAT (2006), HUMAN RESOURCE INFORMATION SYSTEM: A

- REVIEW AND EMPRICAL ANALYSIS, RESEARCH PAPER, Personnel Review, Vol. 35 Iss: 3, pp.297 – 314.

- STEPHANIE C. PAYNE, MARGARET T. HORNER, WENDY R. BOSWELL, AMBER N.

- SCHROEDER, KELLEN J. STINE-CHEYNE, (2009), COMPARISON OF ONLINE AND

- TRADITIONAL APPRAISAL SYSTEM METHOD Journal of Managerial Psychology, Vol. 24 Iss: 6, pp.526 – 544.

- KIRSTIE S. BALL, (2001), THE USE OF HUMAN RESOURCE INFORMATION SYSTEM: Vol. 30 Iss: 6, pp.677 – 693. paper.

- HUUB J.M. RUEL, TANYA V. BONDAROUK, MANDY VAN DER VELDE, (2007), THE

- CONTRIBUTION OF E-HRM TO HRM EFFECTIVENESS: Results from a quantitative study in a Dutch Ministry", Employee Relations, Vol. 29 Iss: 3, pp.280 – 291.

- KHALDOON "KHAL" NUSAIR, H.G. PARSA (2007), CRITICAL FACTORS IN

- IMPLEMENTING HRIS IN RESTAURANT CHAIN in Joseph S. Chen (ed.) 3

- (Advances in Hospitality and Leisure, Volume 3), Emerald Group Publishing Limited, pp.69-86

- HUUB RUEL, RODRIGO MAGALHAES, CHARLES C. CHIEMEKE (2011), CHAPTER 2 HRIS

- AN INTEGARTATED RESEARCH AGENDA in Tanya Bondarouk, Huub Ruël, Jan Kees Looise (ed.) Electronic HRM in Theory and Practice (Advanced Series in Management, Volume 8), Emerald Group Publishing Limited, pp.21-39.

- MARTIN REDDINGTON, GRAEME MARTIN, TANYA BONDAROUK (2011), CHAPTER 4 LINKING HR STRATEGY, e-HR Goals, Architectures, and Outcomes: A Model and Case Study

- Evidence, in Tanya Bondarouk, Huub Ruël, Jan Kees Looise (ed.) Electronic HRM in Theory and Practice (Advanced Series in Management, Volume 8), Emerald Group Publishing Limited, pp.55- 81.

- JUKKA-PEKKA HEIKKILA, ADAM SMALE (2011), CHAPTER 7 LANGUAGE ISSUES IN IMPLEMENTING E-HRM IN GLOBAL MULTINATIONAL CORPORATIONS, in Tanya

- Bondarouk, Huub Ruël, Jan Kees Looise (ed.) Electronic HRM in Theory and Practice (Advanced Series in Management, Volume 8), Emerald Group Publishing Limited, pp.119-141

- STEFAN STROHMEIER, FRANCA PIAZZA (2011)5, CHAPTER 3 "WEB MINING" AS A

- NOVEL RESEARCH IN E-HRM, in Tanya Bondarouk, Huub Ruël, Jan Kees Looise (ed.)

- Electronic HRM in Theory and Practice (Advanced Series in Management, Volume 8), Emerald

- Group Publishing Limited, pp.41-53.

## ELECTRICAL AND OPTICAL PROPERTIES OF SOL–GEL SYNTHESIS OF NANOSTRUCTURED PD-DOPED SNO2 THIN FILMS

**Dipak Ashok Zope**
Shri J. J. T. University Rajasthan Jhunjhunu

**ABSTRACT**

*The sol-gel process was used to make multiple-layer tin dioxide thin films from a chloride-based inorganic salt. Optical and XRD tests were performed on the multilayered films. The films' carrier concentrations were computed and investigated. In the presence of methane gas, a comparative investigation of several multilayered films of both undoped and Pd-doped $SnO_2$ thin films was carried out to evaluate the viability of using it as a room temperature sensor for methane gas.*

*Keywords: $SnO_2$ thin films; XRD; Absorption spectra; UV-Vis spectrometry; Methane sensing*

## INTRODUCTION

One of the highest consequences in underground coalmines is explosion due to methane gas leakage. Within the range of 5-14 percent by volume of methane, a mixture of methane and air is explosive. Different types of methane detectors have been produced on the market to prevent this threat, each with its own set of benefits and drawbacks. Their sensing technologies are what separate them.

Detection of hazardous gases has always been a complex subject and makes choosing an appropriate gas-sensing metal oxide a difficult task. Different gas sensitive metal oxides have been identified and used in the field of air quality monitoring and industrial safety [1,2,3].

Glycerin addition could improve obviously the quality of the thin film, and made it have a more smooth and homogeneous surface without deep fissure [4]. In this work, sol–gel method was applied to synthesize $SnO_2$ thin films. The effect of glycerin addition on the structure and preventing crack formation has been investigated. Sol–gel technique is a useful method to prepare $SnO_2$ thin films. Comparatively, it gives a lot of advantages over other techniques by its low reaction temperature, easy process, and low cost. However, cracks on the thin films prepared by sol–gel technique exhibited adverse effects on response, so cracks on thin films prepared by this method are undesired. Therefore, glycerin was used as additive to prevent cracks [5].

The present work reports a comparative study of various optical and electrical properties of different multilayer undoped and palladium doped $SnO_2$ thin films in presence of methane. Most of the works with $SnO_2$ based methane gas sensors are reported for high temperatures as it is quite difficult to get a good response for methane at low temperatures. A humble effort was made in this study to observe the changes in gas sensitivity at room temperature against the increase in film thickness. With further palladium doping the $SnO_2$ multilayered thin films showed an interesting phenomenon in presence of methane gas.

**Experimental setup**

The gas sensing chamber (fig 1) used for gas sensitivity analysis of the prepared films consist of a steel base with three port holes at the base for insertion of more than one gas at the same time. This helps us to generate the exact mining ambient conditions inside the chamber. Above the steel base there is a raised sample holder made of copper which is placed over a heating coil to raising the temperature of the film. The film placed above the sample holder is connected by two probes which are further connected in series with a Programmable D.C. Power Supply and a Digital Multimeter. The thermocouple as shown in the diagram keeps track of the rise in temperature of the sensing material (though not required in the present study as it was done at room temperature). The whole system is covered by a glass chamber fitted with rubber tube at its base to ensure complete vacuum in the chamber through suction by a high capacity vacuum pump. The chamber is well developed for controlled variations of the inner atmospheric temperature and pressure for controlled gas sensing analysis.

**Experimental details**

These multilayered films were then characterized with XRD and their optical studies were done using UV-Vis-NIR Spectroscope to calculate the band gap of the films.

To increase the sensitivity, the multilayered films were doped with palladium. 0.05% solution of palladium chloride was made with ethanol. It was stirred for 1 hour at 50ºC and was then allowed to cool to the room temperature while stirring. The prepared sol was then spin coated over $SnO_2$ to obtain the doped tin dioxide

multilayer samples. The spin coating speed, number of drops applied, the annealing temperature and time are all kept same as those for the undoped samples.

Small pieces of dimension 0.5 x 0.5 sq. cm of the films were used for sensitivity measurements of both undoped and doped multilayered films. Methane gas diluted with argon gas in a definite concentration of 1500 ppm was introduced into the gas chamber. A digital multimeter (Agilent 34401A) and a constant voltage source (Caddo Programmable DC Power Supply) were used to calculate the change in the resistances of the multilayered films in the range 0 to 28 V. The measurements were carried out initially in vaccum and then in the presence of methane gas at room temperature both for undoped and Pd-doped $SnO_2$ films.
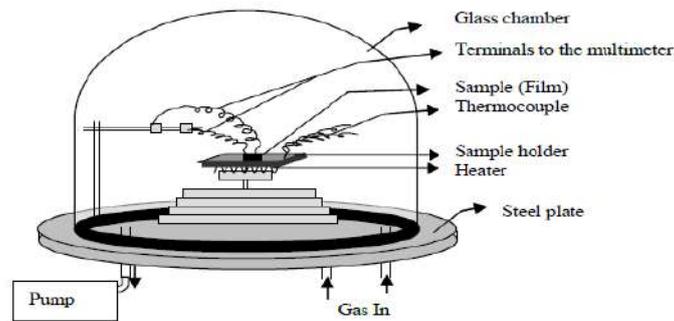


**Fig.1. Schematic diagram of the gas sensing unit used for sensor characteristics measurements.**

## Optical studies

The optical studies of the films were carried out using UV-Vis-NIR Spectroscope and the spectral dependence of the transmittance (T) for one, three, six, eight, ten and twelve layered films are shown in fig.2(a) & (b). The average transmission of the undoped $SnO_2$ films deposited on glass substrates is more than 80% over the range 450 to 800 nm. A sharp fall in transmission at about 310 nm is due to the absorption of the glass substrate. The transparency of the films decreases in major portions of the visible range with the addition of layers. This may be due to the built-up thickness which is also clear from the fringes in the transmission spectra. The absorption edge also shifted slightly to higher wavelengths with the increase in film layers. The transmittance falls rapidly in the low wavelength region. With increase in number of layers, the onset of absorption edge becomes less sharp, this may be due to the presence of bigger crystalline sizes and increased scattering due to the surface roughness [6,7].
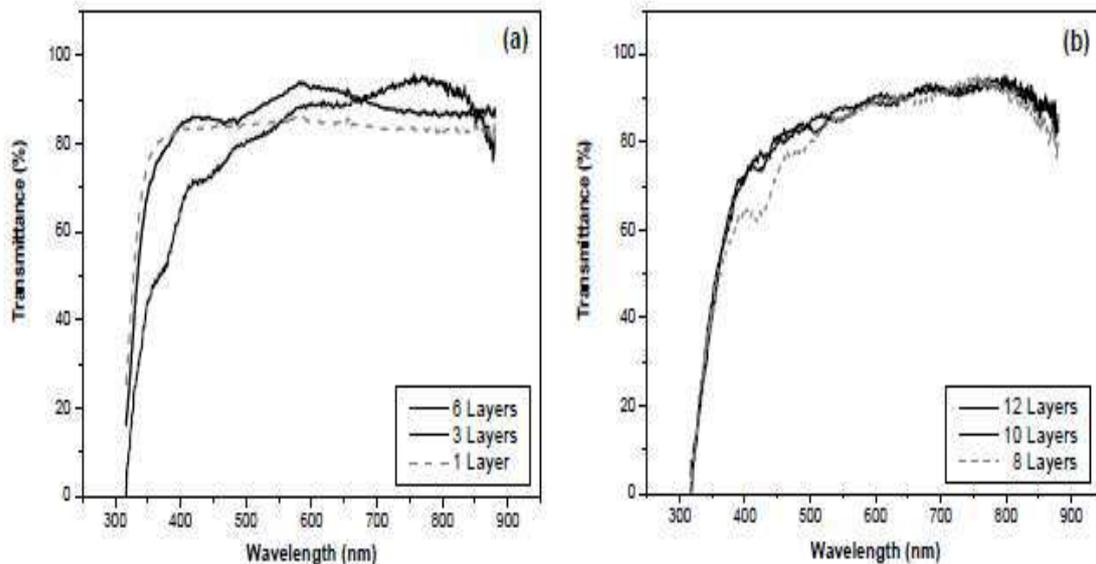


**Fig.2. Optical transmission spectra of multilayered undoped $SnO_2$ films annealed at 673K.**

## RESULT AND DISCUSSION

XRD analysis was performed to investigate the crystal structure of films. In Fig. 2, XRD results are given, and the results show that there is no significant preferential nucleation and growth by changing ethanol and glycerin ratios. The produced phase is mainly cassiterite type of $SnO_2$. The strongest peak for each case is the (110)

plane in Fig. 3a–c. As can be seen from the XRD diagrams, the strongest peak (110) has broadest nature for 2nd solution. The broadest diffraction (110) peak of $SnO_2$, in Fig. 3b, suggests that the nanoparticles are very small in size. The similar effect of decreasing particle size on the peak broadening in tin oxide . [8]
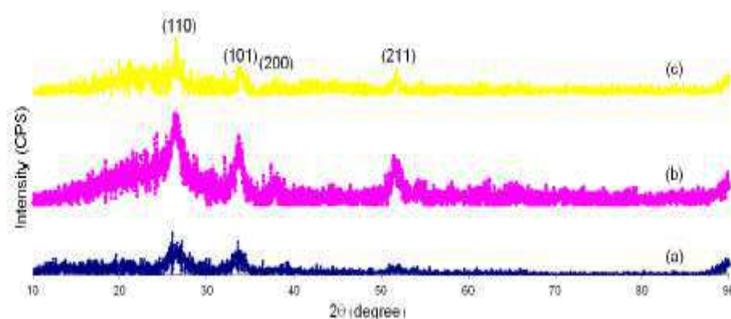


**Fig. 3. XRD diffract grams of SnO$_2$ films Obtained from (a) 1st sol, (b) 2nd sol, (c) 3rd sol.**

## CONCLUSIONS
In this work we have deposited and characterized sol-gel prepared multilayered undoped and Pd-doped $SnO_2$ thin films. Electrical and hall measurements were carried out and it has been found that undoped $SnO_2$ is a mild methane gas sensor at room temperature. However its sensitivity can be increased with the addition of a catalyzing agent like palladium and can further be improved by the buildup of multiple layers. The above result may be utilized to design an efficient methane gas sensor for environmental health and safety.

## REFERENCE
[1] K. Anothainart, M. Burgmair, A. Karthigeyan, M. Zimmer, I. Eisele, Sensors and Actuators B: Chemical 93, 580 (2003).

[2] Z. A. Ansari, S. G. Ansari, T. Ko, J.-H. Oh, Sensors and Actuators B:Chemical 87, 105 (2002).

[3] A. Cabot, J. Arbiol, J.R. Morante, U. Weimar, N. Barsan, W. Gopel, Sensors and Actuators B: Chemical 70, 87 (2000).

[4] S.M. Qin, H.M. Deng, Z.Y. Tong, P.X. Yang, J. Instrum. Anal. 27, 1194 (2008).

[5] S. Gong, J. Liu, J. Xia, L. Quan, H. Liu, D. Zhou, Mater. Sci. Eng. B 164, 85 (2009).

[6] Y.-S. Lee, O.-S. Kwon, S.-M. Lee, K.-D. Song, C.-H. Shim, G.-H. Rue, D.-D. Lee, Sensors and Actuators B: Chemical 93, 556 (2003).

[7] S.A. Mahmoud, A.A. Akl, H. Kamal, K. Abdel-Hady, Physical B 311, 336 (2002).

[8] P. Lian, X. Zhu, S. Liang, Z. Li, W. Yang, H. Wang, Electrochim. Acta 56, 4532 (2011).

## ENVIRONMENT AND HABITAT ASSESSMENT OF THE SLUM DWELLERS IN KOLKATA, INDIA

**[1]Ms. Atiba Batul and [2]Dr. Swapnamoyee Palit**
[1]PhD Research Scholar, Amity School of Economics Kolkata, West Bengal, India
[2]Assistant Professor, KIIT Deemed to be University, Bhubaneswar, Odisha, India

**ABSTRACT**

*Kolkata's slums are rich in diversity which is obscured by poverty, mainly consisting of migrants from rural, outskirts and adjoining states in search of livelihood and other purposes, who came to the city and started living in vacant places wherever available. Though, almost every other literature that talks about development and inclusion, usually focusses on inclusion of the rural and poor population into the mainstream system and stress has been given on strategies in the same direction, slums have not received much attention. They are the ones to be in the margin and therefore, are subject to more sufferings. Slums in the urban center of Kolkata are overcrowded and have no basic amenities which gives rise to city pollution. They are the most polluted regions of any urban centre. In fact, other city pollution like air pollution, affect the slum dwellers lives more apart from their own surroundings. The focus of this paper is to highlight the plight of this vulnerable section of the population and the gap in the policy measures which have not been able to achieve their goal of uplifting this section. It is based on available secondary data from several sources, depicting the status of urban slums in general and Kolkata slums in particular.*

*Keywords: Externalities. Environment, Pollution, Slums, Urbanization, JEL Classification: F64, H55, I0.*

## 1. INTRODUCTION:

The dominant urban center of eastern India, one of India's largest cities and one of its major ports, Kolkata is a city of commerce, transport and manufacture.[1] Frequently referred to as 'the city of joy', Kolkata, which was earlier known as Calcutta, is the capital city of the state of West Bengal, with a strength of 1.49 crores people as of 2020.[1] Due to extreme crises of houses, about three-fourth of the housing units are utilized for dwelling requirement specifically. These urban settlements are known as *bastis* or slums, where about one-third of the population of the city resides.[1] To be brief, the open areas with poorly built tenement on public lands or along drains and railway lines lacking electricity, latrines, sewerage, medical facilities, having taps or tube-well as their major drinking water resource and which gets badly impacted through water lodgings, can be characterized as Slums. The focus of this paper is to highlight the plight of this vulnerable section of the population and the gap in the policy measures which have not been able to achieve their goal of uplifting this section. It is based on available secondary data from several sources, depicting the status of urban slums in general and Kolkata slums in particular.

## 2. LITERATURE REVIEW:

The fact that living in close quarters increases the propensity of spreading of diseases. *"Crowding can lead to respiratory infections, meningitis, asthma and also promote the transmission of epidemic-prone infections like pertussis and group A Streptococcus pyogenes infection, which are associated with rheumatic heart disease"*. Also, slum dwellers are much more susceptible to disease than their rural counterparts. This acts as an increased economic constraint on an already sparse income earning dwellers in Kolkata's slums (Murthy, 2012).

Kolkata slums are diverse in linguistic and ethnic context. They have to bear the absence of elementary facilities like proper provision of hygienic toilets. Usually very low to low income people dwell in them, though they are now in a developing state. The average family size of households inhabiting here is low in comparison to income standards. The rate of mobile density is higher here though people are low on financial inclusion. Non-formal financial institution tends to misguide and exploit its illiterate people relatively more (Bose & Ghosh, 2015).

About 2.5 million people in India died prematurely due to pollution. 1.8 million of these deaths were due to air pollution (Landrigan, et al., 2015).

Economic growth and sustainable development are the goals of any country who are in developing state. The phenomena of urbanization results in inaccessibility of basic services by all the residents. Access to proper physical conditions for living are the rights of every individual and are also important for inclusive growth. Rural development receives immense amount of significance from researchers and policy initiators whereas immediate focus is required to be on urban development due to fast rising urbanization, uncommon needs of

urban residents and less earning people of urban centres, specifically slum regions (Bapat & Bhattacharyay, 2016).

The average income of a slum dweller in Kolkata is 32% more than the rural counterpart employed in farm activities whereas that of slum dwellers is 32% lower than the rural counterpart in terms of non-farm activities. Kolkata has become a poverty trap because 70% inhabitants have lived here for 15 years or so whereas 41% have lived for 30 years or more. Due to surplus of workers in urban areas, wage rate is lower and the chances of becoming unemployed in slums is greater than being in rural areas. School retention rate is higher in urban areas and Infant Mortality Rate is lower in urban areas but Crude Death Rate is higher compared to rural areas. No doubt, urban centre of Kolkata has more job opportunities, better infrastructure and more income possibilities compared to rural parts of West Bengal but slum lives are very difficult. Most families have only one room to live in, no proper and private sanitary facilities or water resources and are more exposed to city pollution. In brief, anybody choosing to migrate from rural to urban area will end up making a bad decision because they may end up living in slums for longer span, earn less wage, more probability of being unemployed, bear ill impacts of pollution and higher probability of dying. In fact, decline in Kolkata's population from 2001 to 2011 suggests that it is less welcoming the prospective migration of workers, indicating the loss of appeal of moving to its locality (Peck, 2017).

The impact of poverty at the face of urbanization and illiteracy are slums. Census report 2011 recorded 1.3 crore urban slum households, i.e. about 65 million of slum population. In Bidhannagar, a satellite township of the urban agglomeration of Kolkata, the slum population is approximately 49,173 that is about 29.3% of the total population of the township. It was found among them that the co-efficient of literacy has non-linear relationship with dwellers knowledge of basic financial awareness. If these slum dwellers from the whole country become literate about the financial avenues that are available then immense amount of untapped savings will creep inside the mainstream formal financial mechanism, helping in huge capital formation in the economy (Chatterjee & Sardar, 2018).

The slum inhabitants live life in such physical conditions that are just not suitable for the survival of any human habitation. Various philanthropic organizations and the slum dwellers themselves have been putting efforts to make slum life better but in order to develop and improvise the slum conditions, the authorities should understand the physical, social and economic characteristics that helps in its formation, the people who lives in it and the political constraints imposed on bastis. Policies should take into consideration the ethnic diversity, disparate professional knowledge and social and political structures of slums that are crucial for its survival and its dwellers and should learn from past policies' shortcomings on slum improvement, clearance and inhabitant's rehabilitation (Schenk).

## 3. OBJECTIVES:

**i.** To assess the impact of slum settlements on urbanization and the environment.

**ii.** To examine the feasibility and effects of development initiatives on slums' life.

**iii.** To make suggestions and recommendations for improving adverse slums' conditions to minimize their negative externalities on urbanization and the environment.

## 4. HYPOTHESIS:

| Hypothesis | Methodology |
|---|---|
| H0: That slum life does not have any impact on urbanization and the environment. | Descriptive Statistics |
| H0: That development initiative undertaken have not improved slum life. | Examining Policy initiatives taken and finding their effect on some major economic parameters like income, savings, investment and expenditure. |
| H0: That adverse slum conditions do not cause any negative externalities. | Examining the air and water pollution, land encroachment as specific parameters. |

## 5. RESEARCH METHODOLOGY:

The research design is exploratory and descriptive in nature for which secondary data is used for this study. To meet the objectives, the data has been collected from different sources consisting of Kolkata Municipal Corporation (KMC) website, Publications of Ministry of Women and Child Development and various

committee reports. Addition to this, various published articles, journals, newspapers, reports, books and academic websites have also been taken into account.

To assess the impact of that habitat on environment which is a very vulnerable section of the population, i.e., slum dwellers, the study uses several descriptive statistical methods to analyze the data collected. Thus, the findings of the study provide useful insights of the slum economy.

## 6. AN OVERVIEW OF THE CURRENT STATUS OF URBAN SLUMS:

There is a good debate about the head count ratio of slum dwellers. Since, the last census report available is of 2011, one cannot be sure of the exact population of slums dwelling in over all India. The Census and the National Sample Survey Organization (NSSO) are two major government agencies held responsible for calculating population. In 2011, Census reported the slum population in India to be 6.5 crores whereas in 2012, NSSO reported the same to be 4.4 crores.[3] The difference in the two government reports is of 2.1 crores, a huge figure, which cannot be owed to any measurement discrepancy or error in calculation. Therefore, this is clear that accurate data on slum population of India is not available. In fact, in the case of Kolkata too, the entity responsible for maintaining data on slum dwellers i.e., Kolkata Municipal Corporation (KMC), does not have data on slum areas population wise. This leads to one of the major drawbacks in the field of research on slums. From this, one can also interpret that the policy benefits that should reach to slum dwellers in not able to travel to the person standing on the last mile. This in turn, leads to more deterioration of such habitat, since the poor population lack the capacity to help their own selves to come out of deteriorating condition of life. Slums are growing every day.

**Figure 1 Slum Status in India**



**THE 2-CRORE GAP**

India had **6.5cr** **slum dwellers** in 2011, according to Census

But NSSO estimate puts it at **4.4cr**, a huge difference of 2.1cr

➤ NSSO **probably used 2001 Census data** to select urban samples

➤ Their definition of slums varies widely, so do survey practices

➤ Poor will **likely miss out** on welfare schemes because of this discrepancy

**Source: Times Of India**

Area under the KMC is divided into 15 boroughs that are the largest possible administrative divisions. Seven of the fifteen boroughs had small fraction of slum population (Bag, Seth & Gupta, 2016). Kolkata attracts population from rural regions as well as its adjacent states due to the opportunities of better livelihood. Not all these people get livelihood or housing when they migrate to the city of joy. The surplus laborers start living wherever they get vacant places irrespective of keeping a check on sanitation and hygiene. Since they start to live in places which are already crowded, this growing human population tend to make the surrounding areas dirty. Due to lack of better drainage and sanitation systems, they tend to live in situation which is just not bearable for normal people like, women bathing in open areas, children and women dumping human waste in and around they live, etc. All these not just make the places where they live poor and dirty but also affects the nearby situated areas. On top of that, pollution in urban areas is already very high. In India, 2.5 million people died premature death because of pollution out of which, 1.8 million of deaths were caused by air pollution (Landrigan, 2015). Kolkata, capital of West Bengal, is one of the major polluted cities. About 70% of its population are sufferers of respiratory disorders caused by air pollution and 47% are sufferers from lower respiratory tract symptoms (Haque & Singh, 2017). Emission from automobiles is much more exhausting in urban areas than rural regions. These emissions contribute a share of 51.4% in city air pollution followed by 24.5% of industry emissions and 21.1% of dust particles, due to which it is said that the urban peoples' lungs are seven times more burdened compared to the rural peoples' lungs (Haque & Singh, 2017). According to the World Health Organization (WHO) air pollution in urban India has a concentration of 65.7 compared to all India average of 62.4 indicating that air pollution in urban centres is worse than all India average (Peck, 2017). All of these recalls that slum dwellers face the utmost impact of pollution compared to other inhabitants. There

is this perception that people who have good earning can fight or face many challenges that stand as obstacles in circumstances of their lives. The worst part is that, due to overcrowd of workers in urban centres, the wage rate tends to fall and probability of unemployment tends to rise as not all people who migrate into the city gets employed. This reflects that in the absence of job or presence of little job, slum dwellers just do not have the capacity to fight with health issues they face, since not much is left with them out of their earning for accessing better health facilities. This paper, will study the impacts of urbanization on environment and will provide important insight on the plight of the vulnerable section as well as the likely impact they have on environment.

## 7.  ASSESSMENT OF THE ELEMENTARY FEATURES OF SLUMS OF KOLKATA-A POLICY REPORT ANALYSIS:

The National Sample Survey (NSS, 2010) in their report states the following about the elementary features of slums, i.e., their basic amenities in the all-India report, as mentioned below-

- Areas recognized by municipalities, corporations, local bodies and development authorities are referred to as 'notified slums' whereas crowded areas with collective tenements in poor condition, insufficient facilities of drinking water and sanitation in unhygienic condition are referred to as 'non-notified slums'.

- About 57% of slums were built on public lands owned by local bodies, state government, etc., whereas 24% are located along drainage lines and 12% along railway lines.

- About 95% slums relied on tap water or tube well for drinking purpose and only 1% notified and 7% non-notified slums lacked electricity.

- 64% of notified and 50% of non-notified dwellings were brick made houses (Pucca structure), 78% notified and 57% non-notified slums had a non-mud road running in their areas and 73% notified and 58% non-notified slums had motorbike approachable road.

- During monsoon season, about 48% of the slums get affected by waterlogging.

- 10% notified slums did not have latrines and drainage facility, whereas 20% non-notified lacked latrine facility and 23% lacked drainage facility and 20% lacked sewerage and medical facilities.

- Other than the efforts put in by the government in the improvement of slums, NGOs also had also attributed to the efforts in the improving elementary educational facility and latrine and sewerage system (Bapat & Bhattacharyay, 2016).

However, NSS (2012) report added the following information to the all-India report -

- About 39.3% were notified slums with average size of 684 and 60.7% were non-notified of average size 257.

- Average ground area for dwelling in urban unit was 40.41 sq. m.

- About 74.7% notified and 50.4% non-notified slums had pucca houses.

- Tap water was the major source of drinking water in 93.2% notified and 82.2% non-notified slums.

- 20.8% lacked bathroom facility and 5.9% lacked latrine facility (Planning Department, 2018). 10% notified and 20% non-notified slums lacked facilities like street light, drainage, latrine, sewerage, regular garbage disposal and medical facility during the years of survey as well as in prior five years. Pucca drainage system existed in about 39% notified and 24% non-notified slums and underground sewerage existed in about 33% notified and 19% non-notified slums. Garbage disposal facility by government agencies was available to 75% notified and 55% non-notified slums. Waste was collected at least once in 7 days in 93% notified and 92% non-notified slums (Bapat & Bhattacharyay, 2016).

The last NSS survey highlighted many important findings in the context of slums in West Bengal as mentioned below –

- About 33,510 slums exists in urban India, in which West Bengal has the third highest share of 12%.

- Out of estimated 19,749 non-notified slums, West Bengal's share is 14% and out of 13,761 notified slums, West Bengal's share is about 9%.

- 52% of the slums in West Bengal are located on a privately-owned land.

- About 69% of the slums in West Bengal, 86% notified and 61% non-notified, has tap as a major source of drinking water.

- 29% of slums in West Bengal, 18% notified and 34% non-notified, lack latrine facility.

- 31% of slums in West Bengal, 0.3% notified and 46% non-notified, lack drainage facility (Bose & Ghosh, 2015)

Nearly 40% of slum dwellers are staying in Kolkata from previous two generations and even more than that.[2] The slum population mainly consist of migrants from rural, outskirts and adjoining states in search of livelihood and other purposes, who came to the city and started living in vacant places wherever available. There are 2011 registered slums usually housing rickshaw pullers, security guards, wage earners, etc. and 3500 unregistered slums usually housing hawkers, beggars, laborers, etc., sheltering nearly 1.5 million people in the city.[2]

Almost every other literature that talks about development and inclusion, usually focusses on inclusion of the rural and poor population and stress has been given on strategies in the same direction. However, the population of slums has not been focused much in that context. The slum dwellers neither fall completely in the Above Poverty Line (APL) category, nor fall completely in the Below Poverty Line (BPL) category. They are the ones to be in the margin and therefore, are subject to more sufferings. In the context of female population particularly, the mechanism of urbanization and increment in urban slums are subject to unique causes and unique consequences and still, these challenges are greatly underexplored by earlier literatures in this field (COHRE, 2008).

No doubt, urban centre of Kolkata has more job opportunities, better infrastructure and more income possibilities compared to rural regions and therefore, it ends up attracting more population in the city but slum lives are very difficult. Most families have only one room to live in, no proper and private sanitary facilities or water resources and are more exposed to city pollution. Anybody choosing to migrate from rural to urban area will end up making a bad decision because they may end up living in slums for longer span, earn less wage, more probability of being unemployed, bear ill impacts of pollution and higher probability of dying (Peck, 2018). The slums in the urban center of Kolkata are overcrowded and these have no basic amenities which gives more rise to city pollution. Slums are the most polluted regions of any urban centre. In fact, other city pollution like air pollution, affect the slum dwellers lives as well, apart from their own surroundings.

## 7. 1 Policy Initiatives Undertaken For Slum Development: An Analysis-

S. Baksi (2013) in 'Internal Labor Migration in India Raises Integration Challenges for Migrants' documented that people in the slums were asked about their spending priorities for their family. The findings show that many people appreciate the value of education for the betterment of their children.

According to the 'Kolkata Study Report (2014)', only 28% of slum households in West Bengal have electricity, tap water and latrine within their home premises.

PRIA (Society for Participatory Research in Asia, 2014), reported that 67.78% of households in the slums have bank savings account, 16.67% post office account, 13.33% have some debt on a short-term basis and 14% had taken loans in the past one year. 78% of loans were taken from self-help groups or cooperative societies, 11% from money lenders (sahukars) and 11% from friends and relatives. Kolkata's slums spend an average 6.26% of their income on education and 11.81% on healthcare. Healthcare spending is more than double that of all West Bengal urban areas (5.32%). 32.22% of households have a life insurance and 2.22% have health and medical claim. On consumption expenditure front, 72.9% households in spend mostly on food which is higher than the average for all West Bengal urban areas. Rentals in the slums are very low about 3%., though the average spending on housing is much higher in West Bengal urban areas about 20.34%. Even though the use of Kerosene within households brings various types of health hazards, it is available through PDS, cheaper than LPG but 40% of Kerosene is purchased from private sources at a much higher price.

UNICEF (2014) in its paper on 'Children Of Migrant Poor In Kolkata: A Study On Human Development Perspectives', surveyed 1000 slum dwellers in Kolkata consisting of 500 dwellers of unauthorized slums who have migrated in the last ten years and 500 dwellers of authorized slums who have been living here for more, depicting attempt to highlight differences between migrants and non-migrants living in slums. The migrant population lived on encroached land in the peripheries of the city and KMC does not provide basic amenities like water, sanitation, health services, etc. to them. About 53% of them have electricity connections taken by illegal hooking from a nearby electric pole with some political support, indicating almost half of the slums lack electricity. 57.4% have toilet facilities outside their premises, 32% use flush latrines and 25.8% use insanitary hanging type toilets. About 41.2% households have no drainage and 28.4% have garbage disposal facility but

71.6% have no garbage collection facility and throw garbage in open vacant places. Whilst government hospital treatment is free though medicines to be bought from outside, still 46.1% consulted private doctors. The non-migrant population were KMC registered slums and KMC provided them all the basic amenities. 59.4% have toilet facilities, almost three-quarters have closed drainage system and 77% have proper garbage collection by KMC. On the healthcare front, 28.9% consulted private doctors.

Abbas et al (2014) in their paper, 'Kolkata Study Report: Government Led Exclusion of the Urban Poor' gave emphasis on bearing ration cards since it helps its holders to get food articles at very subsidized rates. This Public Distribution System, in true sense, is meant for people who are underprivileged, poor and have no fixed income. But sadly, about 73.6% of households in the unregistered slums have no ration card. In fact, they don't have other proper documents to avail any such kind of benefits that are truly meant for them.

R. Bose & S. Ghosh (2015) in their paper, 'Slums in Kolkata: A Socio-Economic Analysis', examined socio-economic aspects of 96 households from five different slums located in diverse areas, namely, Kailash Bose Street, Harinath De Road, Kankulia Road, Metiabruz and E.M. Bye Pass. Though common taps are the major source of water in all the slums, scarcity of water was reported only in one (E.M. Bypass area) out of the five slums, depicting scarcity of water is not that major issue in urban centre of Kolkata. About 89.58% households reported shared sanitation and a steeper ratio of no. of toilets to no. of inhabitants, depicting chaotic situation day to day. About 35 respondents reported that there was some improvement or the other in their slums in the last five years whereas 45 of them reported of no improvement and 16 of them about deterioration.

Data published by the World Health Organization (2016) indicates that air pollution in urban centers is worse than the all India average. According to this study, urban India had particulate (PM2.5) concentration of 65.7 whereas the all India average was 62.4. For reference, 10 is the recommended safe level.

Bag, Seth & Gupta (2016) in their work, 'A Comparative Study of Living Conditions in Slums of Three Metro Cities in India', conducted study in three cities Kolkata, Mumbai and Delhi. It mentioned that area under KMC is divided into 15 boroughs that are the largest possible administrative divisions out of which 30 samples from 7 boroughs were collected, consisting of 808 households from 63 slums in Kolkata. It was reported that 71.2% of households were over-crowded, 76% housing structure is semi-pucca or kutcha or a temporary accommodation without any proper house, 39.1% had leakage in house, 45.4% had cooking arrangement inside sleeping room with no smoke outlet, 83.4% lacked sanitation facility, 59.9% had no access to communication and 71.6% did not had any asset like tv, mobile, cooler, vehicles, etc.

M. Bisset (2016), in his baseline study documented about a social centre, *Jan Seva*, which is a pre-school for kids, provides healthcare for mothers and children, literacy, vocational and computer training for young women, a day-care centre for special needs children and a community awareness programme for nearby slum dwellers. Residents using these services are 45% from Kasba Canal side, 15% from Anandapur (authorised slum),15% from Kalikapur, 15% from Ballygange and 10% from Bosepukur areas. Standpipes provide drinking water to all of them except Kalikapur area where slums have been built on platforms over or surrounding the water bodies. Electricity is available in legal manner in only Anandapur and illegally available in the rest unauthorized slums. The areas have access to private latrines shared in a building between several families, less no. of public toilets and in Kasba Canal region temporary public pit latrines been constructed. All the slums have garbage collection availability through KMC's vat and have closed drainage system except in Kalikapur.

M.S. Haque & R.B. Singh (2017) in their paper, 'Air Pollution and Human Health in Kolkata, India: A Case Study', addressed that *"Kolkata has been dubbed as one of the most unplanned and polluted cities in the world"*. Approximately 70% of Kolkata's population suffer from respiratory disorders caused by air pollution and 47% suffer from lower respiratory tract symptoms. Kolkata city resident's lungs are roughly *"seven times more burdened compared to their rural counterparts due to air pollution"*. The study detailed that *"motor vehicles are the leading contributor to air pollution (51.4%) which is followed by industry (24.5%) and dust particles (21.1%)"*.

D. Peck (2018) in his paper, 'An Overview of the Economics of Kolkata's Slums', reported that Kolkata slum dwellers spent the major portion of their income on healthcare, nearly 11.8% of their earning, indicating the availability of better healthcare facilities in the city, though locality may not be the only factor for such higher expenditure.

## 7.2 A look at some specific schemes:
Apart from the above mentioned information, here is an insight into some specific schemes for slum development.

- There are NGO and community run schools for the children of the slums that work as a backup support for them, where mostly children go to finish their homework (Baksi, 2013).

- The government has undertaken an early childhood development programme for pre-school education through the Integrated Child Development Service (ICDS) and Anganwadi Centres (AWC). The programme aims to address the health, nutrition and development needs of young children of 0-6 years of age, pregnant and nursing mothers. There were 12 ICDS project areas in Kolkata under which 1526 AWCs were operating (as of 2013). Out of them, 1438 AWCs provided Supplementary Nutrition Programme to 40.4% slum dwellers and 1485 provided pre-school education under which 36.8% of 0-5-year-old slum children received education (UNICEF, 2014).

- About 5.56% of the people dwelling in Kolkata slums get an old age pension of Rs. 400 per month, 1% of women receive widow pension of Rs. 400 per month, 1% receive disabled pension of Rs.1500 per month and 2% receive self-employment benefits (PRIA, 2014).

- AIAE (Amicale Internationale d'Aide à l'Enfance) Luxembourg, an international organisation, provides support to India's Society for Indian Children's Welfare (SICW) to run a social centre, *Jan Seva*, in Kolkata which is a pre-school for kids, provides healthcare for mothers and children, literacy, vocational and computer training for young women, a day-care centre for special needs children and a community awareness programme for nearby slum dwellers. They gave local clubs the job to provide vaccinations and de-worming medicines temporarily. Government funded Pre-School child care centres (ICDS) provide pre-school child care, meals, education and medicines to the local communities (Bisset, 2016).

- Children of slums were successfully vaccinated for tuberculosis, diphtheria, pertussis (whooping cough), tetanus, poliomyelitis, measles and Hepatitis B under the Child Immunisation Programme taken by the government. Four more vaccines were added to the programme, namely rota-virus, rubella and Japanese encephalitis, as well as the injectable polio vaccine (Universal Immunization Programme, 2016).

## 8. FINDINGS AND CONCLUSIONS:

It is seen about the slum dwellers of Kolkata that in presence of free medical facilities provided by government hospitals, they still prefer private doctors' service. For this, two reasons can be assumed that either the government hospitals are far away from their locality or they might face loss of a day's earning because of long waiting periods in government hospitals. They spent the major portion of their income on healthcare, no doubt the city pollution takes a toll on their health. This also depicts that Kolkata has better availability of healthcare facilities. The migrant population lived on encroached land in the peripheries of the city and KMC does not provide basic amenities like water, sanitation, health services, etc. to them, hinting the worst sufferers are the unauthorized slum dwellers. Almost, half of the unauthorized slums did not had electricity and those who had, had it in illegal way. Under various initiatives it was found that local clubs were given the job to provide vaccinations and de-worming medicines temporarily but their services depend upon the availability of the local club. Not all areas have such active clubs. Government funded Pre-School child care centres (ICDS) provide pre-school child care, meals, education and medicines but, however, are very limited in resources. Ration cards allow their owners to purchase food and fuel at subsidised prices. Yet though national policy entitles migrants to a new ration card as long as they remove their names from their ration cards at home, in practice they find it difficult to do this. Many do not know the correct procedure for obtaining a new ration card, and others face obstacles if they have never previously held a card because they were absent from their home states when identification documents (such as voter ID cards) were issued. Furthermore, many migrants do not want to risk removing their names from a ration card in their home state because they are uncertain of obtaining a new ration card at their destination. In Kolkata the availability of micro-finance is practically nil. Though a recent phenomenon, households are not aware of the role of micro-finance and institutions, banks, etc. have directed their efforts towards the marginalised rural.

## REFERENCES:

- Abbas, R. & Varma, D. (2014). Government Led Exclusion of the Urban Poor.

- Bag, S., Seth, S., & Gupta, A. (2016). A Comparative Study of Living Conditions in Slums of Three Metro Cities in India.

- Baksi, S. (2013). Internal Labor Migration in India Raises Integration Challenges for Migrants, The Slums of Kolkata.

- Bapat, D., & Bhattacharyay, B. N. (2016). Determinants of financial inclusion of urban poor in India: An empirical analysis. CESIFO Working Paper no. 6096, 1-31.

- Bisset, M. (2016). Jan Seva social centre. Baseline study, AIAE Luxembourg.

- Bose, R. & Ghosh, S. (2015). Slums in Kolkata: A Socio-economic Analysis. *The Empirical Econometrics & Quantitative Economics Letters*, 4 (4), 134-148, ISSN 2286-7147.

- Chatterjee, K. & Sardar, A. (2018). Financial Literacy Amongst Adult Male Slum Dwellers of Bidhannagar, India. *Clear International Journal of Research in Commerce & Management*. 9(3), 13-18.

- COHRE. (2008). Women, Slums and Urbanization: Examining the Causes and Consequences.

- Haque, S, M. & Singh, B, R. (2017). Air Pollution and Human Health in Kolkata, India: A Case Study. *Climate* 5.4, 77. http://dx.doi.org/10.3390/cli5040077

- Kolkata Study Report (2014). *Society for Participatory Research in Asia*. terraurban.files.wordpress.com/2014/01/kolkata-study_april-2014.pdf

- Landrigan, P, J. et al. (2015). The Lancet Commission on pollution and health. *The Lancet*.www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32345-0/fulltext

- Murthy, S, L (2012). Land Security and the Challenges of Realizing the Human Right to Water and Sanitation in the Slums of Mumbai, India. *Health and Human Rights*, 14(2), 61–73. JSTOR, www.jstor.org/stable/healhumarigh.14.2.61.

- Peck, D. (2018). An Overview of the Economics of Kolkata's Slums. www.researchgate.com DOI:10.13140/RG.2.2.29748.96641.

- Planning Department, Government of Maharashtra. Report on Drinking Water, Sanitation, Hygiene and Housing Condition and Particulars of Slums. Directorate of Economics and Statistics.

- Schenk, C, W. Slum Diversity in Kolkata. *Columbia Undergraduate Journal of South Asian Studies*. http://www.columbia.edu

- UNICEF (2014). Children of Migrant Poor in Kolkata: A study on Human Development Perspectives.

- Universal Immunization Programme (2016), Wikipedia.

- World Health Organization. WHO releases country estimates on air pollution exposure and health impact. www.who.int/mediacentre/news/releases/2016/air-pollution-estimates/en/

**Notes**

[1]. Banerjee-Guha, Swapna and Sinha, N.K. "Kolkata". Encyclopedia Britannica, 26 Nov. 2019, https://www.britannica.com/place/Kolkata

[2]. www.smilefoundationindia.org

[3].http://timesofindia.indiatimes.com/articleshow/28415537.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

## ENVIRONMENTAL CHALLENGES

**R D Vaidkar\*, V K Khobarkar\* and N V Shende\*\***
\*Assistant Professor and \*\*Professor, Dr PDKV, Akola, Maharashtra, India

**ABSTRACT**

*The biggest issue facing the environment is over population of humans. The global population has more than tripled in the last 60 years placing stress on every aspect of the environment. Ever increasing area of land is being taken up by urbanization and human settlements to accommodate the fast growing population.*

*Currently, one third of humans have inadequate access to clean, fresh water. The number is expected to increase up to two thirds by 2050. Some experts believe that in the near future water will become a commodity just like Gold and Oil. Some experts say that wars will be fought over who owns the water supply.*

*In India, water availability is becoming increasingly crucial because per capita availability of water in the country has sharply declined as a result of population growth.*

*The latest measurements show that the average sea level is currently 50 mm higher than in 1993. According to a United Nation's forecast, sea levels are likely to rise well over 50 cm by 2100, posing serious threat to coastal communities. Half of the 10 largest cities in the world, including Mumbai, Kolkata, New York City, French Rivera and one-third of the world's 30 largest cities are already threatened by sea level rise.*

*Environmental conservation and effective use of ecosystem services must receive highest priority and should be the under lying theme of all development activity. We have to make an all-out effort to decarbonize the economy, increase resource use efficiency, protect biodiversity and ecosystem services for the benefit of present and future generations.*

Human civilization has, made an impressive progress to achieve economic wellbeing and all-round development that has certainly made life a lot more comfortable. However, this progress has come at enormous cost to the environment that often negates the advantages of economic growth. The term environment refers to everything that is around us land, water, atmosphere, plants and animal life. In fact, environment is the main supplier of vital resources that we need to survive. It is no wonder that the other planets have no life simply because their environments cannot sustain life. It is a truth that ecosystems and its peoples are bound together in a tenuous symbiosis. The industrial society is increasingly destroying this relationship giving rise to many complex environmental problems of far reaching consequences. In addition, the unintended and unanticipated environmental and social damage caused by the prevalent paradigm of economic development has resulted in complex environmental problems that seriously undermine food security, water security and biodiversity. The main problems threatening our life support system of our the planet are elaborated in the following paragraphs.

The biggest issue facing the environment is over population of humans. The global population has more than tripled in the last 60 years placing stress on every aspect of the environment. Ever increasing area of land is being taken up by urbanization and human settlements to accommodate the fast growing population.

Rising levels of carbon dioxide and other gases, such as methane, in the atmosphere create a 'greenhouse effect', trapping the Sun's energy and causing the earth and oceans to warm. The higher the amounts of greenhouse gases in the atmosphere, the warmer the earth becomes.

There is clear evidence to show that climate change is happening. Since the industrial revolution, atmospheric concentrations of greenhouse gases (GHGs) are now at their highest level for hundreds of thousands of years. There is an overwhelming scientific consensus that climate change is primarily due to the use of fossil fuels, which releases carbon dioxide and other greenhouse gases into the atmosphere. The $CO_2$ concentration in the atmosphere is now , and . The average temperature at the earth's surface is now about 1°C higher over the last century. Ambient temperature data show that 13 of the 14 warmest years on record have occurred in the 21st century, and in the last 30 years each decade has been hotter than the previous one. Rising ambient temperature affect crop yields globally, with all other factors being equal. Some studies have estimated that the crop yields may drop by about 10 percent by 2050. Apple cultivation in Himachal Pradesh has suffered adversely from rising temperature, affecting livelihood of lakhs of farmers. For apple trees winter temperature and precipitation in the form of snow are critically important to ensure normal flowering and fruiting in apples. Apple trees requires over 1200 hr. of chilling for satisfactory flowering and fruiting. Relatively warmer December and January fails to provide the critical chilling requirements. Data of last thirty years show that apple crop is getting adversely affected in all apple growing regions (Shimla, Kullu, Lahaul and Spiti) as a

result of relatively faster warming of the Himalayan region than most places in the world. This year in early May, blistering summer heat melted the asphalt roads in Valsad, Gujarat, resulting into a life threatening situation for pedestrians, who found it difficult to walk as their shoes got awkwardly stuck in the melted asphalt and had to struggle to free their shoes.

Currently, one third of humans have inadequate access to clean, fresh water. The number is expected to increase up to two thirds by 2050. Some experts believe that in the near future water will become a commodity just like Gold and Oil. Some experts say that wars will be fought over who owns the water supply.

In India, water availability is becoming increasingly crucial because per capita availability of water in the country has sharply declined as a result of population growth. Most of our rivers are in varying degrees of decline and distress. Over seventy percent water bodies in the country have been polluted or drained. Large volumes of untreated effluents are drained into rives, and water bodies. Most of the Indian rivers are thoughtlessly used for disposing raw sewage and untreated effluents. It is obvious that water of most of our rivers is unfit for drinking, and in many stretches not even fit for bathing. Despite various efforts, pollution of Ganga and other rivers continue to remain a major challenge.

Sea level is rising. The latest measurements show that the average sea level is currently 50 mm higher than in 1993. According to a United Nation's forecast, sea levels are likely to rise well over 50 cm by 2100, posing serious threat to coastal communities. Half of the 10 largest cities in the world, including Mumbai, Kolkata, New York City, French Rivera and one-third of the world's 30 largest cities are already threatened by sea level rise.

The Maldives, a chain of 1,200 islands and coral atolls, about 500 miles from the tip of India, is one of the lowest countries on the planet, with an average land level of 1.5 m above sea level, may disappear, if the present pace of global warming continues unabated. The chemistry of the oceans is also changing as they absorb much of the excess carbon dioxide being emitted into the atmosphere. This is causing the oceans to become acidic more rapidly than at any point in the last 65 million years. Increasing acidity is highly damaging to marine food-chains and ocean productivity.

Climate change promotes melting of polar ice-caps, which in turn contributes to rise in sea level. As the Arctic warms, sea ice is rapidly decreasing. Over the past 20 years the ice sheets in Greenland and the Antarctic have shrunk, as have most glaciers around the world.

India has 5243 glaciers covering an area of 37579 km2 and containing 142.88 km2 of ice. The Gangotri glacier, the source of the Ganga is receding at a rapid pace. Some of the most devastating effects of glacial meltdown occur when glacial lakes overflow and burst and give rise to disastrous floods downstream. The 2013 Uttarakhand disaster resulted from heavy cloudburst coupled with collapsing of an upstream glacial lake. Episodes of extreme rainfall events and cloud burst cases have increased and they are likely to be more frequent in the coming years.

Floods have become more frequent and affect the maximum number of people in the world. Many of the fastest developing cities in coastal areas, means that more people, infrastructure, and buildings are vulnerable to the flooding caused by storm surges or cyclones, and sea level rise. Even if not on the coast, cities have sprawled onto floodplains and wetlands. There is simply more stuff, more people, more industries, more infrastructures and more investment in coastal areas than few decades ago. Globally exposure and vulnerability of coastal communities have increased manifold.

Changing rainfall patterns will affect water supplies. Too much rainfall in some areas and not enough in others will contribute to both flood and drought conditions. We are already seeing increasing numbers of heavy rainfall events, and expect this increase to continue, with greater risk of river and flash flooding.

Growing populations and rapidly expanding urbanization and infrastructure are making the societies more vulnerable to extreme weather events. More extreme weather events are being seen around the world. Heat waves have become more frequent and are lasting longer. Warming is expected to cause more intense, heavy rainfall events. Recent devastating floods in Chennai were to a large extent due to the building of the cyber city in a low lying area without worrying about the local ecological and hydrological features. Accordingly, a heavy spell of rain flooded the area causing enormous hardships to residents and office goers, apart from substantial economic loss to individuals, institutions, entrepreneurs and public exchequer. In future extreme events are expected to become more common, more intense and more frequent and this needs to take into account in future development.

According to the UN projections the global population is expected to grow from 7 billion in 2012 to 9.3 billion by 2050. In spite of growing economic prosperity and technological progress approximately 870 million people remain undernourished even today. The question of food security, hunger, malnutrition, poverty and parity are high on the global agenda.

India with a population of 1.2 billion is the second largest populous country of the world and likely to touch 1.6 billion by 2030, surpassing China. Despite economic growth and self-sufficiency in food grain production, high level of food insecurity and malnutrition persists in the country.

Forests are natural sinks of carbon dioxide and produce fresh oxygen, help in regulating temperature and rainfall, but getting destroyed without realizing that there is no substitute for the services they provide. Trees are now dying globally at a rate never seen before. Since 1990 half of the world's rain forests have been destroyed.

Currently, many plants and animals are in danger of becoming extinct, either from being forced out of their habitats by anthropogenic actions or by climate change. When a species become extinct, it has a knock on effect in the food chain upsetting the structure and function of ecosystem, which have developed through a long process of evolution. The biological, chemical, and physical interactions between the components of an ecosystem (e.g., soil, water, plants, animals and microorganisms) produce a variety of services in the form of oxygen needed for breathing and fuel combustion, clean water, carbon sequestration, soil fertility and control of soil erosion among others. Another critically important ecosystem service for humans is pollination. It is the transfer of pollen from the producing anthers to the receptive stigma and it is an essential step for sexual reproduction leading to fruit and seed formation in flowering plants. Success of pollen transfer to stigma is directly related to yield for all crops in which the pollination is a prerequisite for sexual reproduction. Rapid and large changes in global temperatures 4oC or more, above the pre-industrial temperature, could cause mass extinction of species and collapse of ecosystem services and jeopardize human survival.

The desperate scenario presented by the environment challenges can be reversed and turned into opportunity, provided urgent and concerted actions are taken simultaneously on multiple fronts. Environmental conservation and effective use of ecosystem services must receive highest priority and should be the under lying theme of all development activity. We have to make an all-out effort to decarbonize the economy, increase resource use efficiency, protect biodiversity and ecosystem services for the benefit of present and future generations. Paris climate agreement, and global agreement on sustainable development goals SGDs, are very encouraging developments. We must support these initiatives and resolve on the eve of The World Environment Day to protect Mother earth –Our only home- from environmental abuse and commit to work for improving quality of life and human well-being.

## DIGITAL ADAPTATION OR DISRUPTION: THE WAY AHEAD!

**[1]Dr Ajay Tekchandani and [2]Prof. Sulekha Munshi**

[1,2]Assistant Professor, Management, Amity Global Business School, Malad West, Mumbai, India

**ABSTRACT**

*The paper takes us through the transformation which had been done by the computer technology in human life as well as in businesses & on the top of it mobile technology came as a booster to all these particularly in the last decade. All these have led to different myths in the minds of the people at large. The myth that the digitalization being fully disruptive. It has its own aftereffects on businesses. The 2nd myth here is that it will take the place of physical completely & digital requires 360 degree complete change legacy systems. The authors had gone through the various latest prevailing industry trends on these myths and had attempted to clarify the ingrained myths with the reality in the market with live examples of the industry. To give an impact of the digitalization examples like Aeroflot (a Russian company) which was worst in its performance at one point in time had come to one of the best airline after its digitalization adaptation.*

*Keywords: Digital adaptation, Digital disruption, Technology up gradation.*

**INTRODUCTION:**

When mother day special brunch served by Bombay Canteen had to be celebrated indoors due to lockdown in 2020, the owner gave a thought to it & in 2021 the founders delivered it to their customers in boxes as brunch. The highlight of this box brunch was a QR code with spotifies playlist so while the customers were enjoying their food simultaneously they were enjoying the songs. We can see that when situation get things pushed which necessitates the incorporation of digital technology with innovativeness around the customers in order to make the experience enjoyable. Also the founders asked about what will be mother's day favourite ice-cream flavour through the instgrammers post & the majority of the respondent favoured their Gymkhana cold coffee –ice cream. If we analyse all these belongs to digital adaptation as everything is being done to make the consumer experience enjoyable with the help of digital tools without any disruption.

**Research Methodology:** The author's for the paper has done extensive secondary research with the latest research papers published particularly from March 2020 onwards with the latest addition of the reputed magazines covering the topics on digital tools being used by the organisations to serve the customers in this competitive world. Also the example of the various organisations in different sector has been quoted to cover the diversification of sectors in terms of digital adaptation or disruptions as the case may be.

**Literature Review:** The usage of computers in day to day work had changed the work-life of the people over last some decades and the usage of mobile technology had changed things further particularly in the decade gone by & still the technology is ever evolving, changing and there are certain technological changes which are going to stay over the long run. Covid -19 had pushed the digitalization further and the changes are here to be seen by all of us. Organisation like TCS, Infosys had already decided that a certain pie of their employee will work from home even after the pandemic gets over fully and other organisations are contemplating the work model to be followed hereafter. In the meanwhile across organisation there are discussions & myths that weather digitalization will be disruptive or it will be simply a way for the industry to get themselves adaptable more efficiently with reference to customers' requirements rather than into reinvention mode or be disruptive. These myths or the current debates can be given more clarity by appreciating the action initiated by different organisations as per changing situations time to time. We will go across various prevalent myths & check how much they are applicable or not applicable as per current industry scenario:

a) **Myth: Digital requires radical disruption of the value preposition**: The Company Maersk which deals in supply chain management of goods & services has been there for many years & was facing many inefficiencies , global trade barriers , lack of transparency etc. When the company partnered with Govt. & with IBM for digital technology like block-chain, it started getting end to end data in a secure transparent way with proper permission of the participative members & minimal administrative costs along-with better risk management.This kind of shift has allowed Maersk to serve its customers in a better way with the usage of digital technology. The company did not became any one of the digital giant like Amazon, EBay or Google but it did change its value in terms of digitally connecting with the help of block-chain etc. to serve its customers for a better value preposition. Maersk is still a shipping company with a remarkable positive difference in its efficiency of operations.

Another example of the remarkable positive difference is of the Russian company Aeroflot which was the world's worst airlines at one point in time transitioned to one among the best airline of the world with the incorporation of the digital technology in its passenger booking, operations, scheduling & the customer care. Its passenger load score rose from 64.5% in 2009 to 81.3% in 2016. The net promoter score also got increased from 44% in 2010 to 72%in 2016. Aeroflot had used the dashboards which indicate 450 key performance parameters which help in controlling and get optimization in place. The planes of the company were carrying the sensors which give a transparent view of its indicators of performance and preventative maintenance required. These digital interventions results in saving downtime of machines and also saving overall operations costs. These dashboard were also able to reduce the headcounts as the information on various parameters was already out there. Beside that Aeroflot also created a low cost operations airline with the usage of the same infrastructure. What we can conclude here is airline did the same work of booking passenger seats for the destinations scheduled though more efficiency with the saving in cost as well as providing it modern look with digital.

**Reality is: Digital tools leads to serving the customers' needs in a better way**.

Uber is another case in point which created positive changes for the customers by incorporating digital tools. G7 group of Taxis which were ruling the Paris in taxi market was compelled to change due to arrival of the Uber in the city. G7 was earlier known for its driver's rudeness got changed for better by the number of digital incorporations like Uber. It incorporated App for the booking & for its fare for all variety of options to the customers like providing share a taxi or hybrid taxi or a VIP taxi as per requirement of the customers. Though its fare were slightly higher than Uber in normal course of time but overall when you would have required the taxi the most , Uber applied the surge pricing of 2 to 4 fold more than the standard fare whereas in the case of G7 it was not so. Beside that the taxis provided by the G7 were cleaner & the behaviour of the drivers is good than its competitors as the drivers of G7 also got training on behaviour as well as on etiquettes. Here again truth was that the digital tools led to better service for the customer & taxis were still performing the same function of taking passengers to their destination.

In the case of Hotel business which got competitions from the digital based technology ventures like over the Air (OTA) by Expedia than by Airbnb and later by Google. The Marriott's CEO Mr Arne said at that time, definitely they need to use digital technology while booking the service, delivering the service but the kind of experience that they are going to provide i.e. the mattress which they use across for better experience on the relaxation fronts of their guests are not being matched by their competitors. The model of serving the customers remains the same with digital incorporation and not radical disruption as the myth. Here the physical relaxation comforts served by Marriott are difficult to match.

b) **Myth: Digital will replace Physical**: It's always seen the digital cleans up or shortens the length of the intermediary's particularly inefficient ones. At the same time digital cannot replace the valuable physical intermediaries like in the case of retail, Galeries Lafayette physical store the sales people interacting & making customer understand brings in emotional connect with the customers whereas in case of online/digital connect through the Artificial intelligence – it brings in need of the customer. **Here again if we see digital is not replacing physical rather both are required as they have their own role to play.**

Bonobos is another example of a brand which came into existence on a digital platform but now it uses physical store to let its customers try the brand & make them-selves comfortable with reference to the product. Finally, the company sends the material through its centralized inventory.

Many electric utility companies in Europe had also combined the advantages of physical as well as digital in their home systems. It has thermostats, sensors & detectors. In case any of the heating system gets predicted as an overheat, the sensors pass on the information for further action to thermostat & the maintenance visit by the engineer can be scheduled. Here also we can see the role of digital as well as physical.

c) **Myth: Digital involves buying start up**: A company like Avnet is an apt example to give its acquired start-up company i.e. Harnet.io. to operate as semi-independent business. This start up deals in company's sharing their ideas on monitoring noise levels & pollution levels in a city. These start-ups are free to work on their own in semi control way via a vice president of Avnet but they are independently making their decisions. **So digital does not mean buying & controlling start-ups but rather it is protecting their independence on decision making in order for them to flourish**.

The guardian angel or protection angel for the start-up is also depicted by the Galeries Lafayette's (GL) with its start-up Lafayette Plug & Play in which many other retailers are also partners. The GL were not getting initial positive results with its start-up but when they appointed a dedicated project manager to guide the start up with

liberty on experimenting with the novel ideas freely and also avoiding the administrative blockage which is generally there with the big organisation like GL. Here it is clearly seen that the digital means the protection is being provided by the GL so the advantage of start-up flexibility was intact as well as capabilities, resources & expertise on various functions along-with positivity of the big organisation were also there leaving behind its administrative delays.

d) **Digital is about technology**: It's a myth that digital is all about technology; definitely the role of technology is there & cannot be discounted but mainly it is about the customer. How we as a company are able to serve the customer in a meaning full way than that of competitors by breaking the work which was earlier done in silos & now with the help of digital technology it is being done in more collaborating way with the changes in operations as was done by MasterCard labs – which ask for ideas by the squads (teams from different functional areas) to put across their ideas & to get them qualify as Orangebox, Red box & Green box ideas. The Orange one can explore their ideas & can also pitch it- their team will get 1000$ as a prepaid in their card & they will also get coaching to present their idea. The next stage one will get $25,000 to test the idea & develop the prototype & they also get 90 days training & mentoring ship to fine tune the idea, the last stage is of Green box, here the team will commercialize the idea & they will be given 6 months break from their jobs to work on the project to get it activated. Here again as we see it is not only technology but serving the customer better with the help of innovativeness in ideas by teams along collaborated by the technology.

e) **Digital requires overhauling legacy system**: It's a myth to believe that digital requires overhauling legacy system rather it is a prudent strategy to do it in a modular way. This is practically better for the stakeholders as everything is fluid in nature & changes with the time; be it customers or operations requirements. When Company like TUI which deals in retail, online & Telephone wanted to do its digital transformation as its competitors had done but than its leadership decided to do in modular way even though the company like Expedia & other OTA platforms in travel business were a big threat to its business, the TUI did this modular way over the period of 3 years. Postponing the digital transformation till you can do it fully or not doing it all both are the dangerous strategy. The key for success is focussing on to the customer needs, organization capabilities & adaptability in a phased manner.

**CONCLUSIONS:**

While going through all the myths mentioned above & the practical solutions taken up by the respective organisations in various sectors of the industry has clearly underlined the following facts in the conclusion that digitalization works around the needs of the customers that require digital intervention to serve them better with transparency, efficiency & cost effectiveness as in the case of Maersk with did it in collaboration with IBM & Govt. Aeroflot, Uber & G7 taxi had also worked around the customer's need to serve them better but these companies were not radically disrupted rather it was adaptation to digital tools again to ease out inefficiency's in the system as happened in case of Aeroflot which could transitioned itself from the worst performing airline at one point in time to one of the best airline along-with with customers to its side. Also replacing physical stores is also not possible as in the case of Galeries Lafayette, Bonobos & many others. Digital also does not mean buying of start- ups; rather it is protecting their independence on work style & collaborating with them with in terms of organisation ability in terms of resources as a big brother.

**REFERENCES:**

1. Furr Nathan, Shipilov Andrew, Digital doesn't have to be disruptive, The best of Harvard Business Review, Summer 2021, HBR.org, page 93-99.

2. Jacobides Michael, In the ecosystem economy, what's your strategy, The best of Harvard Business Review, Summer 2021, HBR.org, page 21-27.

3. Mcgrath Rita, McManus Ryan, Discovery- driven digital Transformation, The best of Harvard Business Review, Summer 2021, HBR.org, page 85-91.

4. Podolny Joel, Hansen Morten, How Apple is organised for Innovation, The best of Harvard Business Review, Summer 2021, HBR.org, page 101-108.

5. Shashidhar- Ajita, Wake-up call, As business came to a standstill during 2020 lockdown, Food retail companies & restaurants embraced technology to stay afloat, Business Today, 27th June 2021, Page 65- 69.

# COMPARATIVE STUDY ON EYE AND HAND CO- ORDINATION BETWEEN RIGHT- AND LEFT-HAND CRICKETERS

## Sathyaraja R[1]*, Prabhuraja R[2] and Lingaraj B[3]
[1]Assistant Professor, [3]Intern Student, Faculty of Physiotherapy, Dr. M. G. R. Educational and Research Institute, Maduravoyal, Chennai– Tamil Nadu, India
[2]Assistant Professor, Madha College of Physiotherapy, Madha Nagar, Kundrathur, Chennai - Tamil Nadu, India

## ABSTRACT
*INTRODUCTION; Eye-hand coordination (also known as hand-eye coordination) is the coordinated control of eye movement with hand movement and the processing of visual input to guide reaching and grasping along with the use of proprioception of the hands. This includes activities like writing, cutting, and catching and throwing a ball. The dominant hand is not really a choice because it is not a conscious decision that we make as children. Reaction time is the amount of time it takes to respond to a activity. METHODOLOGY: In this prospective study 30 subjects will be recruited from A.C.S Medical college based on inclusion and exclusion criteria. All the subjects will be explained and written informed consent will be obtained from all participants. The subjects are divided into Group A and B, where Group A consist of 15 right hand batsmen and Group B consists 15 left hand batsmen. Before and After 10 days daily training activity, both the groups are tested with eye-hand co-ordination test. RESULT: On comparing Pre-test and Post-test within Group A & Group B on Alternate Hand Ball Toss Test score and DART Throwing Scoring Test shows highly significant difference in Mean values at P ≤ 0. 001.Hence Null Hypothesis is rejected. CONCLUSION: The study confirms that when the both right- and left-hand cricketers, had significant changes in hand eye co-ordination. The right-hand cricketers are found to have significant hand eye coordination than left hand cricketers.*

*KEYWORDS ; Wall toss test, dart test, cricket, Hand-eye co-ordination.*

## 1. INTRODUCTION
Hand-eye coordination (also known as eye-hand coordination) is the coordinated control of eye movement with hand movement and the processing of visual input to guide reaching and grasping along with the use of proprioception of the hands to guide the eyes

Hand-eye coordination problems are usually first noted as a lack of skill in drawing or writing. Poor hand-eye coordination can have a wide variety of causes, but the main two conditions responsible for inadequate hand-eye coordination are vision problems and movement disorders. In cricket you need hand eye coordination to hit the ball. The ball often comes very fast and needs quick hand eye coordination to hit a good shot. Sometimes it is spinning in different directions and to be able to hit it you need great coordination. Hand dominance is the preference for using one hand over the other to perform fine and gross motor tasks. This includes activities like writing, cutting, and catching and throwing a ball. The dominant hand is not really a choice because it is not a conscious decision that we make as children. Reaction time is the amount of time it takes to respond to an activity [stimulus].

There are evidences which support the claims of vision playing an important role in the perceptual ability of an athlete relating proportionately to his/her motor response. **Review Gabor (1981)** stated that visual abilities affect sports performance and the acquisition of motor skills, which can be improved with training. Supporting the same **Quevedo et al. (1999);** stated that sports vision training is conceived as a group of techniques directed to preserve and improve the visual function, with the goal of incrementing sports performance through a process that involves teaching the visual behaviour required in the practice of different sporting activities. **West & Bresson (1996)** indeed indicated a positive effect other performance of cricketers to judge the length of ball after specific visual training program.

Sport activities often have a close relationship between perception and action therefore temporally constrained sport tasks require that players extract the most valuable source of visual information and use this information to quickly anticipate the opponent's movement outcome **(SHIM et al., 2006).** In spite of this early recognition of visual importance in sports it stood neglected for many years and it was not before the middle of 20th century that new scientific opinions were developed and the thought, "sports being a multidisciplinary approach" came into picture **(JAFARZADEHPUR & YARIGHOLI, 2004).**

However, when subjects reach to a stationary target, it has been reported that gaze is anchored on the target **(Neggers and Beckering, 2000, 2001)** and, under some conditions, may anticipate the hand motion to the target **(Johansson et al., 2001).** Evidence for predictive, saccadic eye movements was also found in a task in which

subjects had to learn coordinated hand movements to control a cursor motion on the screen **(Sailer et al., 2005).** These authors found that, initially, subjects tracked the cursor with their eyes, but as they learned the task, eye movements changed to a predictive mode. Furthermore, neural recordings from posterior parietal cortex suggest that the spatial goal of an arm movement is encoded in an eye-fixed (retinocentric) frame of reference **(Batiste et al., 1999**; **Buneo et al., 2002**). Such an encoding would appear to be simplified if gaze were stable. Based on these considerations, one might expect a predictive saccadic eye movement around the time of the interceptive hand movement, providing a target for the hand. However, we will report the contrary: pursuit was maintained until the target was successfully intercepted, and, in fact, saccades tended to be suppressed during the target interception.

## METHODOLOGY
The Study design is Observational study and study type is Comparative study. The study was done with 30 Subjects in A.C.S Medical College and Hospital by Convenient sampling method. The study duration was 10 days. The subjects of age group between 18-22 years of both gender are included. Subjects with recent fracture in upper limb, congenital disorder, Lower limb problems, Ligament injury, Injury of spine and using spectacles are excluded. The subjects are divided into Group A and B, where Group A consist of 15 right hand batsmen and Group B consists 15 left hand batsmen. The both groups are assessed using Wall-toss test and Dart test eye and hand coordination tests.

## PROCEDURE
In this prospective study 30 subjects will be recruited based on inclusion and exclusion criteria . All the subjects will be explained about the purpose and the procedure of the study and written informed consent will be obtained from all participants. The 30 subjects are divided into group A and B. The **GROUP A** consist of 15 right hand batsmen and **GROUP B** consists 15 left hand batsmen After the normal daily training activity, both the groups are tested with eye-hand coordination test. The Eye-Hand coordination test include Dart throwing scoring test and Alternative hand wall toss test.

## DATA ANALYSIS
The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS) version 24. Paired t-test was adopted to find the statistical difference within the groups &Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

**TABLE- I- COMPARISON OF ALTERNATE HAND WALL TOSS TEST SCORE BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST**

| | #GROUP - A | | #GROUP - B | | t - TEST | df | SIGNIFICANCE |
|---|---|---|---|---|---|---|---|
| | MEAN | S. D | MEAN | S. D | | | |
| PRE-TEST | 25.80 | 4.47 | 25.86 | 3.54 | -.045 | 28 | .964* |
| POST TEST | 32.73 | 3.80 | 28.60 | 3.45 | 3.11 | 28 | .000*** |

**(\*- P > 0.05), (\*\*\*- P ≤ 0.001) Statistically significant.**

**GRAPH – I - COMPARISON OF ALTERNATE HAND ALL TOSS TEST BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST**
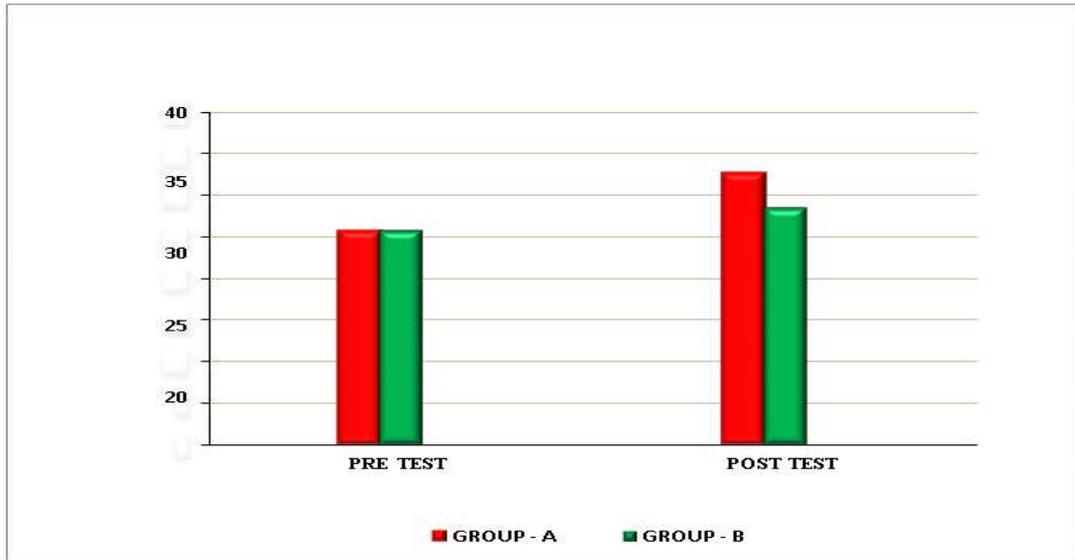
**TABLE- II- COMPARISON OF DART THROWING SCORING TEST BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST**

| | #GROUP - A | | #GROUP - B | | | | |
|---|---|---|---|---|---|---|---|
| | MEAN | S. D | MEAN | S. D | t - TEST | Df | SIGNIFICANCE |
| PRE-TEST | 226.00 | 32.13 | 223.66 | 24.38 | .224 | 28 | .824* |
| POST TEST | 158.66 | 18.27 | 177.33 | 17.81 | -2.83 | 28 | .000*** |

**(*- P > 0.05), (***- P ≤ 0.001) Statistically significant.**

**GRAPH – II- COMPARISON OF DART THROWING SCORING TEST BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST**
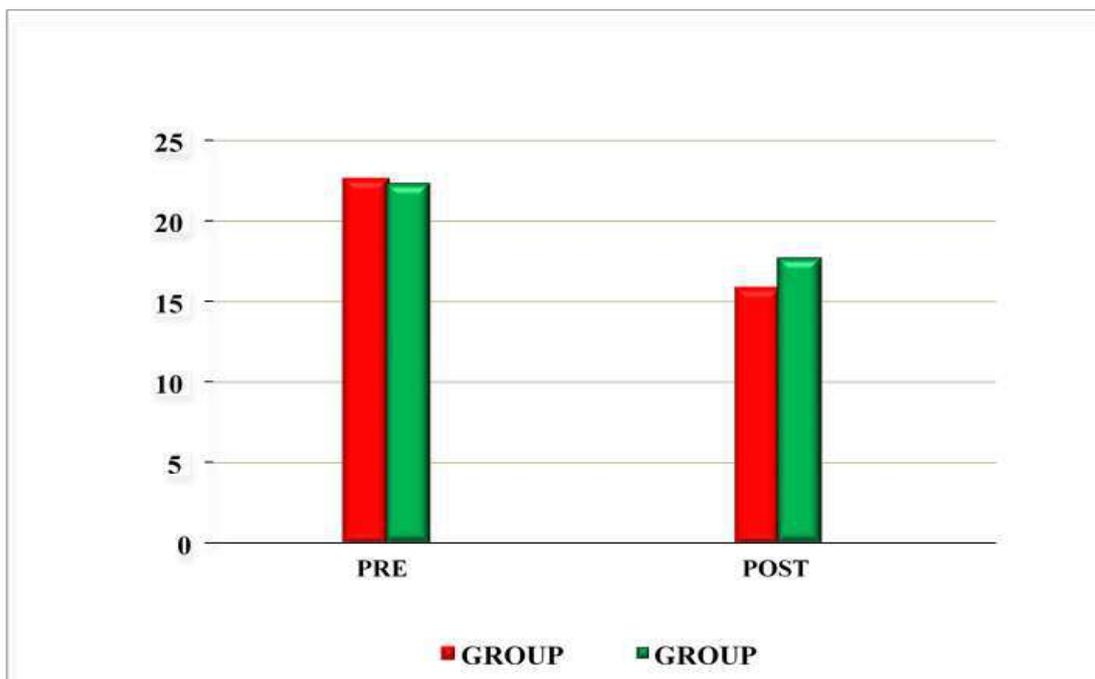
**TABLE – III COMPARISONOF ALTERNATE HAND WALL TOSS TEST WITHIN GROUP – A& GROUP – B BETWEEN PRE & POST TEST VALUES**

| | PRE-TEST | | POST TEST | | t - TEST | SIGNIFICANCE |
|---|---|---|---|---|---|---|
| | MEAN | S. D | MEAN | S. D | | |
| **GROUP- A** | 25.80 | 4.47 | 32.73 | 3.80 | -10.53 | .000*** |
| **GROUP-B** | 25.86 | 3.54 | 28.60 | 3.45 | -13.25 | .000*** |

**(\*\*\*- P ≤ 0.001) Statistically significant.**

**GRAPH – III- COMPARISONOF ALTERNATE HAND WALL TOSS TEST SCORE WITHIN GROUP – A& GROUP – B BETWEEN PRE & POST TEST VALUES**
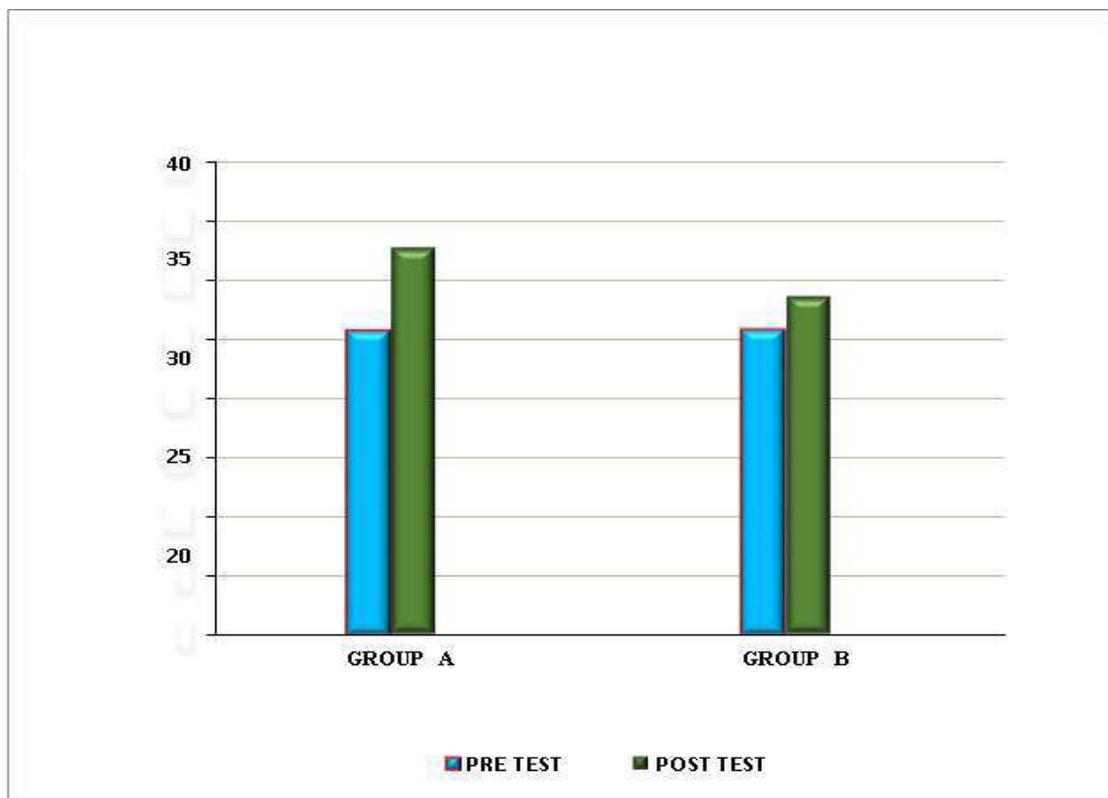


**TABLE – IV- COMPARISON OF DART THROWING SCORING TEST WITHIN GROUP – A & GROUP – B BETWEEN PRE & POST TEST VALUES**

| | PRE-TEST | | POST TEST | | t - TEST | SIGNIFICANCE |
|---|---|---|---|---|---|---|
| | MEAN | S. D | MEAN | S. D | | |
| **GROUP- A** | 226.00 | 32.13 | 158.66 | 18.27 | 11.46 | .000*** |
| **GROUP-B** | 223.66 | 24.38 | 177.33 | 17.81 | 10.93 | .000*** |

**(\*\*\*- P ≤ 0.001) Statistically significant.**

## GRAPH – IV-COMPARISONOF DART THROWING SCORING TEST WITHIN GROUP – A& GROUP – B BETWEEN PRE & POST TEST VALUES
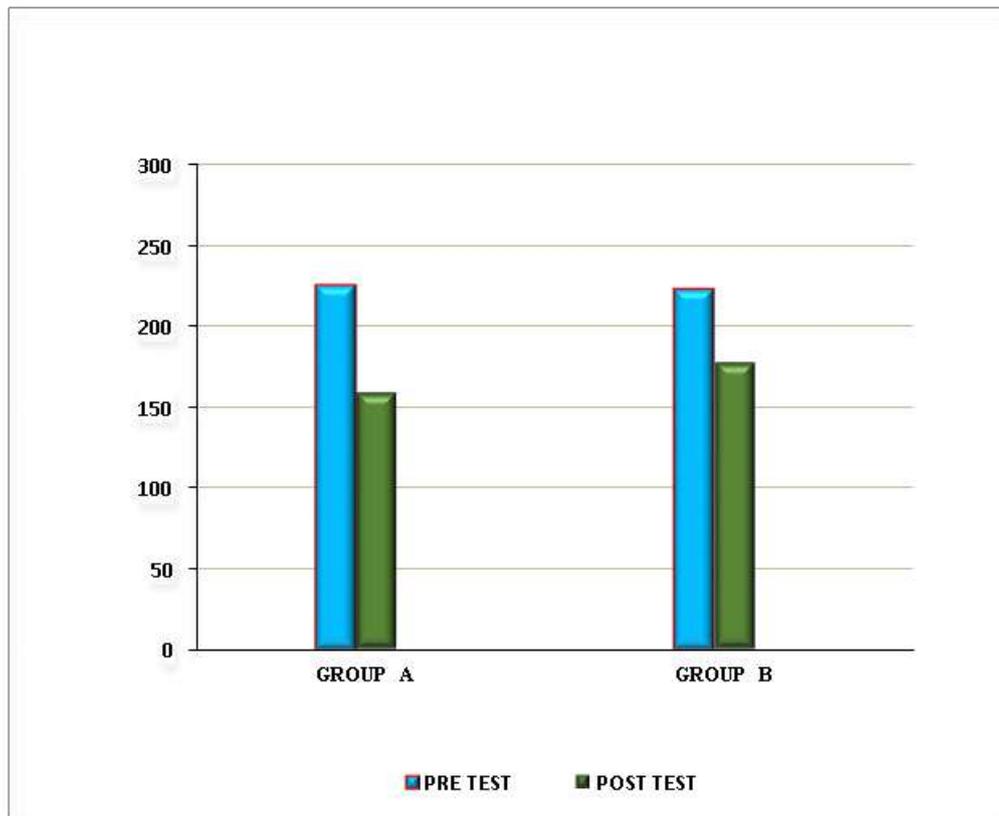


## RESULTS

On comparing the Mean values of Group A & Group B on Alternate Hand Ball Toss Test score, it shows significant increase in the post test Mean values in both groups, but (Group A - Right hand Batsman) shows 32.73 as an excellent score which has the higher mean value is effective than (Group B -Left hand Batsman) 28.60 as a Good score at $P \leq 0.001$. On comparing the Mean values of Group, A & Group B on DART Throwing Scoring Test, it shows significant decrease in the post test Mean values in both groups, but (Group A - Right hand Batsman) shows 158.66 which has the lower mean value is effective than (Group B -Left hand Batsman) 177.33 at $P \leq 0.001$. On comparing Pre-test and Post-test within Group A & Group B on Alternate Hand Ball Toss Test score and DART Throwing Scoring Test shows highly significant difference in Mean values at $P \leq 0.001$.

## DISCUSSION

**Jafarzadehpur and Yarigholi (2004)** showed significant differences between facility of accommodation and acuity in champions and normal non players, stating that the development of these two parameters may improve the efficiency of visual system. this as been found in the study. As such a player with good sensory visual ability has the luxury of increased time to react to the stimulus before it has occurred thereby reducing the overall reaction and movement time during the game. The improvement in visual abilities is in conjunction to human motor learning behaviour, which involve learning of new skills and even refining of existing skills with repetition. Relating to this principle, the continuous repetition of vision exercises and task lead to improvement in visual skill variables Both group A and group B post- test values shows excellent scores in eye-hand coordination.

The players in the study showed improvement in accordance to afore mentioned responses for experimental group. This improvement in eye hand coordination apart from modified neural linkages can also be explained on the hypothesis of spatial and temporal coupling of eye and hand as long as the motor reaction relies on visual information (**SAILER et al., 1999).** On statistical analysis in the study, the improvement in various sensory and motor skills post training can be transferable in performance during actual sports. In the present study a significant improvement in right hand cricketer's performance post training for experimental group was seen. The study therefore concluded that the right-hand batsmen performed well after past training sessions than the left-hand batsmen.

## CONCLUSION

The study confirms that when the both right- and left-hand cricketers, had significant changes in hand eye co-ordination. The right- hand cricketers are found to have significant hand eye coordination than left hand cricketers.

## AKNOWLWDGEMENT

## REFERENCES

1. ABERNETHY, B. Anticipation in squash: Differences in advance cue utilization between expert and novice players. Journal of Sports Sciences, v. 8, p. 17–34, 1990.

2. ABERNETHY, B. Visual search strategies and decision-making in sport. International Journal of Sport Psychology, v. 22, p. 189–210, 1991.

3. ABERNETHY, B.; RUSSELL, D. G. The relationship between expertise and visual search strategy in a racquet sport. Human Movement Science, v. 6, p. 283-319, 1987.

4. ABERNETHY, B.; WOOD, J. M. Do generalized visual training programs for sport really work? An experimental investigation. Journal of sports sciences, v. 19, p. 203-222, 2001.

5. ADAM, J.; WILBERG, R. Individual differences in visual information processing rate and the prediction of performance differences in team sports: A preliminary investigation. Journal of Sports Sciences, v. 10, p. 261-273, 1992.

6. ALLARD, F.; STARKES, J. L. Perception in sport: Volleyball. Journal of Sport Psychology. 2, p. 22–23, 1980.

7. BAHILL, A. T.; LA RITZ, T. Why can't batters keep their eyes on the ball. American Science, v. 72, p. 249-253, 1984.

8. COHEN, A. H. The efficacy of optometric vision therapy. Journal of American Optometric Association, v. 59, p. 95-105, 1988.

9. COHN, T. E.; CHAPLIK, D. D. Visual training in soccer. Perceptual and Motor Skills, v. 72,p. 1238-1240, 1991.

10. DI RUSSO, F.; PITZALIS, S.; SPINELLI, D. Fixation stability and saccadic latency in elite shooters. Vision Research, v. 43, p. 1837-1845, 2003.

11. FERREIRA, J. T. The application of sports vision in cricket. Eyesight, p. 41- 43, 2003.

12. GRIFFITHS, G. Eye speed, motility and athletic potential. Optometry Today, v. 42, p. 34-37, 2002.

13. Thomas, N. G., Harden, L. M., & Rogers, G. G. (2005) Visual evoked potentials, reaction times and eye dominance in cricketers. Journal of sports medicine and physical fitness, 45(3), 428.

14. Rodrigues, S. T., Vickers, J. N., & Williams, A. M. (2002). Head, eye and arm coordination in table tennis. Journal of sports sciences, 20(3), 187-200.

15. Paul, M., Biswas, S. K., & Sandhu, J. S. (2011). Role of sports vision and eye hand coordination training in performance of table tennis players. Brazilian Journal of Bio motricity, 5(2), 106-116.

16. VICTORIA, G. D., ALEXANDRU, S., & FLORENTINA, H. (2010). Eye-hand coordination in third form pupils. Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 10(2).

## ANALYSIS OF THE UNDERLYING CORD BETWEEN AIR POLLUTION AND CARDIO-VSCULAR DISEASES

**¹Ananya Swain and ²Dr Swapnamoyee Palit**
¹Research Scholar and ²Assistant Professor, KIIT School of Humanities, KIIT University, Bhubaneswar

**ABSTRACT**

*In the past decades, air pollution has been one of the trending topics for various studies and analysis. It has been hazardous and critically acclaimed with loss of human life. Non- communicable diseases are one of the most serious leading problems in the world, in particular cardiovascular and respiratory diseases. Cardiovascular diseases stand out with chronic and harmful effects when it is associated with air pollution. Globally, air pollution has reached to a point where it needs to be controlled via measures and policies. Exposure of fine particles and ambient air pollution particles are closely related to cardio-diseases. Cardiovascular disease damages the heart and coronary organs leading to failure and strokes. Short-term and long-term exposure of the fine particulate matters in the air affects the cardio-organs in a negative way. Hence, particulate matter PM2.5 and ozone gas are key air pollutant that is highly under studies, about its effects and its relation to cardiovascular diseases. About 65% of the deaths in the world are due to air pollution and cardiovascular diseases. Dysfunction in the neurological system and vascular dysfunction are among the major adverse impacts of air pollution. Hence, it has been evident that there is a correlation between air particulate matter and cardio-disorders.*

*The focus of this paper is to explore this underlying cord between these two catastrophes with an aim to suggest measures to restrain them at least to a minimum. From the analysis of this paper, it has been evident that cardiovascular diseases and air pollution has correlation and acute exposure to environmental pollutants such as particulate matter and gaseous matters such as carbon monoxide, nitrogen oxides, sulphur dioxide are analogous to cardio-morbidity and mortality. Adverse cardiovascular events and air pollution clearly demonstrates the relation between the two, i.e., higher air pollution leads to higher cardiovascular diseases and decrease in the former results in the decrease of the latter. Improving the air quality through various modern techniques and mechanisms will surely upgrade the air quality and help in reducing the after effects. Elevating the understanding of biological mechanisms will improvise the standard of health.*

*Keywords: - Air, Cardio, Diseases, particulate,Pollution, Vascular*

## 1. INTRODUCTION:

Environmental pollution has eminent impacts on human life. There are several concerns related to human and environment that paves the way towards eternity. There is no evidence that without proper environment humans can survive and vice-versa. Hence, it is evident that environment- human relationship is everlasting. But, with the pace of industrialisation, globalisation, urbanisation and recent special developments across the world, the scenario has changed its block. With the same environment being present, rapid population growth and maintenance of luxurious lifestyle has worsen the very environment which is the roots of sustainability. Many researchers have cited that human greediness will destroy the environment totally. One of the prominent pollution is the air pollution that engrossed itself to be the one of the stress-striven pollution in the world.

Air pollution is the contamination of air with harmful particulate matters which in turn leads to cardio diseases. Cardiovascular diseases and respiratory disease stands out to be one of the chronic diseases caused by air pollution. Cardiovascular diseases damage the heart and blood vessels. The impact of air pollution is very eminent and can be sensed vitally. Cardiovascular diseases can be very aggressive to some people causing premature deaths as well. Amount of air taken and its quality decides the quality of living. There is a direct correlation between air quality and cardio diseases. As per many researches, it is stated that short term and long term impact of air pollution rests upon amount of particulate matter and ambient air pollution. Hence, it is rightly said that air pollution concentrations affects cardio-respiratory health. The focus of this paper is to explore this underlying cord between these two catastrophes with an aim to suggest measures to restrain them at least to a minimum.

## 2. REVIEW OF LITERATURE:

**Tertre et al., (2002),** in the paper " Short term effects of particulate air pollution on cardiovascular diseases in eight European cities- Barcelona, Birmingham, London, Milan, the Netherlands, Paris, Rome, Stockholm" stated that there has been a eminent shower of death-beds due to air pollution. Human life and its associated levels are affected due to ambient air pollution that hampers the national level of income. Sulphur dioxide and

its particulates are extremely harmful for mankind. Cardiovascular diseases and respiratory diseases are at its peak.

**Koken et al., (2003)** in the paper "Temperature, air pollution and Hospitalization for Cardiovascular Diseases among Elderly People in Denver" stated that temperature, level of pollution and gender are all correlated to the level of cardiovascular diseases in elderly people. According to the data sample collected, it revealed that people above 65years in both the gender are highly prone to CVD. As per the paper when hospitals are enquired, the results become one- sided. It revealed that men are more prone to CVD than women as they work more frequently outside near factory and industrial areas. Higher temperature appears to be as an important factor in increasing the frequency of hospitalization for acute myocardial infection and heart failure.

**Martins et al., (2006)** in the paper "The effect of air pollution on Cardiovascular diseases: A Lag structure" stated that there is a lag structure between air pollution exposure and elderly CVD hospital admission by gender. It revealed that acute correlation exists between respiratory and cardiovascular diseases and older people due to less potential to tackle the effect. The study is based on gender susceptibility.

**A.Bener, M Dogan, M.S. Ehlayel, M J Shanks, A. Sabbah (2009)** in the paper "The impact of air pollution on hospital admission for respiratory and cardiovascular in an oil and gas rich country" stated that air pollution and the public health impacts is a growing concern to every community, society and to the very nation. The quality of air inhaled by these groups is closely related to morbidity and mortality from respiratory and cardiovascular diseases. Composed factor like carbon monoxide, sulphur dioxide, nitrates and ozone are the leading components of CVD that is very evident now-a-days, basically, it studied the urban atmospheric pollution and its impact. Hence, it is eminent that there is an association between increasing air pollutants levels and patients admitted for respiratory and CVD.

**Ta-chen Su, Szu-ying Chan, Chang-Chaun Chan (2011)** in the paper" Progress of Ambient air pollution and Cardiovascular Diseases research in Asian" stated that Asian countries are deterioting the air quality accompanying the rapid economic and social development and notified that cardiovascular diseases and respiratory diseases has risen. Epidemiological studies show that short term particulate matter pollution is a stronger component that causes CVD morbidity and mortality.

**Byeong- Jae Lee, Bumseok Kim and Kyuhong Lee (2015)** in the paper "Air pollution exposure and Cardiovascular Diseases" stated that ambient air pollution and particulate matters have been closely associated with adverse health effects such as respiratory diseases and cardiovascular diseases. Mortality and morbidity both affects the human. Strokes and heart failure are major problems seen among the lots.

**S A Meo, F. Suraya(2015)** in the paper" Effect of Environmental air pollution on cardiovascular diseases" stated that the leading concern of human beings today is the environment pollution and damage. Urbanisation, globalization and rapid population growth has somehow damaged the environment to a larger extent. This has lead to cardio-diseases and progression towards cardio-organ damage. It has also lead to prolonged damages such as systemic inflammation, oxidative stress, endothelia dysfunction and other associated damages.

**Zhen An, Yuetei Jin, Juan Li, Wen li, Weidong Wu(2018)** in the paper " Impact of particular air pollution on cardiovascular health" stated that Air pollution is established as an independent risk factor for cardiovascular diseases. Particulate matter is the vital component of air pollutant that adversely affects the human existence. Particulate matter and its other elements include damage of lungs, heart and dysfunctioning of various other associated organs. It subsequently damages the autonomic nervous system and vascular organs.

**Alain Combes and Guillaume Franchineau (2019)** in the paper "Fine particles environmental pollution and cardiovascular diseases" stated that air pollution has lead to several million premature deaths in the world. Fine particles in the air and associated pollution have lead to increase in cardiovascular risks and mortality conjointly. Fine particles in the cardio system include inflammation, activation of prothrombotic pathway, oxidative stress and dysfunction of neuro-organs. The study also revealed that there has been some justified correlation between particulate matter concentrations, ischemic cardio-myopathy, stroke and heart failure.

**Nhung et al., (2020)** in the paper" Exposure to air pollution and risk of hospitalized for cardiovascular diseases amongst Vietnamese adults: case crossover study" stated that there is short term associations between ambient air pollutants and hospital admissions due to cardiovascular conditions.

**3. OBJECTIVES OF THE STUDY:** The objectives of the present paper are as follows:

i. To examine the extent of air pollution and cardiovascular diseases in India.

ii. To examine the correlation between air pollution and cardiovascular diseases.

iii. To suggest measures to reduce air pollution which will help in reducing cardiovascular cases.

## 4. HYPOTHESIS

To achieve the above objectives, the following hypothesis has been set up as given below.

| Hypotheses | Methodology |
|---|---|
| 1. There has been no increase in air pollution and CVD cases in India | Descriptive Statistics |
| 2. There is no correlation between air pollution and CVD | Descriptive Statistics |

**5. OVERVIEW OF THE PRESENT STATUS:** Over the last two decades, there has been an increasing concern about environmental air pollution and its impact on cardio health. Being a complex mixture of various particles, it intended to harm the longevity of human. Air pollution has severe impact on heart, lungs and others vascular organs leading to strokes and heart failure.

As per many studies and researches, it has been evident that constant exposure of human to those fine particles appears to affect the cardiovascular health through three primary pathways-

- Systemic inflammation

- Translocation into the blood

- Direct and indirect effects in the autonomic nervous system

### Figure 1: The pathway of fine particulate matter and the effect in heart and lungs
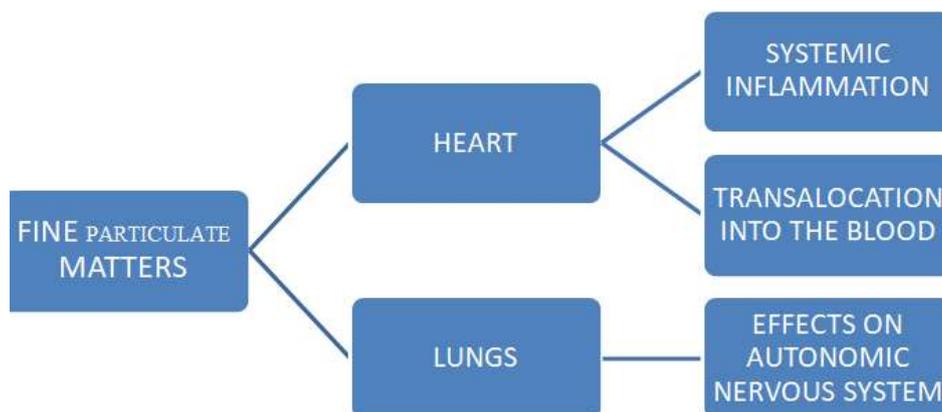


**Source: Author's own**

The key research points guiding the investigation of the correlation between high levels of air pollution and the development of cardiovascular problems focus on the study of air pollutions, specifically carbon monoxide, ozone, nitrogen dioxide, sulphur dioxide and particulate matter which damages the heart implicitly.

## 6. DATA ANALYSIS AND DISCUSSION:-

### Table 1: PM level in the most polluted states of India

| States | PM2016 | PM2017 | PM2018 | PM2019 |
|---|---|---|---|---|
| **NCT of Delhi** | 136.25 | 127.19 | 144.28 | 109.07 |
| **Tamil Nadu** | 41.28 | 44.90 | 47.22 | 42.38 |
| **Odisha** | 64.57 | 60.1 | 63.80 | 65.47 |
| **West Bengal** | 92.71 | 84.44 | 90.02 | 78.63 |
| **Maharashtra** | 46.92 | 48.59 | 50.07 | 50.4 |

**(Source: - Air Quality Life Index, Govt of India)**

The above data in table 1, shows the particulate matter(PM) and its amount from the year 2016 to 2019. This clearly shows how unhealthy is the condition in the states with heavy population. Around 45% of death rates in these states are due to cardio-damages and causes to it are the air quality. When these states are considered due to heavy population and being more industrialised, the air quality becomes reactive to human life through decomposition of fine particles and ambient air particles.

There are several studies and surveys worldwide stated that 21 out of 30 most polluted cities in India. India has pushed the rankings high being polluted due to several reasons. Over 50 percent of the pollution comes from vehicles, 17 percent from crop burning and 7 percent from domestic cooking. Over 2 million Indians lose their life to causes attributed to air pollution. Indians are exposed to an average of 83.2 microns per cubic metre of PM2.5 pollutant as compared to other cleaner countries. Poor air quality has harsh effect on the human respiratory ad cardio system because the small PM2.5 particulate travels deep into the lung tissues as far as alveoli. From there it passes through body tissues and enters heart.

**Table 2: Country wise data about average pollution the year 2020, 2019 and 2018**

| Countries | 2020(AVG) | 2019(AVG) | 2021(AVG) |
|---|---|---|---|
| **Bangladesh** | 77.10 | 83.30 | 97.10 |
| **Pakistan** | 59.00 | 65.80 | 74.30 |
| **India** | 51.90 | 58.10 | 72.50 |
| **China** | 34.70 | 39.10 | 41.20 |
| **Sri-Lanka** | 22.40 | 25.30 | 32.00 |
| **Germany** | 10.10 | 11.00 | 13.00 |
| **USA** | 9.60 | 9.00 | 9.10 |

**(Sources: IQAir Index)**

From the above table 2, it is evident that the level of air pollution in these countries is high and there is clear correlation that the population of these countries are prone to cardiovascular diseases. The link between air particulate matter and cardio damages urges many more damages internally. Bangladesh, Pakistan and India on an average have high PM2.5 and are most polluted in the world. China and Sri-Lanka are moderately affected and Germany and USA are least affected as compared to the former ones.

**Table 3 Contribution of the sources of air pollution (in %)**

| Sources | Percentage |
|---|---|
| **Dust and construction** | 45% |
| **Waste burning** | 17% |
| **Transport** | 14% |
| **Diesel generator** | 9% |
| **Industries** | 8% |
| **Domestic cooking** | 7% |

**Sources: Wikipedia.org.in**

**Figure 2: Sources of air pollution and the amount contributed totally in the air pollution level in the country.**
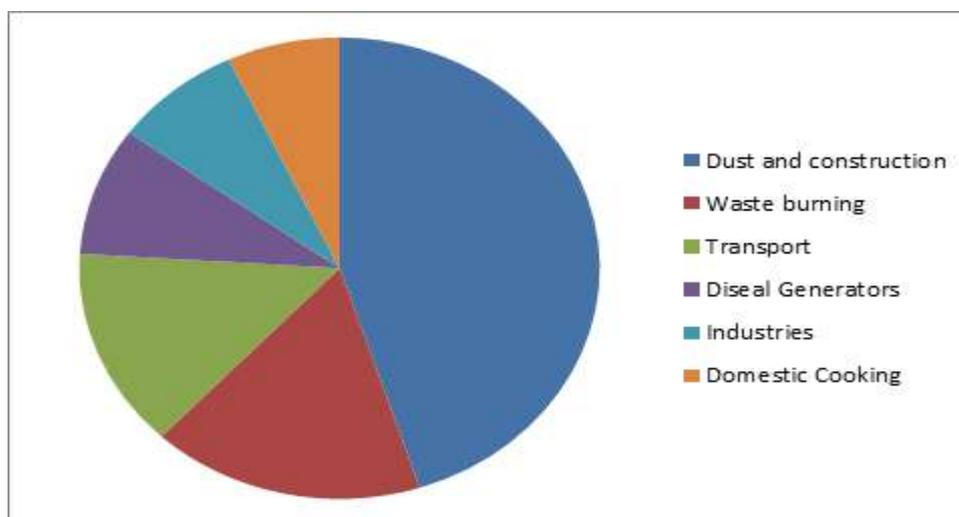


## 7. RESULTS:

There is a strong association between cardiovascular diseases and air particulates which affect human lives causing deaths. Indian air quality can be purified through intervention of government and sponsored

organisation who work for the betterment of the society. In 2019, the Indian govt inaugurated the National Clean Air Programme (NCAP) to address the situation. It is their aim to reduce levels of air pollution by 20-30 percent by 2024 in over 122 of the worst affected cities. NCAP routinely monitor the four air pollutants of sulphur dioxide, nitrogen oxide and nitrogen dioxide and PM10 particulates and suspended particulate matter. These are to be monitored at 308 stations and over 25 states and 4 territories. A constant consciousness towards environmental pollution and attempt to confine them within limit at least will work to reverse the adverse scenario. Of course onus is not to be left on the government alone. It will be fruitful if the vitality is realised by each individual inhabitaing this planet, that we ourselves will perish if we fail to sustain our natural environment in all its aspects.

## REFERENCES:

- A Le Tertre, S Medina, E samoli, B Forsberg, P Michelozzi, A Boumghar, J M Vonk, A Bellini, R Atkinson, J G Ayres, J Sunyer, J Schwartz, K Katsouyanni (2002). Short term effects of particulate air pollution on cardiovascular diseases in eight European cities- Barcelona, Birmingham, London, Milan, the Netherlands, Paris, Rome, Stockholm

- Petra J M Koken, Warren T Piver, Frank Ye, Anne Elix Hausen, Lola M Olsen and Christopher J. Portier (2003).Temperature, air pollution and Hospitalization for Cardiovascular Diseases among Elderly People in Denver

- Lourdes Martins, Luiz A.A. Peira, Chir A lin, Ubiratan P Santos, Gildeoni Prioli, olinda Do Carmo Luiz, Paulo h n saldiva, Alfesio Luis Ferreria Branga (2006). The effect of air pollution on cardiovascular diseases: A Lag structure

- A.Bener, M Dogan, M.S. Ehlayel, M J Shanks, A. Sabbah (2009). The impact of air pollution on hospital admission for respiratory and cardiovascular in an oil and gas rich country

- Ta-chen Su, Szu-ying Chan, Chang-Chaun Chan (2011). Progress of Ambient air pollution and Cardiovascular Diseases research in Asian

- Byeong-Jae Lee, Bumseok Kim and Kyuhong Lee (2015). Air pollution exposure and Cardiovascular Diseases

- S A Meo, F. Suraya(2015). Effect of Environmental air pollution on cardiovascular diseases

- Zhen An, Yuetei Jin, Juan Li, Wen li, Weidong Wu(2018). Impact of particular air pollution on cardiovascular health

- Alain Combes and Guillaume Franchineau (2019). Fine particles environmental pollution and cardiovascular diseases

- Central pollution control broad, https://cpcb.nic.in/

- National air quality index, https://app.cpcbccr.com/AQI_India

- World health organisation, https://www.who.int/

## A STUDY ON PROBLEMS FACED BY WOMEN ENTREPREURS IN PANJAB

**\*Dr. Satpal (A.P), Mr. Kuwar Kaushal, Rishpreet Kaur and Jaspreet Singh**
University School of Law, Rayat Bahra University Mohali, Panjab, India

**ABSTRACT**
*This study endeavors to examine problems of women entrepreneurs faced in Punjab. In order to conduct this study, a sample of 200 respondents has been gathered from state of Punjab for this purpose. Fourteen statements were formulated for respondents and factor analytical model has been utilized to get the meaning inferences. The factor analytical model has clubbed these fourteen statements into five factors. These Five factors are like problem of obtaining finance, problem of demand estimation, competition from big manufacturers, problems of product pricing, local disadvantages, lack of training. This study concluded that these problems can be solved by providing training to women entrepreneurs through using latest technology in the area of managing women entrepreneurs. Women entrepreneurs should lay more emphasis on improving quality improvement because quality is the need of the hour. This is only possible by using latest technology along with modern human resource management practices.*

*Keywords: Women entrepreneurs, problems, Punjab*

## 1` INTRODUCTION-

Small and micro enterprises play an important role in every country. These enterprises provide many advantages in growing their industrial economy by the help of many benefits like low investments, more employment opportunities and wider scope covering in rural and urban areas. Thus small and micro enterprises have been playing crucial role in the economic development of developing economies. These enterprises also provide equal distribution of income and effective utilization of capital and skill effectively. The economic development of every country can be judged with the growth of such small businesses. The progress of advanced countries also depends on the growth of small and micro enterprises. It has been reported that progress of advanced countries has been attributed by the progress of their women enterprises. According to the survey, 40% of all firms in the United States has been running by women. These women owned enterprises have been generating employment for approximately 27.5% million people (NFWBO, 2001). That is why women are starting their own businesses more as compare to men. According to the survey in China that women are running their businesses at least two times more as compare to men. Recently there are approximately 5 million women entrepreneurs running in China. The trend of women entrepreneurs is very small in Japan but its growth is increasing day by day. It was reported that the percentage of women entrepreneurs has been increased from 2.4 in 1980 to 5.2 in 1995 (SHIGEKO, 2000). By considering the zest and keen of women in starting new entrepreneurs, Government of India has been taking many steps now. That's why government of India has started large number of financial institutions in order to provide loans at very economic rates. The growth of NGOs is obvious due to the post reform measures taken by government of India for women entrepreneurs in the country. Recently the growth rate of women entrepreneurs in India is very appreciable. According to the Mckinsey, the country will add up to dollar 770 billion income to GDP by women entrepreneurs which will be more than 18% by 2025. It has also reported that women entrepreneurs had been grown up to 90% in last five years in India.

## 2 REVIEW OF LITERATURE

**Bliss and Garratt (2001)** did his study at organizations run by women in Poland. It highlighted that the main objectives of these organizations are to arrange inputs for women entrepreneurs in the field of professional ethics, protecting their rights, exchange their experiences and activities with other women entrepreneurs.

**Mambula (2002)** examined specific constrains faced by mall and micro entrepreneurs in Nigeria. This study advised that all small business entrepreneurs should work together in order to solve the various problems faced by them. For solving this problem, need of the hour is to form alliance of Government and research institutions should provide appropriate training to women entrepreneurs for running well in the future. On the other hand, financial institutions should provide loans to theses entrepreneurs at very economic rate.

**Watson (2003)** analyzed failure rates in running women entrepreneurs in Australia. It highlighted that failure rate of running women entrepreneurs is more as compare to men entrepreneurs. But this comparison can be removed by providing some effective measures in the future.

**Tagore et al (2005) t**he main objective of this study is to examine the financial challenges faced by urban small micro entrepreneurs in Ghana under financial sector. The main problem faced by SME's is paucity of loan at

concessional rate for running entrepreneurs. To solve this problem, finance should be provided at concessional rates for investment avenues.

**Shankar and Vijay Lakshami (2007)** this study examined motivating factors among women entrepreneurs in Chennai. For this study, data was gathered from 47 respondents regarding motivating factors by classifying into push and pull factors. It highlighted that for promoting women entrepreneurs, pull factors should be motivated in the future.

**Low (2007)** the main objective of this study is to examine economic outcomes of female immigrant entrepreneurs in Sydney. This study has proved that the contribution of these entrepreneurs is praiseworthy in generating more employment opportunities. It resulted in non quantifiable economic benefits for economy of Australia.

**Kavakolanu and S (2014)** studied on problems faced by women entrepreneurs in Krishna district of Andhra Pradesh. For this study, data was gathered from 120 respondents through questionnaires regarding special problems like managerial, marketing, external and internal. Study revealed that government should take necessary steps in order to solve these problems to encourage women entrepreneurs in India in the future.

**Satish kumar and Ramar (2019)** studied on role of women entrepreneurship in Virudhunagar district of Tamilnadu. The data was collected from 200 respondents by adopting stratified random sampling technique regarding problems of finance, installation of plant and machinery, local environment, labor, site, town planning approval, power supply, recruitment and others. This study revealed that women problems are big barriers in their growth. Thus government should take necessary steps to tackle these problems./

## 3    OBJECTIVES OF THE STUDY
The main objective of this study is to throw light on various problems faced by women entrepreneurs in Punjab. In spite of it will cover the following the objectives

- To suggest recommendations in order to solve problems

## 4    CONCEPTUAL FRAMEWORK
**DEPENDENT VARIABLE**                          **INDEPENDENT VARIABLES**



The conceptual framework represents women entrepreneurs in Punjab are taken as independent variable while finance problems, demand estimation, competition, prices of products and training problems are regarded as dependent variables.

## 5    RESEARCH METHODOLOGY

**PRIMARY SOURCE**

The data has been gathered from 300 women entrepreneurs in Punjab by administered questionnaires by employing on Five point LIKERT Scale. There are fifteen statements formulated regarding five variables regarding women entrepreneurs in Punjab as depicted in the under given table-1.Theses respondents are those women entrepreneurs who are running their business by employing more than twenty employee women in their businesses

### 5.1  SAMPLING TECHNIQUES

This study has utilized random sampling technique for selecting respondents.

### 5.2  TOOLS OF ANALYSIS

This study has utilized factor analysis technique to get research results.

### 5.3  RESULTS AND DISCUSSION

**Table-1 various statements with label**

| Label | Name of statements |
|---|---|
| X1 | Do you face paucity of funds for starting women entrepreneurs in Punjab? |
| X2 | Do you face problem of obtaining finance at concessional rate for starting women entrepreneur in Punjab? |
| X3 | Do you think documents regarding getting loan is very complex in the financial institutions? |
| X4 | Do you think financial institutions are hesitating in providing loans to women for starting entrepreneurs? |
| X5 | Do you think paucity of funds is a big problem for starting women entrepreneurs in Punjab? |
| X6 | Do you think women entrepreneurs have lack of security in getting loans from financial institutions ? |
| X7 | Do you think obtaining information regarding products and services is very herculean task for women entrepreneurs in Punjab? |
| X8 | Do you think prices of your products and services are very low? |
| X9 | Do you think decline in profit margin is also a big barrier in your entrepreneurs in Punjab? |
| X10 | Do you face the problem of location regarding your entrepreneurs? |
| X11 | Do you face the problem of changing market conditions day by day? |
| X12 | Do you face problem of big competition from big producers? |
| X13 | Do you think availability of various spurious products and services is big problem for women entrepreneurs in Punjab? |

**Table 2 VARIMAX Rotation Matrix**

| Label | Name of statements | Factor-1 | Factor-2 | Factor-3 | Factor-4 | Communalities |
|---|---|---|---|---|---|---|
| X1 | Do you face paucity of funds for starting women entrepreneurs? | -0.033 | 0.678 | -0.285 | -0.309 | 0.638 |
| X2 | Do you face problem of obtaining finance at concessional rate for starting women entrepreneur in Punjab? | 0.181 | 0.800 | 0.230 | 0.238 | 0.793 |
| X3 | Do you think documents regarding getting | -0.241 | 0.050 | 0.105 | 0.641 | 0.482 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | loan is very complex in the financial institutions? | | | | | |
| X4 | Do you think financial institutions are hesitating in providing loans to women for starting entrepreneurs? | -0.086 | 0.881 | 0.199 | 0.213 | 0.868 |
| X5 | Do you think paucity of funds is a big problem for starting women entrepreneurs in Punjab? | 0.568 | 0.094 | -0.170 | 0.108 | 0.372 |
| X6 | Do you think obtaining information regarding products and services is very herculean task for women entrepreneurs in Punjab? | 0.828 | -0.194 | 0.107 | 0.267 | 0.799 |
| X7 | Do you think prices of your products and services are very low? | 0.705 | 0.083 | 0.125 | -0.080 | 0.526 |
| X8 | Do you think availability of various spurious products and services is a big problem for women entrepreneurs in Punjab? | 0.852 | -0.060 | -0.021 | -0.137 | 0.750 |
| X9 | Do you think decline in profit margin is also a big barrier in your entrepreneurs in Punjab? | 0.562 | 0.175 | 0.394 | -0.057 | 0.505 |
| X10 | Do you think obtaining training regarding your entrepreneurs is also the big problem for your entrepreneurs in Punjab? | 0.285 | 0.153 | -0.101 | 0.729 | 0.647 |
| X11 | Do you think customers do not show any interest in your products and | 0.630 | 0.290 | -0.048 | -.027 | 0.485 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | services? | | | | | |
| X12 | Do you face problems regarding estimating demands relating to your products and services ? | -0.003 | 0.251 | 0.727 | -0.387 | 0.732 |
| X13 | Do you face problems regarding target customers relating to your products and services? | -0.009 | -0.046 | 0.815 | 0.269 | 0.739 |
| Eigen value | 3.370 | 2.100 | 1.450 | 1.416 | | |
| % of variances | 25.921 | 16.154 | 11.150 | 10.895 | | |
| Cumulative % of variance | 25.921 | 42.075 | 53.225 | 64.119 | | |

| Naming of factors | Name of dimensions Label Loading Name of statement Factor |
|---|---|
| F1 | Financial problems   X1   Do you face paucity of funds for starting women entrepreneurs in Punjab? <br> X2   Do you face problem of obtaining finance at concessional rate for starting women entrepreneur in Punjab? <br> X3   Do you think documents regarding getting loan is very complex in the financial institutions? <br> X4   Do you think financial institutions are hesitating in providing loans to women for starting entrepreneurs? <br> X5   Do you think paucity of funds is a big problem for starting women entrepreneurs in Punjab? <br> X6   Do you think women entrepreneurs have lack of security in getting loans from financial institutions ? |
| F2   Prices of products | X7   Do you think obtaining information regarding products and services is very herculean task for women entrepreneurs in Punjab? <br> X8 Do you think prices of your products and services are very low? <br> X9   Do you think decline in profit margin is also a big barrier in your entrepreneurs in Punjab? |
| F3   Location disadvantages | X10 Do you face the problem of location regarding your entrepreneurs? <br> X11   Do you face the problem of changing market |

|  |  | conditions day by day? |
|---|---|---|
| F4 Competition | X12 | Do you face problem of big competition from big producers? |
|  | X13 | Do you think availability of various spurious products and services is big problem for women entrepreneurs in Punjab? |

## 6    RESULTS AND DISCUSSION AND SUGGESTIONS

**1)    FINANCE PROBLEMS** – This is very important factor in order to start any type of business. Here this factor plays very crucial role because it describes maximum percentage of variations equal to 25.92 %. This study has loaded six variables out of total twelve variables. This factor highlights Eigen value more than 3. This value highlights that this factor has important place in affecting performance of the organization. This study has included some variables in this major variable like Do you face paucity of funds for starting women entrepreneurs in Punjab, Do you face problem of obtaining finance at concessional rate for starting women entrepreneur in Punjab, Do you think documents regarding getting loan is very complex in the financial institutions, Do you think financial institutions are hesitating in providing loans to women for starting entrepreneurs, Do you think paucity of funds is a big problem for starting women entrepreneurs in Punjab, Do you think women entrepreneurs have lack of security in getting loans  from financial institutions. Results show that in order to solve this problem the government of Punjab should take necessary steps in order to solve this problem like opening new financial institutions, provide loans at very economical rate with less documents needed to take loans.

**2)    PRICES OF PRODUCTS** – This is also an important factor in disclosing problems of women entrepreneur by accounting variation of 16.15 %. Here the Eigen value is also more than 2 that also revealed the significance of these factors. Prices of these products affect overall performance of the enterprise because it relates with sales and revenue level of the enterprise. For solving this problem women should use market segmentation in order to fix the prices of the products. They should also capture the market by taking into consideration prices of the product, income level of the buyers and sellers of the market. Women should also use market conditions while using their products. For solving location problems, they should open their entrepreneurs near the markets. For making them skilled. They must be given full fledged training in the field of managing small enterprises. The women entrepreneurs must be given relevant, timely information at the right place in order to take the decisions properly. They must be given training regarding modern means of communication in order to attract the customers.

**3)    LOCATION DISADVANTAGES** – This factor shows 11.15% of variation by including only two variables. This factor shows Eigen value more than 1. It indicates that this factor also affects performance of the entrepreneurs. If any enterprise will be located at distant location than more marketing and sales personnel will be needed more in future in order to attract the customers. While opening women entrepreneurs, location of the enterprise should be taken into consideration to maximum extent. Choice of the business location also helps in earning of economies. Agencies should help the women entrepreneurs in selecting the proper locations by training them.

**4)    COMPETITION-** This is the last factor which is very challenging for women entrepreneurs. The large value of Eigen describes its significance impact on women entrepreneurs. In order to solve this problem, all women entrepreneurs should be united to improve the quality of their products with the help of new innovations in the product. All women entrepreneurs should give more importance to research and development department in order to      produce new products. In this matter financial institutions should provide loan facilities and advances at very economical rates to government entrepreneurs. The government of Punjab should start new programs for motivating women entrepreneurs in the area of technological aspects. New interactive programs should also be launched by government in order to solve the variations in the market conditions.

## 7    CONCLUSION

This study reveals various problems faced by women entrepreneurs in Punjab. For getting research results, factor analytical model has been utilized by clubbing thirteen statements into four factors. These statements have been administered by women entrepreneurs in the form of questionnaires. By studying these problems,

study concluded that these problems can be tackled by opening new financial institutions, imparting training, locating the entrepreneurs at the right place and using new technology for improving the quality of the product.

## 8    LIMITATIONS OF THE STUDY

There is not any study without any limitation. Thus here this study has also some limitations as mentioned under

1) This study has been conducted only in Punjab. Same study can be conducted in other states of India.

2) This study has only included 300 respondents so this study can be done by including more respondents.

3) This study is only based on four factor like finance problems, prices of product, location disadvantages and competition. Further study can be conducted by including more factors.

4) This study has utilized factor analytical model. In further study, different research methodology can be adopted.

**REFERENCES**

- Bliss R. T. and Garratt N.L. 2001. Supporting women entrepreneurs in transitioning economies, Journal of Small Business Management, 39(4): 336-344.

- Breen et al. 1995. Female entrepreneurs in Australia: An investigation of financial and family issues, Journal of Enterprising Culture, 3(4): 445-461.

- Caputo R.K. and Dolinsky Arthur. 1998. Women's choice of pursue self-employment: the role of financial and human capital of household members, Journal of Small Business Management, 36 (2): 8-18. Government of India. 2001-02. Third all Indian census of SSI, DC(SSI), Ministry of SSI, New Delhi. Low, Angeline. 2007. Economic outcomes of female immigrant entrepreneurship International Journal of Entrepreneurship and Small Business, 5(3/4): 224-240.

- Kalvakolanu, Sripathi & Hanumantharaoi, S.2014. A study on problems facrd by women entrepreneurs in Krishna district of Andhra Pradesh.DOI:10.5281/Zenodo.4452146

- Mambula. 2002. Perceptions of SME growth constraints in Nigeria, Journal of Small Business Management, 40(1): 58-65.

- Masters R and Meier R. 1988. Sex differences and risk-taking propensity of entrepreneurs, Journal of Small Business Management, 26(1):31-36. National Foundation for Women Business Owners. 2001. Entrepreneurial vision in action: exploring growth among women and men-owned firms. Washington DC.

- Shankar, M.M. and Vijaya lakshmi M.E. 2007. A Study on the motivating factors of women entrepreneurs in Chennai, The ICFAI Journal of Entrepreneurship Development, 6(2): 46-54.

- Satish kumar and Ramar, N.(2019). Role of entrepreneurship in Virudhu Nagar district Tamilnadu, India. International journal of advanced research in management and social sciences.ISSN:2278-6236.

- Shigeko Mitusuhasi. 2000. Access to markets, OECD conference on women entrepreneurs in SMEs 2000: A major force in innovation and job creation. Synthesis, OECD 29 November-1 December, Paris, France. -

- Tagoe et al. 2005. Financial challenges facing urban SMEs under financial sector liberalisation in Ghana, Journal of Small Business Management, 43(3): 331-343. Taylor and Brooks bank. 1995. Marketing practices among small New Zealand organization, Journal of Enterprising Culture, 3(2): 149-160.

- Watson J. 2003. Failure rates for female-controlled businesses: are they any different? Journal of Small Business Management, 41(3): 262-277.

## VALUE EDUCATION FOR STRESS MANAGEMENT- A DISCUSSION

**Ms. Aditi Kejriwal**

Assistant Professor, Department of Commerce, J.B. College, Jorhat, Assam, India

**ABSTRACT**

*The power of life lies in thought. Thought is the key to our mental attitude and actions. Happiness is the all-time universal desire of all human beings. Peace generates happiness in human life. A stressful life lacks peace of mind. We can have a calm and composed mind when we follow a value system. When the mind is peaceful, we have the power to see the pinnacle of unpolluted cognizance. Higher Education in present days witnessed engulfed materialistic values; the stress level among the students and teachers accumulates in a different dimension. However, the education system must evolve a new positive moral value, which could effectively be built into undergraduate and post-graduate curricula. Otherwise, the national goal of democracy, socialism, humanism, and secularism could not be achieved. Value education incorporates social education but encompasses beyond the way an individual deals with his powers and potentialities and his relationship with other people and the community in general. It is much concerned with ruthless holistic personal development and generating a positive attitude towards other fellows, and understanding; what to do and what not to do.*

*This paper attempts to give an overview of value education. Further, it also tries to incorporate the rationale and philosophy of value in human society. Moreover, the paper also describes the role and importance of value education for the overall development of human beings.*

*Key-words: Value Education, Spirituality, Morality, Ethical.*

## INTRODUCTION:

Ministry of Education, Government of India, stated, "Our power of life lies in thoughts. Thought is the secret key of our mental software. Human resources should take us from negative thought (darkness) to positive thought (light), from untruth to truth, from immortality to mortality." In Bhagwat Gita, Krishna explains the developing human values and talks that a mind with divine qualities has Shanti. These values turn us introspective and purify our personality. Swami Vivekananda said, "To be happy is the universal urge of all beings at all times; one has to be at peace with oneself to be happy." N.N. Prahallada, in his article "Contemporary Significance of Higher Education," states that "Indian culture is rooted deeply in her spiritual values and unless these values find their way into the life of the students, education will lose its significance. It will not fulfill its function of endowing the students with a vision to life and by and with ideals to work for. Therefore, indifference to the cherished goals of democracy, socialism, humanism, and secularism, it is essential that our education system should evolve a new positive morality which could effectively be built into the school, under-graduate and post-graduate curriculum."

The conference on Dialogue among Civilizations, "Quest for New Perspective," in 2003 explains the needs of values. It states that "Humankind is passing today through an acute crisis, and the reason behind this crisis is disequilibrium between the progress that has been registered in recent times in the externalities of life and the progress or lack of progress in the inner realms of life. The human mind has achieved an enormous development in building a structure of hugeness and complexity. On the other hand, the contemporary human being has not developed enough spiritual and moral capacity to manage the hugeness of structure and its complexity. Inwardly, man has remained too small to utilize and manage the complex social, political, administrative, economic, and cultural machinery. The world has become global, but man has not developed the required global consciousness yet. This disequilibrium is reflected in the significant challenges that the contemporary civilizations of the world are confronting.

Value Education encompasses social education. Further, it covers an individual's behavior through his power and potentialities with other people in society. It also relates to putting best endeavor for holistic development of human beings by creating a responsible and ethical outlook for others.

It is paramount important to develop quality education. However, quality education includes aspects of educational milestones to be achieved, and the aspects of the curriculum should incorporate peace, shared values, tolerance, human rights, democracy, and interpersonal understanding. Educational Institutions and teaching-learning materials should act as a vehicle for peace, discussion, and intellectual understanding, but as instrumental in carrying misunderstanding, intolerance and hatred. In this respect, UNESCO spelled out the need for addressing these issues, i.e., peace and human rights, in long-term educational planning. Quality education must highlight in addition to peace and security:

i.   Developing knowledge of culture, tradition, religion, including civilization.

ii.  Improving mutual understanding of values.

iii. Improving the key competencies for peace and restricting conflict.

Modern education mainly focuses on acquiring knowledge on technology and skills without anchoring in the country's cultural roots and perspective dimensions. If education does not help the students develop their identity, education cannot be said to have accomplished its vital role. Here, personal identity refers to a host of value perspectives and global views connected with one's cultural tradition. All scholars in the field of education and other allied branches believe that moral, social, and human values are the only and much-needed remedies to improve the quality of life. Chandralekha Rao rightly viewed that the art of living and other values should be incorporated with the college curriculum. In university education, the highest education stage, the students are able to acquire democratic, intellectual, and aesthetic values and deep concern for the environment. So that they are able to develop an integrated personality and cultivate values of patriotism, national unity, respect, and appreciation for diverse cultures, and promote a humanistic attitude. But in the last decade since independence, the national education system has neglected these issues. The current focus should be on the revival of moral and spiritual values in Education. The following chart shows how value education leads to a stress-free harmonic society.
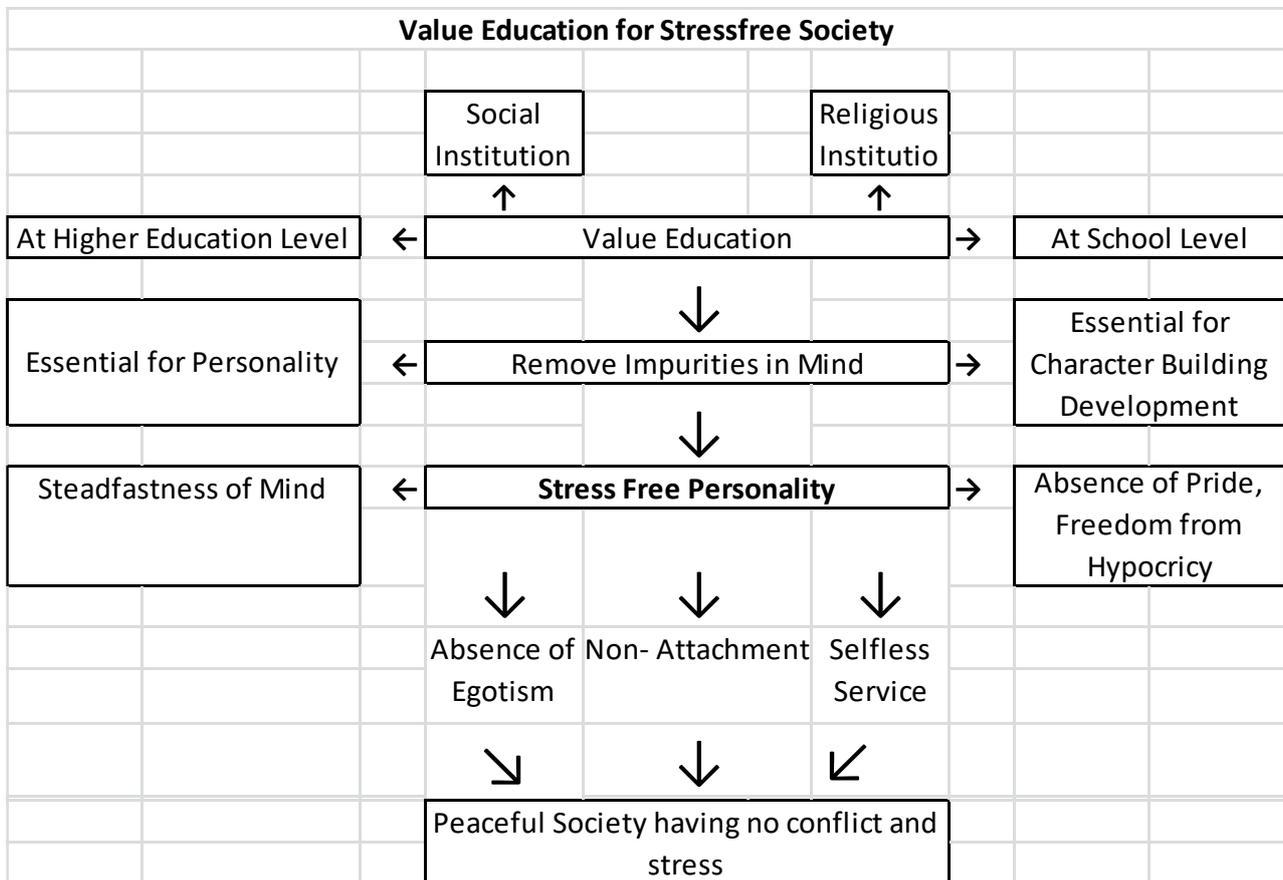


**Objectives of the study:**
1.  To highlight the rationale and philosophy of value education.

2.  To critically analyze the role and importance of value education in present society.

**Rationale and Philosophy**

The concept of value is defined nicely and elaborately in the conference "Dialogue among civilizations quest for new perspectives." According to this conference, "values are those desirable ideals and goals which are intrinsic in them and which, when achieved or attempted to be achieved, evoke a deep sense of fulfillment to one or many or all parts of what we consider to be the highest elements of our nature. Values are norms, which hold and sustain life and society and establish a symbolic and interdependent relationship between humankind and the ecosystem." Values refer to the fundamental category; in general understanding, these correspond to what we understand and mean when the Truth, Beauty, and Goodness are extreme values of life. They occur to us

whenever we attempt to conceive all these states within us in which we are likely to find some kind of ultimate accomplishment or fulfillment.

These are values of physical life, emotional life, and mental life, but these values point towards specific fundamental and ultimate values that are moral and spiritual in nature. Moral and spiritual values are the foundations of the highest point of civilization, and they deserve to be understood more clearly and meaningfully. It is needless to mention that moral and spiritual values are the common attributes of different religions that promote everlasting peace and universal harmony. So, we must look into the ethical and spiritual values in our effort to rise beyond the disparities among religions. Presently, an attempt has been made to discover the pursuit of these values- moral and spiritual which are to be found among all religions. The most important religion is the pursuit of ethical and spiritual values, which transcend the externalities of religious institutions.

It is to be noted that science, morality, and spirituality are intimately linked with one another, and they should not be viewed as antagonistic to one another. Moreover, the survival of human civilization at the present crucial period of human history will be based on the pursuit of ethical and spiritual values. Presently, peace is the most desirable aspect of the world. Peace cannot be achieved unless people contemplate ethical and spiritual values such as unity, harmony, mutuality, friendship, faithfulness, sincerity, and respect for diversity.

Spirituality is the foundation of universal consciousness that acts as the basis of the unity of humankind, and the ethical system that derives its power and sustains it from spiritual consciousness. Ethical and spiritual values are indispensable for the students' and from this viewpoint, it is essential in the education domain. The UNESCO report stated that fullness of personality involves fullness of ethical and spiritual values.

The National Policy on Education has emphasized deeply on value education. It has stated that "In our culturally plural society, education should foster universal and eternal values, oriented towards the unity and integration of our people. Such value education must help to eliminate obscurantisms, religious fanaticism, violence, superstition, and fatalism. Apart from this vital role, value education has a profound positive context based on our heritage, national goals, universal perception."

Sir Aurobindo viewed yoga as "a methodized effort toward self-perfection by the expression of potentialities latent in the being, and a union of the individual with the universal and transcendent Existence we see partially expressed in man and in the cosmos" In the words of Anita Shetty, "Value is a conception, explicit or implicit, distinctive of an individual or characteristics which influence the selection from available modes and ends of action." Uluchohn (1957) and Rokeach (1973) define values "as an enduring belief, a specific mode of conduct or end-state existence along a continuum of relative importance."

The value may be described as an interconnected system of personality traits that are in harmony with an individual's inner nature that conform with the values approved by society."

### Role of Value Education

1. **Develop human beings with strength and power based on our ancient national heritage:** Swami Vivekananda rightly mentioned that all political and social systems and institutions are based on the goodness of the man, the act of parliament cannot build virtuous person. When the people of a nation are excellent, a nation becomes automatically strong. Man is the most valuable wealth amongst all forms of wealth. As such, first of all, "India requires an upheaval in religion." The first attempts that demand our attention are that the most precious truth confined in our Upanishads, Puranas, and our Scriptures must be bought out from the books, brought out from the monasteries, brought out from the forests, brought out from the bodies of selected people and spurted all over the land. The secret of achieving national spirit lies in regaining our spiritual strength, which appears to be the last. If we have to lift, we must keep the motto, "Elevation of the masses without injuring their religion."

2. **Education for Peace:** Dalai Rama, in his lecture at NCERT, spoke about the exceptional intellectual ability of human beings, which makes them superior to all other creatures. These qualities must be developed and nurtured through education to help people achieve higher levels. The rich legacy of Indian culture and tradition and its ancient education system promote spirituality and moulded great thinkers, philosophers, and spiritual leaders. The qualities like compassion, respect, sense of truthfulness, caring, etc., have been a part of the Indian way of life. However, there is no place for spirituality in modern India, but human values are essential for a happy and peaceful life. Therefore, human values should be brought back to the Indian education system without attaching them to any religion. Children from a young age must learn about the interdependence between human beings.

3. **Promotes efficiency**: When the mind is concentrated, efficiency is bound to happen. In order to manage our own life at home and outside the home and in the professional field, higher values are necessary, so that our reaction to the outside world and our judgment of the situation that is around us is changed, which lead us not only to face challenges but also it provides us extra mental energy that can be used for future planning. Ethical values are the intelligent ways of reviving man's exhausted energies to live. These healthy values help the individual unshackle his psychological personality from its self-made entanglements.

4. **Co-ordinal Relation between the teacher and the student**: According to Indian tradition, the 'teacher' is the 'guru' who imparts knowledge. The teacher must be knowledgeable, and otherwise, he is not entitled to teach. Like, a blind man cannot lead another blind man. Academic qualification is not only the criterion of a teacher. He should possess moral excellence in addition to his knowledge on respective domain. He should not teach high moral principles, but he must live them. A teacher is an example of what is best in man. Knowledge is useless if it does not make a man perfect- perfect not merely in skill and abilities but also in character. Apart from imparting knowledge, the teacher must also train his student's body and mind and train his faculties to use them to their best advantage. A healthy and controlled mind is man's best friend and guide. A teacher can give his student a sense of direction, that is, tell him what to learn and how to learn and how to apply that knowledge for his own good and the good of his community. The relationship between the teacher and the student is like the gardener and the flowers. The gardener does not create the flowers on the bush, and the flowers come from the bush. The gardener can only tend its root, water it, protect it, and see that it has appropriate sunlight and shade. Similarly, the teacher's job is to nurture the student with the proper thought. The student must be given a conducive and protective environment where he or she need not overstrain to live. However, the real fragrance and beauty of the personality must come from within.

5. **Value Education promotes personality development and social cohesion**: Education is a personality-building process. It is always a link with society. It has personal and social dimensions, like two sides of the same coin; these are not separable. According to Gandhi, real Education does not consist of packing the brain with information, facts, and figures or passing the examinations by reading the prescribed number of books, but by developing the exemplary character. At present, our education system is primarily involved in preparing the younger generation for developing their cognitive domain. Today, we educate heads and hands but not the hearts. Education must lead to the internalization of the obligation of each human being to be value-conscious in words, thoughts, and deeds. Lack of value education has been an important factor in the global scenario of growing violence, terrorism, pollution, and ecological imbalances. The Education Commission (1964-66), National Policy on Education (1986) emphasized the importance of value-oriented Education. National Education Policy 2020 also gave more importance to value education and stressed that it must be an integral part of the entire education process.

6. **An integral 'vision' for National Regeneration:** Value Education makes the young generation more powerful. They contribute significantly to the national reconstruction and national development 'A Man without a dream and a nation without a vision perish'. We need a grand vision to build a great nation. In the context of the multi-religious social structure in India, the vision has to be inclusive. It must be deeply rooted in the truth, goodness, and beauty of our ancient culture and tradition, and at the same time, it must also be in harmony with the scientific developments of the era. Our constitution has been able to capture and embody this spirit of unity and harmony of culture and religions and the scientific temperament of the modern world. Bharatiya Dharma Rajya is the vision of an India of love, unity, and peace built on the integral concept of Dharma and Bharatiya Dharma as embodied in the preamble and Article 51(A) of the Indian Constitution. This vision of an awakened India of political stability, social harmony, and economic prosperity built on an integral vision of life and reality. It is the vision of our nation where all religions and cultures will be respected for their unique insights into truth and their valuable contributions towards human welfare. This is the vision of the great India of the millennium that will be a land and light of Dharma in humanity's quest for a culture of life, unity, and peace of life. Peace and value education for schools/ colleges should present and promote this noble vision of inter-religious spirit in our institutions of learning and among our youth to lead to the much-needed national regeneration of India.

7. **Value Education will build character:** The Government of this country is striving to bring about universal education. In this context, it will be useful to consider the purpose of education. Education should foster character, help the acquisition of good qualities. Right Education should make us know that God is the truth. Knowledge must fill one with good qualities through which one alone can realize the truth that is God. Therefore, the goal of knowledge should be to understand the ultimate truth. The first fruit of

Education must be humanity and self-control. Education is useless if it is unable to produce these qualities. It is unfortunate to note the modern Education in our school and colleges; indiscipline is rampant nowadays. All these developments give rise to the question of whether this kind of Education is desirable or valuable. Such Education is the cause of stress among the students.

8. **Study of the life of Great Men:** We must train our people from an early age to study the lives of great men who lead an unattached life, free from debasing passions like lust, anger, greed, fear, and following their example develop faith in God. This will help them grow into dutiful and honest citizens, disciplined to lead a moral and ethical life. The inculcation of moral and spiritual values in the minds of the people from the early years is most desirable that provision should be made to teach moral and spiritual values in educational institutions.

9. **Core Values-based Education promotes ideal humanity**: The Parliamentary Standing Committee on Human Resource Development (1999) has highlighted that truth, righteous conduct, peace, love, and non-violence as the core universal values, which needs to be identified as the foundation on which value-based education programme can be built up. All the world religions have also emphasized that non-violence, tolerance, and peace are the fundamental elements of humanity. The great scholars and thinkers have seen education as a process leading ultimately to spiritual development. In the context of peace, UNESCO refers not only to general Education acquiring cognitive capital but also the ability to live together.

10. **Growth in Spiritual Status**: The screaming cry of all evolution is to grow, and growth in the biological apparatus was the command in the lower stage of evolution. After having attained manhood, the demand is to grow our moral stature in our spiritual capacity and our cultural dignity. This is where the study of scriptures, regular and continuous sadhana, consent and sincerity, come to serve us. The goal and the way-the sadhana (concentration) yields to us the energy and vitality to walk the path and explode into the goal.

11. **External and Internal Environment must act in harmony**: The tremendous development of science and technology in the last years witnessed only in the external environment. The study of the nature and potentialities of the human mind is of more recent origin as compared to physical science. It is true that with the help of scientific equipment, scientists can explore and discover the exterior world. Nevertheless, the nature of the mind, its constant tendency to flow outward, prevents it from getting an insight into many other aspects of the mind, which can be achieved only by the practice of meditation. The progress is to take place in two fields. It relates to two faces of nature; one is the physical nature, the nature of the external world. The other is the inner nature of the man. The one is related to the world that we see, and the other is related to the inner- self of the man with whose help he is able to see the world outside and investigate. If a man is able to increase his power to free himself from the hold of his surrounding world or environment, if he increases his freedom, if he gains control over nature, we may say that the change we call development leads to progress.

12. **Value of devotion and dedication**: Out of the innumerable techniques prescribed by scholars for self-development, the most popular ones are the path of selfless, dedicated service, the path of discriminative knowledge, and the mystic path of self-development through disciplined contemplation. According to Sage Narada, true devotion to the lord is superior and nobler to all these because devotion is the final outcome of all other methods of self-development. The supreme devotion is indeed, as a technique, even superior to the path of actions, knowledge, and disciplined contemplation.

```
┌─────────────────────────────────┐
│         Value Education         │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│  Promotion  of value essential for │
│            quality life          │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│  Promotion of peace at individual │
│        and collective level      │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│        Mind free of desires      │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│ Stress free life leading to harmony │
└─────────────────────────────────┘
```
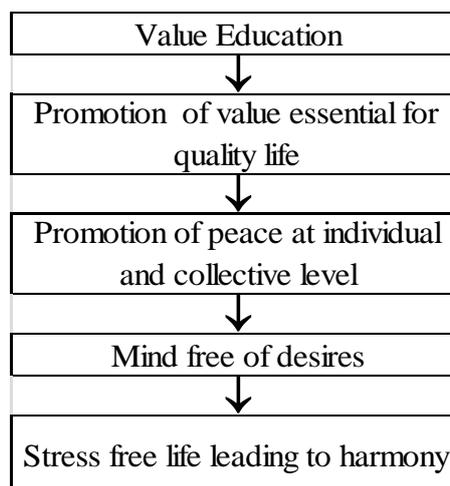
**CONCLUSION:**

After independence in 1947, the worst days of serious threat to Indian society were over. Under foreign domination and due to the influence of western culture, the moral, ethical, and spiritual values were degrading. The remarkable phenomenon taking place after independence is that we are returning to those things that have lent stability and strength to our culture over the centuries. This is because NCERT, UGC, and other organizations initiated several educational programmes. Keeping all the way from nursery to post-graduate level is bringing the valuable components of our culture into proper focus. The NEP 2020 has made value-based Education an integral part of the national education system. The Ministry of Education had set up National Resource Centers for Value Education (NRCVE) of NGOs from different religious faith, including IIT, IIM, and some well-known reputed NGOs. These NGOs can help schools set up action plans, workshops, study materials, etc. In addition to these, NCERT, UNESCO, IGNOU has developed books, guidance, and other means for value-based education. The primary aim of these programmes is to provide a theoretical and conceptual base in the national educational curriculum.

Further, it also seeks to transform the quality of life through the inculcation of human values of peace, love, truth, spirituality, right conduct, and above all, national character, which in fact represent the highest part of our national culture. In the backdrop of phenomenal developments on the educational front, reorientation of values in post-modernist Education assumes special significance. The following are some of the areas which need special importance for human happiness:

a. Education must promote a rational outlook on life and scientific approaches for confronting real-life situations.

b. A fundamental course on freedom and human right within degree curriculum.

c. Power of Education for constructive human purpose.

d. Education must generate sensitivity to environmental issues.

e. Humanism should be the central concern of Education.

f. Education must develop an effective mechanism to fight against evils.

What is now needed is a practical and pragmatic action plan for developing a curriculum that can inculcate three things in students' minds.

a. Firstly, humanity shares one basic impulse towards progress, and by sharing this impulse, humanity can be seen as one vast surge which aims at continuous self- exceeding.

b. Adopt law of unity that allows and respects cultural diversity, and

c. The future development of humankind is attached to the progress of science and art of living together, which has given rise to accepting the low of mutuality rather than conflict and low of varied expression rather than any uniform monotone.

Education is the most potent instrument to prepare a mind which can promote democratic and universal human values and mutual respect.

**REFERENCES**

1. Dhannavel, P. (May 1, 2000). Importance of Value Based Teachers. *University News*. Pp. 2.

2. Dhokalia, R. (2001). External Human Values and World Religions. *NCERT- New Delhi*. Pp. 10-13.

3. Gautamananda, S. (1998). Values in our Education. *Values: The key to a Meaningful Life*. Ramakrishna Math, Madras, India. Pp. 83-85.

4. H.H. The Dalai Lama. (January, 2002). Education for Peace. *Journal of Value Education*. 2 (1). Pp. 1.

5. Khandai, H.K. (2003). Value Oriented Approach from Primary to University Education. *University News*. Pp. 9-10.

6. Kunal, G. (2000). How to inculcate Value Education through Teacher Education. *Journal of Value Education*. Pp. 118-119.

7. Nataranjan, R. (July 21, 2001). *University News*. Pp. 16.

8. National Education Policy (1986, 2020).

9.  Purananda, S. (2002). Making Life Valuable by Imbiding Values. *Journal of Value Education.* 2 (1). Pp. 30-31.

10. Rajiv, R.S. (December, 2001). Human values in University Management. *Value Education in India*. New Delhi. Pp. 86-87.

11. Rao, N., & Das, R.P. (2002). Bringing Values Back: The Role of Teachers in Higher Education. *Journal of Value Education*. 2 (1). Pp. 89.

12. Sachidananda, S. (January, 2002). Vision and Values for National Regeneration. *Journal of Value Education*. 2 (1). Pp. 70-71.

13. Shetty, A. (Oct 13, 1997). Value Education: Need of the present generation. *University News*. 12.

14. Shetty, A., & Pushpanadham , K. (Dec 29, 1997). Valuing Values. *University News*. Pp. 7-8.

15. Sir Aurobindo. (1976). The Synthesis of Yoga. Sixth Edition. Sir Aurobindo Ashram. Pondicherry. Pp. 2.

16. Swami Jagadatmananda. (2000). Learn to Live. Ramakrishna Math. Chennai, India. 2. Pp. 154- 157.

17. Venkataiah, H. (June 22, 1998). Value Education- Curriculum for Graduates and Post- Graduates. *University News*.

## THE ROLE OF MATHEMATICS AND STATISTICS IN BUSINESS

**Dr. Manohar Baburao Bhagirath**

Assistant Professor, Department of Mathematics, Annasaheb Vartak College of Arts, Commerce and Science, Vasai West, Dist. Palghar, Maharashtra, India

### ABSTRACT

*It is important to understand the basics of business to keep profitable efforts and accurate records. In business, various terms such as management mathematics, statistics, operations research, analytical techniques, basic mathematics and management sciences are used for business decisions. Mathematics and statistics is the soul of any business. There is no doubt that business mathematical concepts play an important role in planning your financial life and achieving it. This paper explains the role of mathematics and statistics in business. The main purpose of this paper is to underline the nature of mathematics and statistics in business.*

*Keywords and phrases: Business Mathematics, operation research, statistical analysis.*

### INTRODUCTION:

Mathematics and statistics play a vital role in making progress in all areas of business today, not only that, but our lives are also going through a lot of development in various fields. Business Math and stats always deals with profit or loss. Mathematics and statistics are used in commerce, industry, economics and almost every other field, so the use of mathematics and statistics is very wide. Mathematics and statistics play an important role in solving most of the complex problems that arise in business as well as in statistical analysis. Business and commerce seem helpless without Mathematics and Statistics. Explaining the interrelationships between business and mathematics and statistics, this paper seeks to find out what problems are faced and how to find alternatives.

### Research Hypotheses and Methodology:

The research hypothesis is a temporary solution to the problem being investigated. A research hypothesis is a precise and clear. In this paper, I have adopted both descriptive and exploratory methods. The methodology of this research paper is based on a theoretical framework and is intended to achieve research objectives.

### Why Mathematics and Statistics in Business:

Answers to how business works, how data can be used more efficiently, and which business practices can be adapted can help you use mathematics and statistics to make your business more successful. It is easy for the decision maker to take immediate and perfect necessary action. Mathematics and statistics help to make sound business decisions and are able to adapt to economic growth.

### Objectives and Importance of Mathematics and Statistics in Business:

The following points are presented to clarify the objectives and importance of the Role of Mathematics and Statistics in Business.

- Most of the businesses have to pay income tax to the government based on the total profit of the company. Using the statistical method, the company will pay income tax and pay the salaries of the employees working in their company.

- Proper use of arithmetic in buying and selling transactions in a business as well as avoiding fraud in analyzing business investment debt.

- Establishing a causal relationship between business sales and demand.

- The role of statistics in the business involves a random sampling process to collect samples.

- A successful professional needs to be quick and accurate in all situations and make the right decision according to the situation. Statistics help the trader to plan the product according to the customer's preference and the quality of the products can be checked more efficiently using the statistical method.

- Correlation is related to the use of this useful statistical method in business as well as the most common useful statistical tools for comparing the effects and performance of these variables.

- Time series analysis is used to determine a good model that can be used to predict business metrics such as stock market price, sales, turnover and more.

- Calculus is a branch of mathematics and plays an important role in management and business decision making.

- Professional organizations use mathematics in financial analysis, sales forecasting, accounting, etc.

- Business management can be made more effective in some cases by using more advanced mathematics.

- Establish a causal relationship between business sales and demand.

- Profit is determined by deducting total revenue from total expenses. This helps in analyzing business revenue and financial health.

- Statisticians have developed many tools for application and can be used to improve their business.

**Characteristics and challenges of Mathematics and Statistics in Business:**
There is no doubt that business is important for the entrepreneurship and economic development of any nation. We lack new entrepreneurial skills and a sense of self-sufficiency contributes to the current unemployment rate. Starting and running a business is no small task, so when you use mathematics and statistics as a modern business planning technique in business, you can grow your business by focusing on the key issues like doing business properly, playing capital, maximizing profits, etc. Small business opportunities are decumbent to events and changes quickly affect businesses.
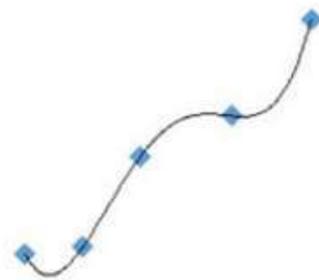


**Figure shows business profit and loss analysis.**

Here are some key features of Mathematics and Statistics in Business:

- It was easy to reconcile the fact.

- It must be expressed numerically.

- Its calculations and predictions are accurately achieved.

- Statistics are regularly used in business to improve and measure business performance.

- Estimates are used to draw conclusions, interpret data, or make decisions with the help of mathematics and statistics.

- While helping statisticians plan products according to customer preferences, product quality can also be more efficiently checked using mathematical and statistical methods.

- Mathematical formulas help a business to do financial analysis.

- Statistics and mathematics are very useful for making various decisions related to production, finance, materials and marketing in the industry.

- Learn the use of determinants and metrics when calculating the price of a particular product.

- Mathematical and statistical models are used for quantitative analysis of drug and patient interactions.

- Learn how to use financial math when making financial decisions.

**Limitations of Mathematics and Statistics in Business:**
Everything has its limits. While there are advantages to the business due to statistics and mathematics, there are some limitations, some of which are as follows:

- The statistics are highly quantitative but not enough data can have an impact on the business.

- The results are only true on average which can have an adverse effect on the business.

**According to W. L. King**

"Statistics largely deals with averages and these averages may be made up of individual items radically different from each other." —W.L King.

- Since there are many methods to study problems, there is confusion about which method to use.

**According to Croxten and Cowden**

"It must not be assumed that the statistics is the only method to use in research, neither should this method of considered the best attack for the problem." — Croxten and Cowden.

- Mathematical descriptions may be incomplete and may affect business.

- There are some phenomena or concepts where statistics and mathematics cannot be used so they are of no use in business.

- If the quality of the products becomes difficult to maintain and improve, it also affects the business.

**Analysis and Findings:**

The final step in the research process is the analysis of the findings. Business analysis is about identifying business needs and solving business problems. To solve business problems; we should use mathematical analysis which is easy for everyone to understand. Business mathematics is useful for keeping abreast of the day-to-day operations of a large organization. Mathematics and statistics can be used in business and it helps you to run your business in a systematic and easy way. Mathematics and statistics helps man to interpret his ideas and conclusions accurately. Mathematics and statistics play an important and unique role in human society as well as in business and represent a strategic key in the development of the whole human race.

**CONCLUSION:**

In this paper, I have described a number of issues related to the implementation of mathematical and statistical methods in business and industry. The importance of knowledge of mathematics and statistics became clear to all business. This study examines the relation between business and mathematics, statistics. The use of mathematics and statistics is the key to business sustainability and success. Business management systems are able to be more effective in some cases using more advanced calculations.

**REFERENCES :**

1. Bovas Abraham1, Implementation of Statistics in Business and Industry, Revista Colombiana de Estadística Volumen 30 No. 1. (2007) pp. 1-11.

2. Christopher Chukwudi Orga & Ann I. Ogbo, Application of Probability Theory in Small Business Management in Nigeria, European Journal of Business and Management www.iiste.org ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online) Vol 4, No.12, (2012) 72-83.

3. Ms. Radha K. and Sri. BALAJI G., Role of Statistics on Business Research, International Journal of Engineering Research and Technology (IJERT) ISSN: 2278-0181 Vol. 2 Issue 10, (2013) 3386-3394.

4. Satinder Pal Kaur, Role of Mathematics in Business and Commerce – A Study, (ICRTESM-17), ISBN: 978-93-86171-21-4, (2017), 726-729.

5. Sebastian O Uremadu and Charity E Duru-Uremadu, Agricultural Research and Technology, Open Access Journal ISSN: 2471.6774, (2017 ) 125-130

6. Tularam (2013) "Mathematics in Finance and Economics: Importance of Teaching Higher Order Mathematical Thinking Skills in Finance", e-Journal of Business Education and Scholarship of Teaching, 7[1]: 43-73

## THE USE OF REMDESIVIR LEADING TO EMERGENCY USE FOR THE TREATMENT OF COVID-19

**J. Priyadharshini, Ragavi C, Ivo Romauld S and P. Vivek***

Department of Bio-Engineering, Vels Institute of Science Technology and Advanced Studies, Tamilnadu, Chennai

**ABSTRACT**

*The novel Coronavirus infection initially found at the end of the year 2019 has been attracted great attention among the people. So far, the cases has been spreading like a fire across the world and the outbreak has been defined as a pandemic situation, but still now there are some specific drugs to control the spread of corona virus among people. The first medical experience of the patients had led the remdesivir to be specific drug. It is RNA- dependent viral RNA polymerase inhibitor that are used to treat variety of RNA virus infection. Remdesivir is a broad-spectrum antiviral drug which is being tested as a potential treatment for COVID-19. The current evidence about the effects of remdesivir against coronavirus is primarily based on in-vitro and in-vivo studies. Its unique structural features allows higher concentration of tri-phosphate to deliver intercellularly to inhibit viral RNA in humans and zoonotic beta-coronavirus which includes SARS-COV-2. In this review, we provide an overview of coronavirus outbreaks and then summarize the effects and use of remdesivir for the treatment of COVID-19.*

*KEYWORDS: Remdesivir, COVID-19, Antiviral drug, SARS-COV-2.*

## INTRODUCTION:

Coronavirus are large, enveloped, positive RNA strand viruses. In recent research, human coronavirus receives more attention as they were considered as low-virulence organisms [1]. The World Health Organisation (WHO) named this as novel coronavirus disease and there have been confirmed cases around 189 countries (or) territories outside China including Japan, US and so on [2]. Due to newly emerged virus, researchers have taken quick actions to isolate the virus and performs gene sequencing which makes to identify treatments possible [6]. The first coronavirus outbreak, SARS, caused by SARS-CoV occurred in Guangdong province of China in 2002-2003. The mortality rate during this outbreak is of 9% rate with a higher mortality rate of 50% in elderly population. The next coronavirus outbreak occurred in Middle East (ie) Saudi Arabia in 2002 that was named as MERS-CoV [1]. COVID-19 is caused by novel beta-coronavirus, a type of Ribo Nucleic Acid (RNA) virus that belongs to SARS virus. It is then therefore been designated as SARS coronavirus-2 by International Committee of Taxonomy of Viruses. SARS-CoV-2 shares 79% of homology sequence with SARS-CoV-2 and more with Middle East Respiratory Syndrome coronavirus (MRES-CoV) [30]. Since the outbreak were reported in Dec 2019, infection with severe SARS-CoV-2 has become a world wide pandemic. Older patients and those with suffering from pre-existing respiratory (or) other disease appearing to be at greatest risk for severe complications [3]. The clinical features of COVID-19 are different and are ranging from asymptomatic state to acute respiratory syndrome. The common symptoms include fever, cold, sore throat, headache and so on [2]. When the researchers set their sights on broad-spectrum antiviral drug, they found that the remdesivir has demonstrated strength in trials related to MERS-CoV [6].

## STRUCTURE AND MECHANISM OF COVID-19:

i. *Structure of COVID-19:-*

SARS-CoV-2 is an enveloped, single and RNA stranded virus with a diameter of about 60-140nm. The particles are round (or) oval in shape. In general, COVID-19 is an acute disease and the most common symptom include fever, dry cough and fatigue and partly with the symptoms of nausea, diarrhoea and so on [6]. This disease appears to be a spectrum of clinical trials ranging from asymptomatic to severe respiratory failure [10].



FIGURE:1- 3D structure of COVID-19
SOURCE: download from pdb



FIGURE:2- spike structure of COVID-19.
SOURCE: journal of biomolecular structure and dynamics
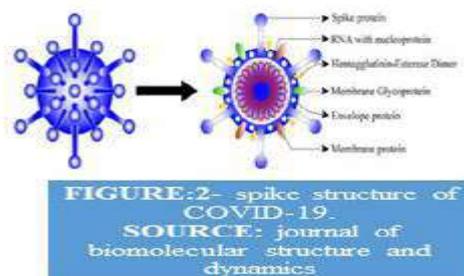
Coronavirus consist of 4 proteins: the nucleocapsid protein (N) which forms the helical capsid to bind with its genome. The structure is further surrounded by a lipid envelope that is made of spike (S), envelope (E) and membrane (M) proteins [35]. It is a contagious viral infection which can spread through inhalation (or) ingestion of viral droplets [37].

*ii.    Mechanism of COVID-19:*

The mechanism of viral entry and replication is shown in (figure:3). The spike protein attaches to Angiotensin-Complex Enzyme-2 receptors that is found to be on the surface of human cells. The searching for antibodies can find support on molecular targeting which utilizes the structural information of the binding region. The human cell ingests the virus in a process known as endocytosis [37]. Through endocytosis, the spike protein is processed by Cathepsin L and Cathepsin B lysosomal proteases [35]. A different two-step mechanism has been suggested and in this case, the virion binds to the receptor on target host cell through S1 subunit and then it is cleaved by host protease. Then, the fusion at low pH between viral and host target membrane via S2 subunit occurs. Finally, the viral genetic material is released fully into cytoplasm. There takes place Replication Transcription Complex (RTC) followed by translation [37]. The viral entry of the host cell can occur via endocytic pathway and non-endosomal pathway [35]. Finally, the virions are exported from infected cells by transportation of cell membranes in smooth wall vesicles and then secreted through a process called exocytosis. Eventually, the cell death may occur by the stress of viral production on Endoplasmic Reticulum. Still now, the mechanism of action of COVID-19 is unknown [37].
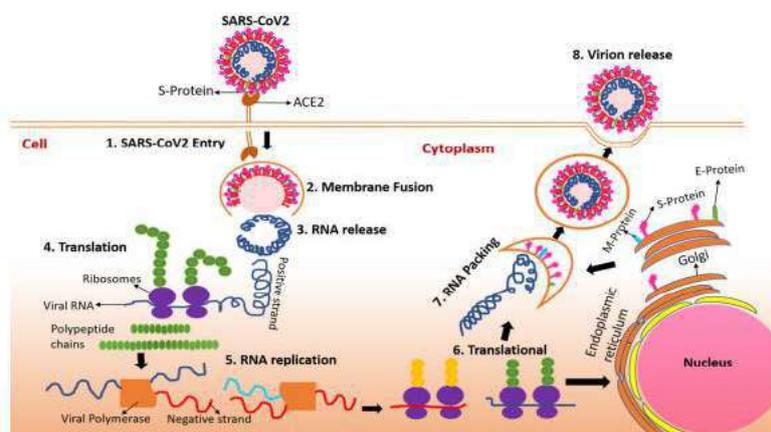


**FIGURE:3** - Mechanism and transmission of COVID-19

## REMDESIVIR:

Remdesivir (GS-5784) is the first drug that has been approved by US FDA (Food and Drug Administration) for clinical use in patients with illness of COVID-19 [32]. It is a nucleoside analog drug with anti-viral activity. As an RNA-dependent RNA polymerase inhibitor, it inhibits the replication of coronavirus in epithelial cells [6]. Remdesivir has the property of both therapeutic and prophylactic activity against non-human primates in vivo model [10]. Remdesivir has a molecular weight of 602.6 g/mol with water solubility. It is administered through IV at a dose of 200mg followed by 100 mg daily for 5-10 days in adults [20]. The randomized placebo-controlled trial of remdesivir among the patient who suffered with COVID-19 was conducted in Wuhan, China couldn't able to complete the assess efficacy. However, in large randomized double-blind clinical trials,the patients with severe suffer were treated with 10-day course of remdesivir which had a significant shorter time to recover from COVID-19 [11]. Several clinical trials were made on the use of remdesivir for COVID-19 patients. The purpose of this clinical trials are to evaluate the efficacy and safety of dosage of remdesivir in adults [12].
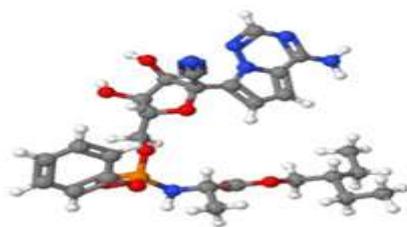


**FIGURE:4** – 3D structure of remdesivir
SOURCE: download form pdb
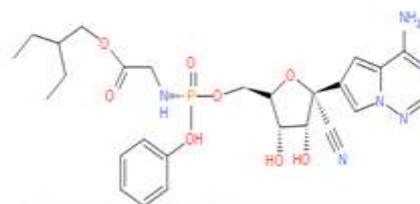
**FIGURE:5** – chemical structure of remdesivir
SOURCE: from kingdraw

## MECHANISM OF REMDESIVIR:

Remdesivir is an RNA dependent RNA polymerase (RdRp) inhibitor which can achieve anti-viral effects by inhibiting viral nucleic acid [12]. The RdRp is a protein complex CoVs which is used to replicate their RNA-based genomes [15]. After the virus invades the host cell the viral RNA is directly used as a template and the protein synthesis system is used for translation of RdRp [13]. RdRp is an effective target for anti-viral drug targeting coronavirus and are nucleoside analogues [13]. The host metabolizes the remdesivir activates into active Nucleoside Tri Phosphate (NTP) and the metabolite competes with ATP (ie) Adenosine Tri Phosphate for incorporation into RNA strand [15]. This process is called as "chain termination" and it occurs at a position i+5. Through this process, the viral replication is suppressed [13]. . Although CoVs have a proof-reading process which can able to detect and can remove other nucleoside analogs, rendering them resistant to many of these drugs and remdesivir seems to outpace this viral proof-reading activity and thus maintaining antiviral activity [15].

The mechanism of action of remdesivir in host cell is shown in figure-6. The blue arrows and numbers represent the viral infection steps: (1) attachment of the coronavirus particle to its specific receptor ACE2 and uncoating of virus after adsorption into host cells; (2) establishing replication organelles at the endoplasmic reticulum, where both genome replication and gene expressions occur; (3) early translation of the incoming viral genome, which results in generating the RdRP; and (4) viral RNA replication. The purple wireframe and arrows represents the intracellular triphosphorylation of remdesivir and the competitive binding of NTP and ATP to RdRP to terminate the viral RNA replication [13]. Figure-7 represents that the Remdesivir is a prodrug that metabolized to remdesivir triphosphate, which acts as an analog of ATP, competing for incorporation by RDRP and interfering with viral RNA replication [20].
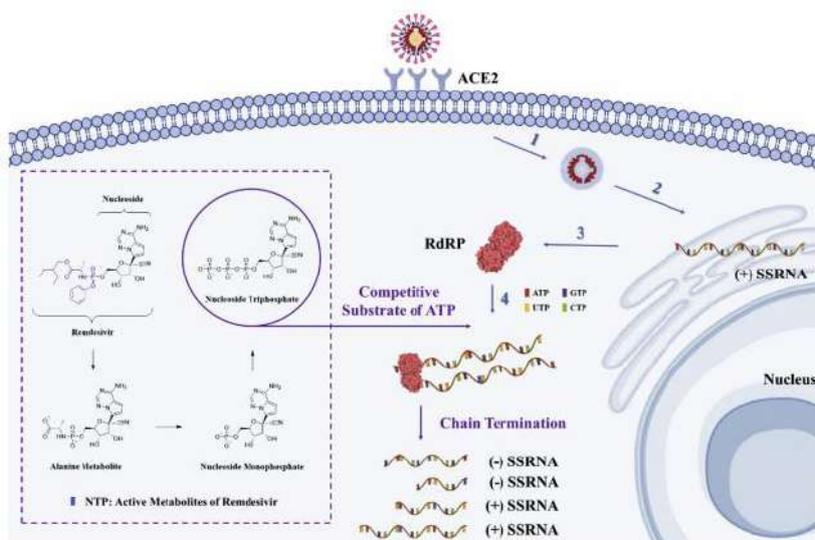


**FIGURE:6-** Mechanism of action remdesivir in host cell.

**SOURCE:** European Journal of Medicinal Chemistry
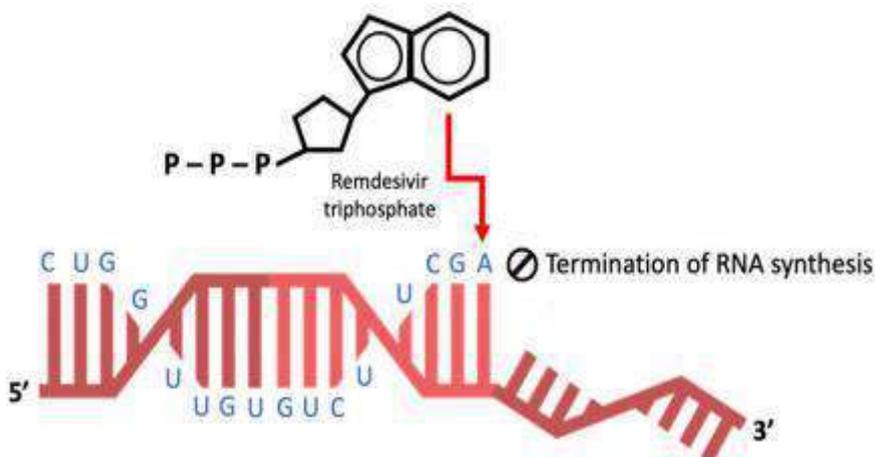


**FIGURE:7-** Action of remdesivir at chain termination process

## SUMMARY STUDIES ON REMDESIVIR:

### i. In vivo studies:

In 2016, an in-vivo study was conducted against Ebola-infected rhesus monkeys and in which various doses of remdesivir in-transmuscular injections were injected [26]. Using this models of MERS-CoV pathogenesis, prophylactic and therapeutic administration of remdesivir shows favourable results in which reducing respiratory tract viral titers and pulmonary pathology [15]. In addition to which, remdesivir inhibited MERS-CoV replication in the organs of rhesus monkeys which leads to a reduction in lung lesions [26]. Remdesivir also shown to exert antiviral activity against coronavirus [15]. Although, remdesivir-treated animals didn't showed any signs of pulmonary disease [26].

### ii. In-vitro studies:

The majority of in-vitro studies have reported positive results on the anti-coronavirus activity of remdesivir [15]. In 2016, a study showed that the remdesivir is an effective inhibitor for the Ebola virus [26]. The typical outcome measured in such studies includes the amount of viral RNA in the culture. In recent studies of SARS-CoV and MERS-CoV in human respiratory epithelial cell culture, it demonstrated anti-viral activity with relative consistency [15]. The RdRp sequences of SARS-CoV-2 and SARS-CoV displays the 80% of similarity. Therefore, it is suggested to be the potential exert anti-viral activities against SARS-CoV. These initial studies suggest that the remdesivir which inhibit the replication of SARS-CoV-2 which has the capable of using in the treatment of COVID-19 [26].

### iii. Microbiological studies:

Remdesivir has demonstrated broad-spectrum activity against zoonotic and clinical human coronavirus in multiple in-vitro systems. Emerging data suggest that the remdesivir also exhibits potent activity against SARS-CoV-2. Researchers evaluated the impact of remdesivir and six other compounds on SARS-CoV-2 viral titres and their infection rates recently. The clinical outcomes may depend on 90% higher inhibition but the values are reported to a minority of studies. It is measured that the values reported is achieved with the dosing region under evaluation [27].

## REMDEISIVR-AN ANTIVIRAL DRUG:

In order to find suitable anti-viral drug against RNA viruses, approximately 1000 modified nucleoside prodrugs was compiled. Out of these, results shows that GS-5734, a prodrug form of GS-441.524, later named as remdesivir were considered to be highly potent antivirals [38]. Since, it is an adenosine analogue with broad-spectrum of antiviral activity against RNA virus, it shows the inhibition of viral replication in both MERS-CoV and SARS-CoV [30]. In 2016, the first clinical experience using remdesivir against Ebola virus in humans were reported. The patient was successfully treated by remdesivir for 2 weeks and analyse that any serious adverse event was not observed [38]. A dose-dependent reduction for both SARS-CoV and MERS-CoV were demonstrated in which is consistent with titre reduction [30]. In 2017, it was shown that the remdesivir could prevent the replication of SARS and MERS CoV which had been effective against circulating human coronavirus in-vitro. In mice, early therapeutic administration of remdesivir has decreased the pulmonary viral loads in which it improves the clinical symptoms of the disease and lung function [38]. These findings are consistent with studies related to non-human primates [30]. Recent evidence showed that the remdesivir and interferon-beta have superior and anti-viral activity compared to lopinavir and ritonavir against MERS-CoV [38]. The respiratory rate of animals treated prophylactically with remdesivir might improve the disease outcomes in COVID-infected patients. It is also useful in the protection of health care workers in regions and inhibit future COVID epidemics [38].

## EFFICACY OF REMDESIVIR:

The compassionate use of remdesivir in patients with COVID-19 has been reported in some of the cases over the last couple of months [5]. Knowledge about the potential efficacy of remdesivir against COVID-19 is restricted in in-vitro studies. However, information related to COVID-19 is growing higher and higher [38]. The first high-profile single case report form a 35 year old male infected with COVID-19 was treated with intravenous (IV) remdesivir after the development of pneumonia in USA [38,5]. This patient received the first dose of remdesivir was administered for continuous 7 days and the patient's condition was rapidly improved on 8th day and no adverse effect of administration of remdesivir was reported [38,5]. In the first double-blind, placebo-controlled multicentre trial, half of the patients receives remdesivir and remaining patients are under placebo groups. The patients who receives remdesivir had a shorter recovery time when compared to those who receives placebo [5].

Another set of double-blind, randomized, placebo-controlled trial on intravenous (IV) remdesivir in patients with COVID-19 were conducted. The patients were randomly divided and receives remdesivir for up to 10 days.

The time of recovery in the patients who receives remdesivir was shorter than that of placebo groups [38]. There are some slight differences across the trials; first, ACTT-1 (Adaptive Coronavirus Treatment Trial) was larger and therefore powered to find smaller differences. However, ACTT-1 recruited patients who requires oxygen (or) ventilation and patients who need not oxygen has been observed. The ACTT-1 reported that the patients requires only low-flow supplementary oxygen and perhaps breathing air. Moreover, it is possible that the anti-viral is more efficacious if started soon [9]. These are the current efficacy studies with remdesivir as of now [5].

## CLINICAL STUDIES AND TRIALS ON REMDESIVIR:

Remdesivir was first treated for Ebola virus an an investigational drug [30]. In a recent study, investigators have used this remdesivir as a compassionate use for patients hospitalized for COVID-19. Several clinical trials of intravenous (IV) remdesivir are ongoing to treat COVID-19 [14]. The patients were assessed by physical examination of respiratory status and under concomitant medications. The trial days (ie 1,3,5,8,10 and 14, the patient's blood sample were collected for blood count [33]. The primary outcome of the trial in patients was assessed in each category of seven-point scale which is showed below in table-1 [15]. A double-blinded, placebo-controlled trial patients are divided into placebo and remdesivir groups randomly to assist the efficacy in patients. The patients receives the dose of remdesivir for continuous 10-days. The outcome of the trial is the "time of recovery" [38]. The time of clinical improvement for 50%of patients was 10 days in 5-day treatment groups and 11 days in 10-day treatment groups. More than 50% of patients was discharged by day 14. The overall mortality rate of day 14 was 7% across both the treatment groups. No side effects were detected by the use of remdesivir across both treatment groups [14].

**TABLE:1-** seven-point category scale

**SOURCE:** science direct/elsevier

| Severity rating | Category description |
|---|---|
| 1 | Death |
| 2 | Hospitalized, on invasive mechanical ventilation (or) extracorporeal membrane oxygenation |
| 3 | Hospitalized, on non-invasive ventilation or high-flow of oxygen devices |
| 4 | Hospitalized, requiring supplemental of oxygen |
| 5 | Hospitalized, not requiring supplemental of oxygen |
| 6 | Not hospitalized and requires limitation on activities |
| 7 | Not hospitalized and requires no limitations on activities |

## FUTURE PERSPECTIVES:

Initial findings of different clinical trials are very much important for the development of efficient treatment against COVID-19. Results showed that remdesivir had moderate clinical efficacy against COVID-19 [38]. All the patients are experiencing good prognosis and were declared cured or improving. The majority of patients with severe coronavirus symptoms treated with remdesivir shows clinical improvement in a compassionate use trial. Recently, due to the public health emergency, the FDA has granted an Emergency Use Authorization (EUA) for the use of investigational anti-viral remdesivir for the treatment of hospitalized patients with COVID-19 in the United States [13]. For the patients requiring only oxygen, administration of dexamethasone decreases the mortality rate by about one-fifth of the patients. Evaluating the efficacy of remdesivir along with dexamethasone in patients on ventilators with COVID-19 may be an interesting one [38]. Researchers provides a comprehensive summary of the available information related to the development and clinical trials of remdesivir [13].

## CONCLUSION:

Remdesivir is a nucleotide analog prodrug which inhibits the SARS-CoV-2 RdRp [26]. As the COVID-19 pandemic races across the globe, the scientific community, from academic and government laboratories to small biotechnology companies and MNC pharmaceutical corporations, has mobilized for the development of potential therapeutics and vaccines [10]. While previous studies on remdesivir are promising and formal clinical evaluation is strongly warranted. Nonetheless, there are hundreds of clinical trials are ongoing internationally on different drugs that utilize various mechanisms of action which includes trials on other nucleosides inhibitors (e.g., ribavirin), protease inhibitors (e.g., lopinavir/ritonavir), and interleukin-6 receptor inhibitors (e.g., sarilumab) . Another well-known candidate which is being evaluated in multiple trials against COVID-19 is chloroquine (or hydroxychloroquine), which is already approved as an antimalarial and for extraintestinal amebiasis [15]. The increasing number of recovered patients and the higher ratio of recoveries seems to be in favour of the above-described approach of experimental therapies [21]. In vitro and in vivo studies shows the

efficacy of remdesivir against coronaviruses. Moreover, in the current pandemic situation, some evidences indicates that the compassionate use of remdesivir may cause some clinical improvement in patients with COVID-19 [38]. Thus, the studies showed that the intravenous doses of Remdesivir were adequately tolerated in patients and this medication was not utilized in patients seriously infected by COVID-19, necessitating control clinical trials. Because of this, more scientific information is needed to reach conclusions about Remdesivir, its benefits, and in what situations it should be used [2].

## REFERENCE:

1. Pardo J, Shukla AM, Chamarthi G, Gupte A. The journey of remdesivir: from Ebola to COVID-19. Drugs in context. 2020;9.

2. Azevedo TC, Azevedo PC, Silveira Filho RN, Carvalho AR, Cezarotti Filho ML, Barbosa FT, Sousa-Rodrigues CF, Matos-Rocha TJ, Ramos FW. Use of remdesivir for patients with Covid-19: a review article. Revista da Associação Médica Brasileira. 2020 Jun;66(6):838-41.

3. Grein J, Ohmagari N, Shin D, Diaz G, Asperges E, Castagna A, Feldt T, Green G, Green ML, Lescure FX, Nicastri E. Compassionate use of remdesivir for patients with severe Covid-19. New England Journal of Medicine. 2020 Jun 11;382(24):2327-36.

4. Beigel JH, Tomashek KM, Dodd LE, Mehta AK, Zingman BS, Kalil AC, Hohmann E, Chu HY, Luetkemeyer A, Kline S, Lopez de Castilla D. Remdesivir for the treatment of Covid-19. New England Journal of Medicine. 2020 Nov 5;383(19):1813-26.

5. Singh AK, Singh A, Singh R, Misra A. Remdesivir in COVID-19: a critical review of pharmacology, pre-clinical and clinical studies. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020 Jul 1;14(4):641-8.

6. Cao YC, Deng QX, Dai SX. Remdesivir for severe acute respiratory syndrome coronavirus 2 causing COVID-19: An evaluation of the evidence. Travel medicine and infectious disease. 2020 May 1;35:101647.

7. Wang M, Cao R, Zhang L, Yang X, Liu J, Xu M, Shi Z, Hu Z, Zhong W, Xiao G. Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. Cell research. 2020 Mar;30(3):269-71.

8. Wang Y, Zhang D, Du G, Du R, Zhao J, Jin Y, Fu S, Gao L, Cheng Z, Lu Q, Hu Y. Remdesivir in adults with severe COVID-19: a randomised, double-blind, placebo-controlled, multicentre trial. The Lancet. 2020 May 16;395(10236):1569-78.

9. Montastruc F, Thuriot S, Durrieu G. Hepatic disorders with the use of remdesivir for coronavirus 2019. Clinical Gastroenterology and Hepatology. 2020 Nov 1;18(12):2835-6.

10. Eastman RT, Roth JS, Brimacombe KR, Simeonov A, Shen M, Patnaik S, Hall MD. Remdesivir: a review of its discovery and development leading to emergency use authorization for treatment of COVID-19. ACS central Science. 2020 May 4;6(5):672-83.

11. Spinner CD, Gottlieb RL, Criner GJ, López JR, Cattelan AM, Viladomiu AS, Ogbuagu O, Malhotra P, Mullane KM, Castagna A, Chai LY. Effect of remdesivir vs standard care on clinical status at 11 days in patients with moderate COVID-19: a randomized clinical trial. Jama. 2020 Sep 15;324(11):1048-57.

12. Norrie JD. Remdesivir for COVID-19: challenges of underpowered studies. The Lancet. 2020 May 16;395(10236):1525-7.

13. Liang C, Tian L, Liu Y, Hui N, Qiao G, Li H, Shi Z, Tang Y, Zhang D, Xie X, Zhao X. A promising antiviral candidate drug for the COVID-19 pandemic: A mini-review of remdesivir. European journal of medicinal chemistry. 2020 Jun 6:112527.

14. Hendaus MA. Remdesivir in the treatment of Coronavirus Disease 2019 (COVID-19): A simplified summary. Journal of Biomolecular Structure and Dynamics. 2020 May 19:1-6.

15. Amirian ES, Levy JK. Current knowledge about the antivirals remdesivir (GS-5734) and GS-441524 as therapeutic options for coronaviruses. One Health. 2020 Jun 1;9:100128.

16. Davies M, Osborne V, Lane S, Roy D, Dhanda S, Evans A, Shakir S. Remdesivir in treatment of COVID-19: A systematic benefit–risk assessment. Drug safety. 2020 Jul;43:645-56.

17. Burwick RM, Yawetz S, Stephenson KE, Collier AR, Sen P, Blackburn BG, Kojic EM, Hirshberg A, Suarez JF, Sobieszczyk ME, Marks KM. Compassionate use of remdesivir in pregnant women with severe coronavirus disease 2019. Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America. 2020.

18. Popov D. Treatment of Covid-19 Infection. A rationale for current and future pharmacological approach. EC Pulmonol. Respir. Med. 2020;9:38-58.

19. McCreary EK, Angus DC. Efficacy of Remdesivir in COVID-19. Jama. 2020 Sep 15;324(11):1041-2.

20. Adamsick ML, Gandhi RG, Bidell MR, Elshaboury RH, Bhattacharyya RP, Kim AY, Nigwekar S, Rhee EP, Sise ME. Remdesivir in patients with acute or chronic kidney disease and COVID-19. Journal of the American Society of Nephrology. 2020 Jul 1;31(7):1384-6.

21. Costanzo M, De Giglio MA, Roviello GN. SARS-CoV-2: recent reports on antiviral therapies based on lopinavir/ritonavir, darunavir/umifenovir, hydroxychloroquine, remdesivir, favipiravir and other drugs for the treatment of the new coronavirus. Current medicinal chemistry. 2020 Aug 1;27(27):4536-41.

22. Vitiello A, Ferrara F, La Porta R. Remdesivir and COVID-19 infection, therapeutic benefits or unnecessary risks?. Irish Journal of Medical Science (1971-). 2021 Jan 12:1-2.

23. Li Z, Wang X, Cao D, Sun R, Li C, Li G. Rapid review for the anti-coronavirus effect of remdesivir. Drug discoveries & therapeutics. 2020 Apr 30;14(2):73-6.

24. Rochwerg B, Agarwal A, Zeng L, Leo YS, Appiah JA, Agoritsas T, Bartoszko J, Brignardello-Petersen R, Ergan B, Ge L, Geduld H. Remdesivir for severe covid-19: a clinical practice guideline. bmj. 2020 Jul 30;370.

25. Gao Y, Yan L, Huang Y, Liu F, Zhao Y, Cao L, Wang T, Sun Q, Ming Z, Zhang L, Ge J. Structure of the RNA-dependent RNA polymerase from COVID-19 virus. Science. 2020 May 15;368(6492):779-82.

26. Frediansyah A, Nainu F, Dhama K, Mudatsir M, Harapan H. Remdesivir and its antiviral activity against COVID-19: A systematic review. Clinical epidemiology and global health. 2020 Aug 7.

27. Jorgensen SC, Kebriaei R, Dresser LD. Remdesivir: review of pharmacology, pre-clinical data, and emerging clinical experience for COVID-19. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy. 2020 Jul;40(7):659-71.

28. Nasir M, Talha KA, Islam T, Saha SK, Selina F, Parveen RA. Use of remdesivir in the management of COVID-19: a systematic review on current evidences. Mymensingh Med J. 2020 Apr 1;29(2):481-7.

29. Musa A, Pendi K, Hashemi A, Warbasse E, Kouyoumjian S, Yousif J, Blodget E, Stevens S, Aly B, Baron DA. Remdesivir for the Treatment of COVID-19: A Systematic Review of the Literature. Western Journal of Emergency Medicine. 2020 Jul;21(4):737.

30. Lin HX, Cho S, Aravamudan VM, Sanda HY, Palraj R, Molton JS, Venkatachalam I. Remdesivir in Coronavirus Disease 2019 (COVID-19) treatment: a review of evidence. Infection. 2021 Jan 2:1-0.

31. Alexander PE, Piticaru J, Lewis K, Aryal K, Thomas P, Szczeklik W, Fronczek J, Polok K, Alhazzani W, Mammen M. Remdesivir use in patients with coronavirus COVID-19 disease: a systematic review and meta-analysis. MedRXiv. 2020 Jan 1.

32. Aleem A, Kothadia J. Remdesivir. StatPearls. 2021 Apr 8.

33. Goldman JD, Lye DC, Hui DS, Marks KM, Bruno R, Montejano R, Spinner CD, Galli M, Ahn MY, Nahass RG, Chen YS. Remdesivir for 5 or 10 days in patients with severe Covid-19. New England Journal of Medicine. 2020 Nov 5;383(19):1827-37.

34. Al-Tawfiq JA, Al-Homoud AH, Memish ZA. Remdesivir as a possible therapeutic option for the COVID-19. Travel medicine and infectious disease. 2020 Mar 5.

35. Yesudhas D, Srivastava A, Gromiha MM. COVID-19 outbreak: history, mechanism, transmission, structural studies and therapeutics. Infection. 2020 Sep 4:1-5.

36. Alanagreh LA, Alzoughool F, Atoum M. The human coronavirus disease COVID-19: its origin, characteristics, and insights into potential drugs and its mechanisms. Pathogens. 2020 May;9(5):331.

37. Boopathi S, Poma AB, Kolandaivel P. Novel 2019 coronavirus structure, mechanism of action, antiviral drug promises and rule out against its treatment. Journal of Biomolecular Structure and Dynamics. 2020 Apr 29:1-0.

38. Hashemian SM, Farhadi T, Velayati AA. A review on remdesivir: a possible promising agent for the treatment of COVID-19. Drug design, development and therapy. 2020;14:3215.

## EARLY PREDICTION AND CLASSIFICATION OF HEART DISEASE USING MACHINE LEARNING

**[1]Shubha Soni, [2]Dr. Neeraj Sharma and [3]Dr. Harsh Pratap Singh**

[1]Research Scholar, [2]Associate Professor and [3]Assistant Professor, Computer Science and Engineering, Sri Satya Sai University of Technology and Medical Sciences, Sehore

**ABSTRACT**

*For doctors or practitioners, heart disease prediction is critical since it aids in precise decision-making for the development of heart patients. The heart is one of the most vital organs in the human body. It aids in the cleansing and circulation of blood throughout the body. The method of machine learning is commonly employed to comprehend the symptoms of cardiac patients. Machine learning is an analytical method that is utilised when a task is huge and difficult to programme, such as converting medical records into knowledge, predicting pandemics, and analysing genomic data. In this paper, we give a review of the literature on heart disease prediction, as well as different machine learning techniques for heart disease prediction, such as decision trees, Nave Bayes algorithms, and logistic regression.*

*Keywords: Machine Learning, Heart Disease, Prediction, Decision tree, Heart Patients, Regression*

## INTRODUCTION

Heart disease is the top cause of death in the United States, according to the Centers for Disease Control and Prevention (CDC). Heart disease kills one out of every four people in the United States, and it affects people of all genders, races, and ethnicities. Heart disease knows no boundaries. It is the leading cause of death for a variety of individuals, including whites, Hispanics, and African-Americans. Heart disease affects about half of all Americans, and the number is rising. While heart disease is fatal, it is also avoidable in the majority of cases. Early adoption of healthy living choices will help you live longer and have a healthier heart. [1]. Unhealthy food, physical inactivity, cigarette use, and problematic alcohol consumption are the most major behavioural risk factors for heart disease and stroke. Individuals may experience symptoms such as high blood pressure, high blood glucose, high blood lipids, and overweight or obesity as a result of behavioural risk factors. These "intermediate risk factors" are detectable in primary care settings and signal a higher risk of heart attack, stroke, heart failure, and other consequences. Tobacco cessation, salt reduction in the diet, increased fruit and vegetable consumption, regular physical activity, and avoidance of problematic alcohol use have all been demonstrated to lessen the risk of cardiovascular disease. Health policies that create environments that make healthy options affordable and accessible are critical for encouraging people to develop and maintain healthy habits. CVDs are also influenced by a number of underlying factors [2]. Globalization, urbanisation, and population ageing are three primary drivers pushing social, economic, and cultural change. Poverty, stress, and inherited factors are other determinants of CVDs. Furthermore, pharmacological treatment for hypertension, diabetes, and high blood lipids is required to lower cardiovascular risk and prevent heart attacks and strokes in persons with these diseases. Machine learning approaches have been utilised in recent studies to diagnose and forecast various heart issues.

**Types of Heart Disease**

There are many types of heart disease, and each one has its own symptoms and treatment. For some, lifestyle changes and medicine can make a huge difference in improving your health. For others, you may need surgery to make your ticker work well again [3].

*Heart Arrhythmias*

When you have an arrhythmia, your heart has an irregular beating pattern. Serious arrhythmias often develop from other heart problems but may also happen on their own.

*Heart Failure*

With heart failure, your heart doesn't pump blood as well as it should to meet your body's needs. It is usually caused by coronary artery disease, but it can also happen because you have thyroid disease, high blood pressure, heart muscle disease (cardiomyopathy), or certain other conditions.

*Heart Valve Disease*

Your heart has four valves that open and close to direct blood flow between your heart's four chambers, the lungs, and blood vessels. An abnormality could make it hard for a valve to open and close the right way.

When that happens, your blood flow could be blocked or blood can leak. Your valve may not open and close right.

Diseases of the heart valves include:

- **Endocarditis.** This is an infection that's usually caused by bacteria, which may enter the blood and take root in your heart during illness, after surgery, or after using intravenous drugs. It often happens if you already have valve problems. Antibiotics can usually cure it, but the disease is life threatening without treatment. If your heart valves are seriously damaged as a result of endocarditis, you may need valve replacement surgery.

- **Rheumatic heart disease.** This condition develops when your heart muscle and valves are damaged by rheumatic fever, which is linked to strep throat and scarlet fever. Rheumatic heart disease was more common earlier in the 20th century. But doctors are now able to prevent it by using antibiotics to treat the diseases that lead to it. If you do get it, the symptoms usually show up many years after the infection [3].

*Pericardial Disease*

Any disease of the pericardium, the sac that surrounds your heart, is called a pericardial disease. One of the more common diseases is pericarditis or inflammation of the pericardium.

*Cardiomyopathy (Heart Muscle Disease)*

Cardiomyopathy is a disease of your heart muscle, or myocardium. It gets stretched, thickened, or stiff. Your heart may get too weak to pump well.

There are many possible causes of the disease, including genetic heart conditions, reactions to certain drugs or toxins (such as alcohol), and infections from a virus. Sometimes, chemotherapy causes cardiomyopathy. Many times, doctors can't find the exact cause.

*Congenital Heart Disease*

When something goes wrong while a baby's heart is still growing in the womb, it's called congenital heart disease. Sometimes the cardiac anomaly causes issues shortly after birth, but other times you don't notice anything until you're an adult. Septal defects are one of the most frequent congenital heart defects. The left and right halves of your heart are separated by these holes in the wall. You can get the hole patched with a procedure. Pulmonary stenosis is another form of defect. The flow of blood to your lungs is slowed by a tight valve. The valve can be opened or replaced using a procedure or surgery. A small blood channel called the ductus arteriosus does not close in certain newborns up at birth as it should. When this happens, some blood leaks back into the pulmonary artery, which puts strain on your heart. Doctors can treat this with surgery or a procedure or sometimes with medication.
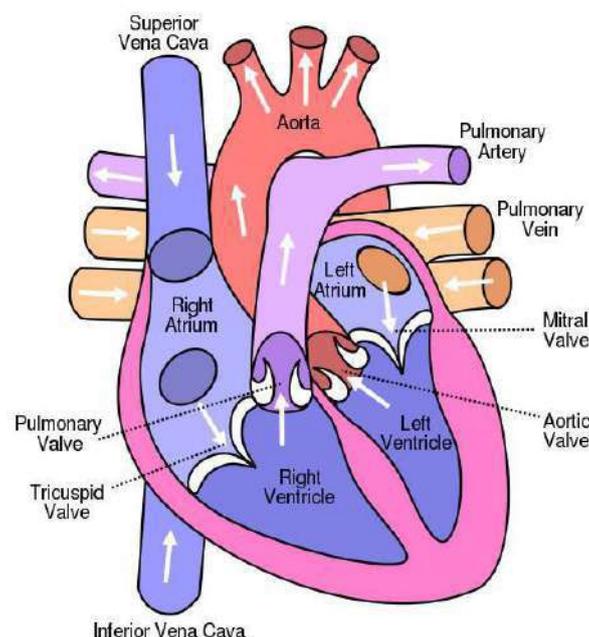


**Fig. 1: Structure of Human Heart [16]**

## Symptoms of Heart Disease

Often, there are no symptoms of the underlying disease of the blood vessels. A heart attack or stroke may be the first sign of underlying disease [4]. Symptoms of a heart attack include:

- Pain or discomfort in the centre of the chest; and/or

- Pain or discomfort in the arms, the left shoulder, elbows, jaw, or back.

In addition the person may experience difficulty in breathing or shortness of breath; nausea or vomiting; light-headedness or faintness; a cold sweat; and turning pale. Women are more likely than men to have shortness of breath, nausea, vomiting, and back or jaw pain.

The most common symptom of a stroke is sudden weakness of the face, arm, or leg, most often on one side of the body. Other symptoms include sudden onset of:

- Numbness of the face, arm, or leg, especially on one side of the body;

- Confusion, difficulty speaking or understanding speech;

- Difficulty seeing with one or both eyes;

- Difficulty walking, dizziness and/or loss of balance or coordination;

- Severe headache with no known cause; and/or

- Fainting or unconsciousness.

## Related Work

**Anna Karen Garate-Escamila, Amir Hajjam El Hassani, Emmanuel Andres (2020)** A dimensionality reduction strategy is proposed, as well as a feature selection technique for discovering heart disease features. The data for this analysis came from the UCI Machine Learning Repository's Heart Disease section. Six machine learning classifiers verified 74 features and a label in the dataset. The maximum accuracy was 98.7% for Cleveland, 99.0% for Hungarian, and 99.4% for Cleveland-Hungarian (CH) datasets using Chi-square and principal component analysis (CHI-PCA) with random forests (RF). ChiSqSelector identified anatomical and physiological variables from the analysis, including cholesterol, greatest heart rate, chest discomfort, traits associated to ST depression, and cardiac vessels. The results of the experiments showed that combining chi-square with PCA improves the performance of most classifiers. The usage of PCA directly from the raw data computed lower results and would require greater dimensionality to improve the results [5]. **G. Jignesh Chowdary, Suganya. G, Premalatha. M (2020)** proposed a novel ensemble methodology that predicts the possibility of heart illness using the voting of Logistic Regression (LR), Random Forest (RF), Artificial Neural Network activated with ReLU function (NNR), K-Nearest Neighbors (KNN), and Gaussian Naive Bayes (GNB). The model is built with Python-based Jupyter Notebook and Flask and trained on Kaggle's standard dataset. The accuracy, precision, specificity, sensitivity, and error of the model are all examined and evaluated. Testing revealed an accuracy of 89 percent, precision of 91.6 percent, sensitivity of 86 percent, and specificity of 91 percent, as well as a sensitivity of 86 percent and specificity of 91 percent. When compared to individual models, the results show that ensemble modelling provides superior accuracy and thus better prediction, resulting in life-saving decisions. [6]. **Amin Ul Haq , Jian Ping Li , Muhammad Hammad Memon , Shah Nazir , and Ruinan Sun (2018)** Using a heart illness dataset, researchers built a machine-learning-based diagnosis method for heart disease prediction. We used seven popular machine learning algorithms, three feature selection algorithms, the cross-validation method, and performance evaluation metrics like classification accuracy, specificity, sensitivity, Matthews' correlation coefficient, and execution time to evaluate the performance of seven classifiers. The proposed technology can quickly distinguish between those with heart disease and those who are healthy. Receiver optimistic curves and area under the curves were also computed for each classifier. In this paper, we've covered all of the classifiers, feature selection techniques, pre-processing methods, validation methods, and metrics for evaluating classifier performance. The suggested system's performance has been validated on both full features and a reduced set of features. The features reduction has an impact on classifiers performance in terms of accuracy and execution time of classifiers. The proposed machine-learning-based decision support system will assist the doctors to diagnosis heart patients efficiently [7]. **Senthilkumar Mohan, Chandrasegar Thirumalai, and Gautam Srivastava (2019)** proposed a novel method that aims at finding significant features by applying machine learning techniques resulting in improving the accuracy in the prediction of cardiovascular disease. The prediction model is introduced with different combinations of features and several known classification techniques. We produce an enhanced performance level with an accuracy level of 88:7% through the prediction model for heart disease with the hybrid random

forest with a linear model (HRFLM) [8]. ***Akram Ahmed Mohammed, Rajkumar Basa, Anirudh Kumar Kuchuru, Shiva Prasad Nandigama, Maneeshwar Gangolla (2020)*** proposed an integrated method of Random Forest Machine Learning Algorithm is with the Flask Web framework for predicting of Heart Disease is proposed. The ensemble learning methods are used for predicting heart disease. The proposed methodology involved integration of the Flask Web framework with the Random Forest machine learning technique to estimate the heart disease stages. Artery Blockage indicates the presence of heart disease. The higher the blockage, higher is the stage of heart disease. Stage 1 and Stage 2 indicate the presence of heart disease whereas Stage 3 and Stage 4 are called chronic heart disease and the risk of a heart attack at any day in such patients is very high. The Data required for the prediction contains parameters such as Age, Sex, Blood Pressure, Sugar levels which are collected from the Kaggle website. Experimental results say that predictions by using the proposed approach are consistently better than those obtained using the other methods [9]. ***Malavika G, Rajathi N, Vanitha V and Parameswari P (2020)*** extract the hidden information, which is useful to predict disease at the earlier. In medical field, predicting heart disease is treated as one of the intricate tasks. Therefore, there is a necessity to develop a decision support system to forecast the cardio vascular disease in a patient. Machine learning plays a vital part in disease prediction. In this paper, various machine learning methods were used to predict the heart disease and their performances were compared. The results obtained show the superiority of the Random forest algorithm [10]. ***Harshit Jindal, Sarthak Agrawal, Rishabh Khera, Rachna Jain and Preeti Nagrath (2020)*** focused on which patient is more likely to have a heart disease based on various medical attributes. We prepared a heart disease prediction system to predict whether the patient is likely to be diagnosed with a heart disease or not using the medical history of the patient. We used different algorithms of machine learning such as logistic regression and KNN to predict and classify the patient with heart disease. A quite Helpful approach was used to regulate how the model can be used to improve the accuracy of prediction of Heart Attack in any individual. The strength of the proposed model was quiet satisfying and was able to predict evidence of having a heart disease in a particular individual by using KNN and Logistic Regression which showed a good accuracy in comparison to the previously used classifier such as Naive Bayes etc. So a quiet significant amount of pressure has been lift off by using the given model in finding the probability of the classifier to correctly and accurately identify the heart disease. The Given heart disease prediction system enhances medical care and reduces the cost. This project gives us significant knowledge that can help us predict the patients with heart disease It is implemented on the .pynb format [11]. ***Riddhi Kasabe and Prof. Dr. Geetika Narang (2020)*** evaluate different classification techniques in heart diagnosis. First, the heart numeric dataset is extracted and preprocess them. After that using extract the features that is condition to be find to be classified by machine learning. Compared to existing; machine learning provides better performance. After classification, performance criteria including accuracy, precision, F-measure is to be calculated. Machine learning provides better performance. The comparison measure expose that Random Forest is the best classifier for the diagnosis of heart disease on the existing dataset [12]. ***Dinesh Kumar G, Santhosh Kumar D, Arumugaraj K, Mareeswari V(2018)*** proposed research, data pre-processing uses techniques like the removal of noisy data, removal of missing data, filling default values if applicable and classification of attributes for prediction and decision making at different levels. The performance of the diagnosis model is obtained by using methods like classification, accuracy, sensitivity and specificity analysis. This project proposes a prediction model to predict whether a people have a heart disease or not and to provide an awareness or diagnosis on that. This is done by comparing the accuracies of applying rules to the individual results of Support Vector Machine, Gradient Boosting, Random forest, Naive Bayes classifier and logistic regression on the dataset taken in a region to present an accurate model of predicting cardiovascular disease [13]. ***Aditi Gavhane, Gouthami Kokkula, Isha Pandya, Kailas Devadkar(2018)*** put a system in place to be able to detect the symptoms of a heart stroke at an early stage and thus prevent it. It is impractical for a common man to frequently undergo costly tests like the ECG and thus there needs to be a system in place which is handy and at the same time reliable, in predicting the chances of a heart disease. Thus we propose to develop an application which can predict the vulnerability of a heart disease given basic symptoms like age, sex, pulse rate etc. The machine learning algorithm neural networks has proven to be the most accurate [14]. ***Indu Yekkala, Sunanda Dixit (2018)*** insights not only diagnose the diseases but also predict and can prevent disease. One such use of these techniques is cardiovascular diseases. Heart disease or coronary artery disease (CAD) is one of the major causes of death all over the world. Comprehensive research using single data mining techniques have not resulted in an acceptable accuracy. Further research is being carried out on the effectiveness of hybridizing more than one technique for increasing accuracy in the diagnosis of heart disease. In this article, the authors worked on heart stalog dataset collected from the UCI repository, used the Random Forest algorithm and Feature Selection using rough sets to accurately predict the occurrence of heart disease [15].

## Heart Disease Prediction Techniques

For prediction of heart disease various machine learning techniques has been developed and among from them some prediction techniques are explained below:

### Decision Tree

The Decision Tree methodology is a widely used data mining method for creating prediction models for a target instance based on many explanatory parameters. This path divides a population into tree-like branch segments that form an inverted tree with a root node, internal nodes, and leaf nodes. A decision tree is a non-parametric approach for dealing with large, complex data sets without the use of several parametric structures. Study data can be separated into training and validation data sets if the sample size is large enough. To create the best final model, use the training data set to develop a decision tree model and the validation data set to decide on the optimum tree size. [17].

### Naïve Bayes Classifier

Classifiers based on the Naive Bayes principle 0T is an Uprobabilistic classifier based on Bayes' theoremU0T24T 0Tand strong (naive)0T 0T24TUindependenceU0T24T 0Tassumptions between features. A Naive Bayesian model is simple to construct and does not require iterative parameter estimate, making it very useful in medical science for identifying cardiac patients. Despite its simplicity, the Nave Bayesian classifier[18] frequently works admirably and is commonly used because it outperforms more complex classification algorithms. The Bayes theorem allows you to calculate the posterior probability, P(c|x), from P(c), P(x), and P(x|c) using P(c), P(x), and P(x|c). The value of a predictor (x) on a given class (c) is assumed to be independent of the values of other predictors by the Nave Bayes classifier. This is known as class conditional independence.



$$P(c \mid x) = \frac{P(x \mid c) P(c)}{P(x)}$$

$$P(c \mid X) = P(x_1 \mid c) \times P(x_2 \mid c) \times \cdots \times P(x_n \mid c) \times P(c)$$
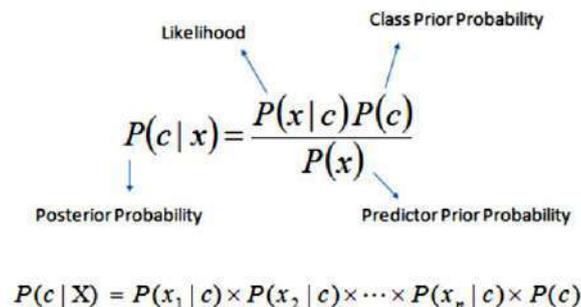
- $P(c/x)$ is the posterior probability of *class* (*target*) given *predictor* (*attribute*).

- $P(c)$ is the prior probability of *class*.

- $P(x/c)$ is the likelihood which is the probability of *predictor* given *class*.

- $P(x)$ is the prior probability of *predictor*

Where C and X are two events (e.g. the probability that the train will arrive on time given that the weather is rainy). Such Naïve Bayes classifiers use the probability theory to find the most likely classification of an unseen (unclassified) instance. The algorithm performs positively with categorical data but poorly if we have numerical data in the training set.

### Logistic Regression

The dependent variable (target) is categorical data with a nominal or ordinal scale, and the independent variable (predictor) is categorical data with an interval or ratio scale. Logistic regression is a predictive model used to evaluate the relationship between the dependent variable (target) and the independent variable (predictor). This approach can also be used to discover the relationship between the variables in a time series model. The procedure for predicting the likelihood of categorical dependent variables is known as logistic regression. The dependant variable in logistic regression is represented as a binary variable with a value of 1 (yes) or 0 (no) (no). As a function of X, the logistic regression model predicts. The following are the assumptions that are utilised in logistic regression: Binary logistic regression necessitates binary dependent variables, and the factor 1 level is required for binary regression of the dependent variable must represent the desired result, independent variables must be independent of each other. In this case, the model must have little or no multicollinearity and be linearly related to log opportunities [19]. When the dependent variable is dichotomous, logistic regression is utilised to perform the necessary regression analysis (binary). Logistic regression is an analytical model that

predicts the future. At the nominal, ordinal, interval, or ratio level, logistic regression is used to describe data and explain the relationship between one dependent binary variable and one or more independent variables. Logistic regression provides a number of benefits and drawbacks [20]. The following are some of the advantages of logistic regression. To begin with, logistic regression can reveal a substantial link between the dependent and independent variables. Second, logistic regression analysis can be used to compare the impact of factors assessed at various scales, such as price changes and the number of promotional activities. This benefit helps market researchers or data analysts to eliminate and evaluate the best set of variables that will be used to build predictive models. Third, the logistic regression model is not only a classification model, but also provides information related to probability. To achieve a better result using Logistic Regression, first all independent variable must contain their valid value. Secondly, logistic regression works well for predicting categorical results and multinomial results. Third, there is no multicollinearity between variables in the dataset [21].

## Random Forest

RF (see Figure 1 for an illustration) is a collection or ensemble of Classification and Regression Trees (CART) [22] trained on datasets of the same size as training set, called bootstraps, created from a random resampling on the training set itself. Once a tree is constructed, a set of bootstraps, which do not include any particular record from the original dataset [out-of-bag (OOB) samples], is used as test set. The error rate of the classification of all the test sets is the OOB estimate of the generalization error. [23] showed by empirical evidence that, for the bagged classifiers, the OOB error is accurate as using a test set of the same size as the training set. Thus, using the OOB estimate removes the need for a separate test set. To classify new input data, each individual CART tree (colored branches in Figure 1) votes for one class and the forest predicts the class that obtains the plurality of votes.
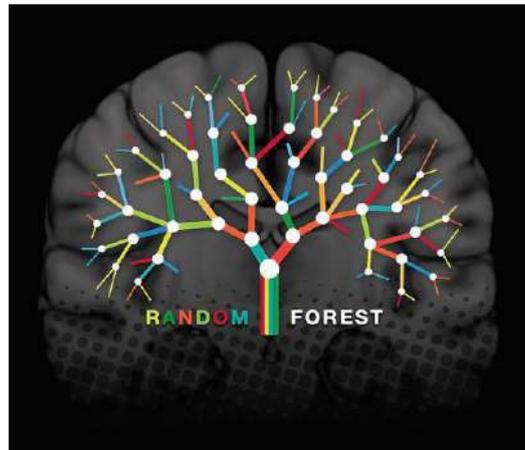


**Fig. 2:** Illustration of a random forest construct superimposed on a coronal slice of the MNI 152 (Montreal Neurological Institute) standard template. Each binary node (white circles) is partitioned based on a single feature, and each branch ends in a terminal node, where the prediction of the class is provided. The different colors of the branches represent each of the trees in the forest. The final prediction for a test set is obtained by combining with a majority vote the predictions of all single trees.

RF follows specific rules for tree growing, tree combination, self-testing and post-processing, it is robust to overfitting and it is considered more stable in the presence of outliers and in very high dimensional parameter spaces than other machine learning algorithms ([24, 25]. The concept of variable importance is an implicit feature selection performed by RF with a random subspace methodology, and it is assessed by the Gini impurity criterion index [26]. The Gini index is a measure of prediction power of variables in regression or classification, based on the principle of impurity reduction [27]; it is non-parametric and therefore does not rely on data belonging to a particular type of distribution. For a binary split (white circles in Figure 1), the Gini index of a node n is calculated as follows:

$$Gini(n) = 1 - \sum_{j=1}^{2} (P_j)^2$$

where pj is the relative frequency of class j in the node n. For splitting a binary node in the best way, the improvement in the Gini index should be maximized. In other words, a low Gini (i.e., a greater decrease in Gini) means that a particular predictor feature plays a greater role in partitioning the data into the two classes. Thus, the Gini index can be used to rank the importance of features for a classification problem.

## CONCLUSION

On the basis of available datasets, the machine learning concept is frequently employed in the medical field for early disease prediction and diagnosis of cardiac patients. Decision trees, nave bayes, logistic regression, and other machine learning algorithms have been created by the researchers for the diagnosis of heart disease. We give a complete review of heart disease prediction and diagnosis in this study. The application of machine learning algorithms yields reliable prediction findings, allowing practitioners to deliver improved therapy to cardiac patients. This includes a discussion of numerous machine learning techniques, with the conclusion that no single strategy outperforms the others. In future work, we will use the hybrid approach of machine learning techniques and their analysis will also be perform on some other measuring parameters such as precision, recall and F1 measure.

## REFERENCE

[1] Heart disease webpage on Mayo Clinic [Online]. Available: https://www.mayoclinic.org/diseases-conditions/heart-disease/symptoms-causes/syc-20353118, 2019.

[2] Chaitrali S.Dangare, and Sulabha S.Apte, "Improved Study of Heart Disease Prediction System using Data Mining Classification Techniques", International Journal of Computer Applications (0975 – 888), Vol. 47, No.10, June.2021.

[3] Guizhou Hu, Martin M. Root, "Building Prediction Models for Coronary Heart Disease by Synthesizing Multiple Longitudinal Research Findings", European Science of Cardiology, 10 May 2005.

[4] T.Mythili, Dev Mukherji, Nikita Padaila and Abhiram Naidu, "A Heart Disease Prediction Model using SVM- Decision Trees- Logistic Regression (SDL)", International Journal of Computer Applications, vol. 68, 16 April 2013.

[5] Anna Karen Garate-Escamila, Amir Hajjam El Hassani, Emmanuel Andres, "Classification models for heart disease prediction using feature selection and PCA", Informatics in Medicine Unlocked 19 (2020) 100330.

[6] G. Jignesh Chowdary, Suganya. G, Premalatha. M, "Effective Prediction of Cardiovascular Disease Using Cluster of Machine Learning Algorithms", Journal of Critical Reviews, ISSN- 2394-5125 VOL 7, ISSUE 18, 2020.

[7] Amin Ul Haq , Jian Ping Li , Muhammad Hammad Memon , Shah Nazir , and Ruinan Sun, "A Hybrid Intelligent System Framework for the Prediction of Heart Disease Using Machine Learning Algorithms", Hindawi Mobile Information Systems, Volume 2018, Article ID 3860146, 21 pages, https://doi.org/10.1155/2018/3860146.

[8] Senthilkumar Mohan, Chandrasegar Thirumalai, and Gautam Srivastava, "Effective Heart Disease Prediction Using Hybrid Machine Learning Techniques", In IEEE Access, 2019.

[9] Akram Ahmed Mohammed, Rajkumar Basa, Anirudh Kumar Kuchuru, Shiva Prasad Nandigama, Maneeshwar Gangolla, "Random Forest Machine Learning technique to predict Heart disease", European Journal of Molecular & Clinical Medicine ISSN 2515-8260 Volume 7, Issue 4, 2020.

[10] Malavika G, Rajathi N, Vanitha V and Parameswari P "Heart Disease Prediction Using Machine Learning Algorithms ", Biosc.Biotech.Res.Comm. Special Issue Vol 13 No 11 (2020) Pp-24-27

[11] Harshit Jindal, Sarthak Agrawal, Rishabh Khera, Rachna Jain and Preeti Nagrath, "Heart disease prediction using machine learning algorithms" IOP Conf. Series: Materials Science and Engineering 1022 (2020) 012072.

[12] Riddhi Kasabe, Geetika Narang, "Heart Disease Prediction using Machine Learning", International Journal of Engineering Research & Technology (IJERT) ,Vol. 9 Issue 08, August-2020

[13] Dinesh Kumar G,  Santhosh Kumar D, Arumugaraj K, Mareeswari V, "Prediction of Cardiovascular Disease Using Machine Learning Algorithms", Proceeding of 2018 IEEE International Conference on Current Trends toward Converging Technologies, Coimbatore, India.

[14] Aditi Gavhane, Gouthami Kokkula, Isha Pandya, Kailas Devadkar, "Prediction of Heart Disease Using Machine Learning" Proceedings of the 2nd International conference on Electronics, Communication and Aerospace Technology (ICECA 2018) IEEE Conference Record # 42487; IEEE Xplore ISBN:978-1-5386-0965-1

[15] Indu Yekkala, Sunanda Dixit, "Prediction of Heart Disease Using Random Forest and Rough Set Based Feature Selection", International Journal of Big Data and Analytics in Healthcare, Volume 3, Issue 1, January-June 2018.

[16] Nimai Chand Das Adhikari, Arpana Alka, and rajat Garg, "HPPS: Heart Problem Prediction System using Machine Learning". ACADEMY & INDUSTRY RESEARCH COLLABORATION CENTER (AIRCC), 2017.

[17] S Radhika, S Ramiya Shree, V Rukhmani Divyadharsini and A Ranjitha, "Symptoms Based Disease Prediction Using Decision Tree and Electronic Health Record Analysis", European Journal of Molecular & Clinical Medicine ISSN 2515-8260 Volume 7, Issue 4, 2020.

[18] K. Vembandasamy, R. Sasipriya P and E. Deepa, "Heart Diseases Detection Using Naive Bayes Algorithm", IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 9, September 2015

[19] E. Y. Boateng, and D. A. Abaye, "A Review of the Logistic Regression Model with Emphasis on Medical Research". Journal of Data Analysis and Information Processing, Vol.7. No.4, pp.190-207, 2019.

[20] J. Harrell and E. Frank, "Regression Modeling Strategies: With Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis". Springer, 2015.

[21] Vaseem Naiyer, Jitendra Sheetlani, Harsh Pratap Singh, "Software Quality Prediction Using Machine Learning Application", Smart Intelligent Computing and Applications, 2020, Pages 319-327, Springer.

[22] Breiman, L., Friedman, J., Stone, C. J., and Olshen, R. A. (1984). Classification and Regression Trees. Boca Raton, FL: CRC press.

[23] Breiman, L. (1996). Bagging predictors. Mach. Learn. 24, 123–140. doi: 10.1007/ BF00058655.

[24] Caruana, R., and Niculescu-Mizil, A. (2006). "An empirical comparison of supervised learning algorithms," in 23rd International Conference on Machine Learning, (Pittsburgh, PA: ACM Press), 161–168.

[25] Menze, B. H., Kelm, B. M., Masuch, R., Himmelreich, U., Bachert, P., Petrich, W., et al. (2009). A comparison of random forest and its Gini importance with standard chemometric methods for the feature selection and classification of spectral data. BMC Bioinformatics 10:213. doi: 10.1186/1471-2105- 10-213.

[26] Ceriani, L., and Verme, P. (2012). The origins of the gini index: extracts from variabilità e mutabilità (1912) by corrado gini. J. Econ. Inequal. 10, 421–443. doi: 10.1007/s10888-011-9188-x.

[27] Strobl, C., Boulesteix, A. L., and Augustin, T. (2007). Unbiased split selection for classification trees based on the gini index. Comput. Stat. Data Anal. 52, 483–501. doi: 10.1016/j.csda.2006.12.030

## DEEPER INSIGHT INTO HAIR DYES

**Shikha Baghel Chauhan**

Assistant Professor, Amity Institute of Pharmacy, Amity University, Noida, Uttar Pradesh, India

**ABSTRACT**

*Hair dyes are one of the most widely used cosmetic products utilised by men and women available in the form of conditioners, lotions, powders to enhance their appearance by changing the colour. Modern Hair dyes are present in the form or oxidative and non-oxidative dyes and they were further classified on the basis of duration of retention over hair are: permanent, temporary, semi-permanent and demi-permanent. Around 90% of marketed products are of oxidising nature. This article provides insight on various aspects of hair dyes starting from classification, difference between each category, chemicals used in permanent dyes, mechanism involved in colouring, potential hazards or risk associated with these and regulatory aspects. Although different chemicals are involved in the preparation but para-phenylene diamine being a main ingredient is major cause of dermatitis and other allergic reaction.*

*Keywords: Oxidative Hair dyes, Composition, Mechanism, Para-phenylenediamine*

**INTRODUCTION:**

**Colouring** of hair is a fine art in order to modify the looks or to hide the grey or white hairs by application of cosmetic products known as hair dyes. Initially these products were most frequently used by women but now-a-days these are designed especially for men, also available in market. Hair dyes are cosmetics products available in the form of powders, emulsions, lotions, conditioners to restore the original colour, to change the colour according to the fashion. These has been used for Egyptian times when Ramases used Heena for Red Colour, Greece people used potassium solution along with yellow flower petal to bleach the hair [1]. In earlier days, these dyes were obtained from natural sources but with development now synthetic dyes are being used. First chemical dye was synthesized in 1907 by Eugene and Schuller (the founder of L'Oréal). Modern Hair dyes are present in the form or oxidative and non-oxidative dyes and they were further classified on the basis of duration of retention over hair are permanent, temporary, semi-permanent and demi-permanent. [2]. Around 90% of marketed products are of oxidising nature and concentration of oxidant in hair dyes plays important role in the colour delivery, higher concentration of these speeds up the process. Some hair colours may cause allergic reactions, irritation, hair loss and continuous prolong use may cause certain form of Cancers, (Leukaemia, Bladder cancer) [3].

**A good hair dye should possess the following characteristics:**

1) It should impart the hair colour without losing its natural texture and gloss.

2) It should not cause any kind of irritation on skin hair.

3) It should be non-toxic.

4). The applied colour should be resistant to air, sunlight, friction.

5) It should not change its colour or bleach out in the presence of any other cosmetic formulation such as shampoos, hair setting lotions, hair waving lotion, soaps e t.c.

6) It should posses' high stability in the formulation form.

7.) It should not have different colouring effect on different part of hairs.

8) It should posses' good affinity with hair keratin and good permeability through hair shaft.

**Classification of Hair Dyes:**

**Natural Hair dyes:** These are herbal based preparation which have been used since ancient time. Natural dyes are environmentally friendly, less toxic and free from side effects. They have catechin, ascorbic acid, flavonoids etc. in their structure and possess antioxidant property, does not cause any damage to hair cuticle or scalp. These have different pigments like carotene (golden), lutein(yellow), and anthocyanin(red). Some examples of natural hair dyes include Heena, Madder, Walnut, Chamomile.

**HEENA:** "Lawsone", is the main component which provides the properties of Heena, which is to provide reddish orange colour to the hair. Lawsone is a red-orange compound constituted in Heena dry leaves and the concentration is about 1-1.5% w/w [4].

At 1.5% concentration, lawsone is proven to provide non- oxidizing hair coloring agent in the cosmetic product.Apart from lawsone, there are other constituents as well i.e., "gallic acid" and flavonoids which provide colouring effect as organic mordants. Various carbohydrates are also present in heena that serves as the suitable constituent which provide proper consistency to the heena paste so that the paste adhere to the hair properly [5]. Heena has keratinized properties as well but in a fixed environment of pH 5.5 which is slightly acidic environment. Generally, natural Heena is accepted by all skin type and hair type, as it is organic and hypoallergenic but exceptions are always there, and sometimes allergic reactions occur in mixed type, such as normal Heena mixed with black Heena. This reaction occurs due to the compound 2-nitro-4-phenylenediamine, para-phenylenediamine, 3-aminophenol and 4-aminophenol [6].

Apart from dyeing properties, Heena has antifungal properties as well which works against dandruff causing agent which is "Malassezia species" [7]. Other property of Heena is, to alleviate jaundice, smallpox and any skin disease.

**Madder:** It the ancient source of hair dyes. Chemical structure of madder is "anthraquinone" which is different in different region such as, Purpurin obtained from Indian madder while alizarin anthraquinones is obtained from European madder and these are the main components that are responsible for providing dyeing property [8].

Madder plant has some additional properties as well like, anticancer, antifungal, hypotensive, antimicrobial and antipain properties [9]. Along with these properties, madder act as blood purifier, antirheumatic and antiseptic as well [10].

**Walnut:** Prominent constituent of walnut is the isomer of well-known lawsone i.e., "juglone" (5-hydroxy-1-4-naphthoquinone). Generally, the hull of walnut and its leaves are used for dyeing hair. The main components walnut contains is the methionine, linoleic acid, cysteine, oleic acid, linolenic acid, macadamia and threonine [11]. Apart from all these compound, one small component i.e., the 1,4-benzoquinone is the one which is responsible for providing the semipermanent hair dye effect and it also provides strong antibacterial properties as well.

**Chamomile:** it is a vegetable dye which provide yellowish shade to the hair and promote light reflection. The core active ingredient in chamomile is the 1,3,4-trihydroxyflavone, which is commonly known as "apigenin" [12].

Other properties of chamomile are the skin soothing, softening, and moisturizing. It is also used for diarrhoea, indigestion, sciatica and sleeplessness.

**Temporary dye:** The colouring process of these dyes involved no oxidising substance that's why they are known as non-oxidative dyes. These dyes have high molecular weight and cannot permeate the hair cortex, adsorbed on the surface decreasing the stay time and can be removed after first washing of hairs. These colours are more like fashion colours, they are lighter than the actual shade and generally difficult to identify if the original colour is black. They does not have 100% ability to cover grey hair as they do not permeate the cortex, only 15% hair get covered. These are used by those, who frequently wishes to change by appearance as per changing fashion. These can be used for hiding yellowish effect in white hair, adding colourful reflection. Temporary hair dyes are anionic, acidic in nature have high water solubility. For promoting strong effect over hair, they are used in higher concentration of about 0.1 to 2.0% and kept for 30 minutes and available in the form of gel, emulsions and shampoo [13].

**Semi-Permanent dye:** These are also non- oxidative dyes as they do not have hydrogen peroxide or any other oxidant. These are basic or cationic in nature and contain aromatic aminoanthraquinone or nitro aromatic amine. These are of low molecular weight as compared to temporary dyes, diffuse inside the hair cortex after 5-6 washing with the shampoo. These dyes are generally applied after washing the hair with shampoo and kept for 10-40 minutes and then rinsed off with water. They are available in the form of mousse, emulsion, lotions, shampoos. They have optimum viscosity which restrict their flow [14].

**Demi- Permanent dye:** These are the semipermanant dye with precursors of oxidation dyes and generally accompanied by hydrogen peroxide or any other oxidising agent or these can also be formulated by mixing nitroaniline dye with acidic dyes, these dyes or colour remain for longer duration around 20 washing of hair with shampoo [15].

**Permanent Hair dyes:** These are one of the most effective hair colours which are completely resistant to the washing and other factors including dyeing friction etc. They have capacity to cover 100% of hairs and covers

80% of sold dyes. These include oxidising agents like calcium peroxide, hydrogen peroxide and barium peroxide which oxidised p-amino phenol and p-diamines which produces intermediates and these intermediates in turn with couplers to provide colours to the hair. The reaction take place in the presence of alkalizing agent as they opens the hair cuticle while oxidising agents starts the reaction allowing the formation of colouring complex. These dyes involve redox reaction and contain ortho and para substituted amine, oxidising agent, alkalizing agent [16].

**Table 1 Hair dyes Properties and Example**

| S.No. | Types | Properties | Examples with INCI name. |
|-------|-------|-----------|--------------------------|
| 1 | Natural | Herbal Origin, Less Toxic | Heena, Walnut, Chamomile, Retha, Jatamanshi |
| 2 | Temporary | Non oxidative, High molar mass, Acidic, anionic, leaves hair after one wash, cover 15% of hairs. | Acid Yellow 23, Acid Orange 7 Acid Yellow 1 Acid Red 33 Acid Blue 9 Acid Black 1 |
| 3 | Semi-Permanent | Non-Oxidative, Cationic, Nitro aromatic amine or aromatic nitroanthroquinone, leaves hairs after 4-6 wash | 2-nitro-p-phenylenediamine, 4-nitro-o-phenylenediamine, HC Yellow No.3, HC Red No.4, Disperse black 9, Acid Orange 3, HC Yellow No.1 |
| 4 | Permanent | Oxidative, Low molecular weight, Cover 100 % hair, p-diamines and p-diamino phenols | 4-chlororesorcinol 2,4-diaminophenoxyethanol HCl, 4-amino-2-hydroxytoluene, 2-amino-hydroxyethylaminoanisole sulphate, Resorcinol, *m*-aminophenol |

**Composition of Permanent Hair dyes:**

**Coupling Agent:** These are sometimes called as Reaction modifiers. These are derived from benzene ring and are aromatic in nature with substitution at ortho and meta position by electron donating group i.e., $NH_2$ and OH to facilitate oxidation. Couplers does not produce colour separately but they modify the hair colours where they react with primary intermediates or oxygen releasing compound. Examples of coupling agent includes p-phenylenediamine, resorcinol, p-aminophenol [17].

**Alkalizing agent:** These are one of the most important component of hair dyes which are responsible for adjusting pH to begin the oxidation reaction. They have ability to hide the 100% grey hairs by removing melanin (natural pigments) from the hairs, as they produce coloured complex after the reaction between precursor or coupler in hair cortex, it become difficult to remove these. Reducing agent like sodium hypochlorite can be used for removal of these. Example of alkalising agent includes ammonia/ammonium hydroxide, mono-ethanolamine, triethanolamine etc. Methanol amine is used for maintaining similar colours or maintaining the dark shade because it does not get oxidized in the medium [18].

**Reducing agent:** These are added to hair dye preparation to prevent the reaction between the coupling agent and the alkalizing agent in the packed container during the shelf life. Most commonly used reducing agent in hair dyes is sodium meta bisulphite [19].

**Antioxidants:** These are added to hair dyes to prevent the initiation of reaction before oxidising agents are added to the formulation. Generally, water soluble anti-oxidants are recommended, as alkalizing agent and reaction modifiers may initiate the oxidation reaction which could affect the final colour of hair dyes. One of the most common examples of water-soluble dye is erythorbic acid. Oil soluble can also be utilised when the vehicle used in the form of emulsion as these can present yellowing of fatty bases (wax). Example of commonly used base is t-butyl quinone [20].

**Oxidants:** Generally, two different forms of anti-oxidants are being used in preparation, one is hydrogen peroxide which is highly unstable and requires addition of stabilizers (Sodium stannate and Potassium stannate. It is available in the form of emulsions known as "creamy hydrogen peroxide" and used water as a vehicle.

**Vehicles:** Oxidative Permanent hair dyes are available in the form of emulsions, solutions, gels and powder. Among all of these most commonly used marketed preparation is of emulsion type.

## Preparation of Permanent Oxidative Dye:

For the preparation of emulsion type of hair dyes, first dye mixture was added to the reducing agents, antioxidants and ammonium hydroxide which contribute around 20% of aqueous phase and remaining 80% aqueous phase was heated up to 70 C under constant stirring. After reaching the temperature the wax and emulsifying bases are added to 80% aqueous under constant stirring until cooling to 40 C. To the above mixture previously prepared 20% aqueous phase was added. At last ammonium content was checked to ascertain the alkalising agent quantity as it is highly volatile, there are always chances of its loss.

## Mechanism involved in hair dye formation:

p-phenylenediamine reacts with the coupling base in the presence of hydrogen peroxide in the alkaline medium leads to formation of Bondrowski Base. The molecular formula for Bondrowski base is $C_{18}H_{18}N_6$ and its CAS number is 20048-27-25. It is the compound which is responsible for further reaction with the modifiers and the reaction continues until final colour formation takes place. Around 3 to 5% of Bondrowski base is formed which does not have any influence on final colour during oxidation reaction. The reaction rate is slow around 30 to 40 minutes.

There are basically three steps; Step 1 Oxidation of P-phenylenediamine into Quinoamine intermediate, Step2. Formation of Indo-phenolic compound by the reaction with the electrophilic group, Step3. Formation of coloured complex by the reaction between the indophenol compound formed at the second stage [21].

## Toxicity associated with Repetitive and Prolong use of Hair Dyes:

Hair dyes basically consist of p-phenylenediamine and p-toluene diamine mixed with m-phenols and resorcinol's as couplers are used as oxidising agent. Hydrogen peroxide is responsible for initiating colour dyeing process. If hydrogen peroxide gets higher in the preparation, it removes sulphur from the hairs making them harder that's why its concentration is kept less then 30%. Temporary hair dyes have azo triphenylmethane, indamines while semipermanant have nitrophenyl diamine or nitro aminophenol. During 1980 some hair dye chemicals were banned due to mutagenic and carcinogenic effect. Chemicals which are used in hair dyes have mild to high toxicity. Different cohort studies showed the linked between the permanent hair dyes and the associated cancer risk. The use of permanent hair dye has been reported with leukaemia, non-follicular Hodgkin disease.

Para-phenylene diamine which is the potent sensitizer in the hair dyes, is used as intermediate in the permanent formulation was declared as Contact allergen in Year 2006 by American Contact dermatitis society. Mild reaction associated with it involved dermatitis's in upper rim of the Hair and in most severe cases swelling and reddening of face and scalp. Hair dresser also developed dermatitis on hands, patch test revealed that hypersensitivity reactions are mainly due to it and accounts 6.0 % in North America, 4.4 % prevalence in Asia and 4.1 % in Europe. European union allows around 6% of it in the formulation. It is immune activator that can cause severe hypersensitivity reaction inside the mice. It caused delayed type hypersensitivity reaction and involve cytokine activation and T-cell infiltration. Some recently developed preparation promotes the use of toluene diamine sulphate in the semi-permanent and permanent dyes as it is less allergic in comparison with it and can be tolerated by 50 % of the people.

Toluene 2-5 diamine, another most frequently used chemical in the preparation of permanent oxidative hair dye is also a potent immune activator and shows pro and anti-inflammatory actions. The hair dye containing 1.60 % of it initiate T-cell and B-Cell infiltration due to which number of T-cell in lymphoid tissue increases while the use of it in lower concentration around 0.48% only showed skin inflammation and minor response. Use of these in the concentration of 3 to 4 % were found to be safe and effective for the use.

Studies were done to find risk associated with the hair dyes in developing cancer in laboratory animals. Some of them showed to cause cancer while others show when dye is applied to the skin, it is absorbed through the skin and reaches into bloodstream and does not showed any link between use of hair dyes and cancer. Still more studies are needed to get clear evidence [22].

## CONCLUSION

Hair dyes are the most utmost gentle manner. As world scenario is changing day by day so natural remedies are more preferred over the traditional thing usage. So, plants play an important role in all sector almost because they are safe in use and have less side effects. These herbal based cosmetics are non-toxic, non- irritable, non-habit, no chemicals in nature. It provides nourishment and gentle smoothness to the hairs and the scalp. Hair dyes basically remove excess oil and treat various hair related problems like dandruff, fizziness, greying etc. After frequent use of hair dyes hair becomes manageable and have shine and smoothness. Contamination, maturing, stress and cruel environments severely influence the nature of hair. In this examination, we observed powerful properties of the natural hair pack and further investigations are should have been performed to investigate more helpful advantages of this home-grown hair pack. Normal cures are broadly acknowledged with open hands these days as they are more secure with insignificant aftereffects when contrasted with chemical-based products. Natural remedies are in incredible interest to satisfy the requirements of the developing market. In this article we have discussed a various types of hair dyes and their composition. Alkaline medium goes about as an essential job in hair shading component, on the grounds that the response happens in a soluble medium and it advances the opening of cuticles of the hair skin that permits the infiltration of the colors particles into the cortex. P-Phenylenediamine goes through a coupling response within the sight of the oxidizing agent with higher pH and structure a Bandrowski's base.

## REFERENCES:

1. Shahi Z, Mehrizi MK, Hadizadeh M. A review of the natural resources used to hair color and hair care products. Journal of Pharmaceutical Sciences and Research. 2017 Jul 1;9(7):1026.

2. Chisvert A, Miralles P, Salvador A. Hair Dyes in Cosmetics: Regulatory Aspects and Analytical Methods. InAnalysis of Cosmetic Products 2018 Jan 1 (pp. 159-173). Elsevier.

3. Dias MF. Hair cosmetics: an overview. International journal of trichology. 2015 Jan;7(1):2.

4. Shahid M, Mohammad F. Recent advancements in natural dye applications: a review. Journal of Cleaner Production. 2013 Aug 15;53:310-31.

5. Shahi Z, Mehrizi MK, Hadizadeh M. A review of the natural resources used to hair color and hair care products. Journal of Pharmaceutical Sciences and Research. 2017 Jul 1;9(7):1026.

6. Sankar J, Sawarkar S, Malakar J, Rawat BS, Ali MA. Mechanism of Hair Dying and Their Safety Aspects: A Review. Asian Journal of Applied Sciences. 2017;10:190-6.

7. Da França SA, Dario MF, Esteves VB, Baby AR, Velasco MV. Types of hair dye and their mechanisms of action. Cosmetics. 2015 Jun;2(2):110-26.

8. Nohynek GJ, Fautz R, Benech-Kieffer F, Toutain H. Toxicity and human health risk of hair dyes. Food and Chemical Toxicology. 2004 Apr 1;42(4):517-43.

9. Khan S, Sultana N, Ahmad S. Health Risks of Synthetic Hair Dyes; Advantages of Natural Hair Dying Agents in Unani Medicine. Traditional and Integrative Medicine. 2019 Mar 18:37-46.

10. Kim KH, Kabir E, Jahan SA. The use of personal hair dye and its implications for human health. Environment international. 2016 Apr 1; 89:222-7

11. Hamdouk MI, Abdelraheem MB, Taha AA, Benghanem M, De Broe ME. Paraphenylene diamine hair dye poisoning. InClinical Nephrotoxins 2008 (pp. 871-879). Springer, Boston, MA.

12. Chong HP et.al. para-Phenylenediamine Containing Hair Dye: An Overview of Mutagenicity, Carcinogenicity and Toxicity. J Environ Anal Toxicol 2016;6(5):403.

13. S.G. DESIGN AND EVALUTION OF HERBAL HAIR OIL FORMULATIONS BY USING ETHANOLIC EXTRACT OF Ziziphus jujuba Mill. LEAVES Int J Pharma Bio Sci 2017; 8(3): 322-7.

14. Rehman S, Khan SA, Sultana S, Ahmad S. Health Risk of Synthetic Hair Dyes: Advantages of Natural hair dyeing agent in Unani Medicine Trad Integer Med 2019; 4(1), 37-46.

15. Anjali J¸. Hair care formulations. World J Pharm Pharm Sci 2016; 5(6): 630-48.

16. Aparecida¸ S., Ferrera¸ M., Brigatto¸ V., Rolim¸ A.¸ Cosmetics. 2015¸ 2, 2, 110-126.

17. Boga¸C.¸ et al.¸ Dyes and Pigments. 2013¸ 97, 9-18

18. Patel, M.¸ et al.¸ J Adv Pharm Tech Res. 2013¸ 4, 3, 160-165.

19. Nigha, M.¸ Zafar, M. H.¸ Ghaffar, A.¸ Imperial Journal of Interdisciplinary Research. 2016¸ 2, 2, 190-197.

20. Saif, F. A.¸ Journal of Pakistan Association of Dermatologists. 2016¸ 26, 1, 58-65.

21. Naishadham, P.¸ S. P.R.¸ Dasika, R.¸ Tangirala, S.¸ Tangirala, S.¸ International Journal of Pharmaceutical Sciences Review and Research. 2013¸ 21, 2, 152-157.

22. Green, C.L.¸ Food and agricul ture organization of the United Nations.1995¸ 1-116.

## CONSUMER PERCEPTION ABOUT HAIR SHAMPOO

**Avil Saldanha[1] and Ananthu Sunil[2]**

[1]Assistant Professor and [2]Student, St Joseph's Institute of Management, 28/1, Primrose Road, Bangalore, India

**ABSTRACT**

*Hair shampoo usage has significantly increased among Indian consumers especially after the introduction of small-sized shampoo sachets. However, the majority of the Indian consumers are price-sensitive and use basic level personal care products including shampoos. The urban Indian consumers are brand conscious and buy shampoos to address specific problems like dandruff, hair fall, dry scalp, etc. Cheaper floral perfume shampoos in low-cost sachet packing are popular in rural areas. In this context, the present study tries to examine the consumer perception of Indian consumers towards hair shampoo. This study tries to understand the consumer perception of Indian consumers concerning hair shampoo. The study also tries to analyze the buying behaviour of consumers and find out the major factors that influence consumers' buying decision of hair shampoo. Major findings of this study are that packaging plays an important role in the purchase of hair shampoos. The study found that smell of the shampoo is an important element for consumer preference towards hair shampoo. It was found out that majority of the respondents wanted their shampoo to be sulfate and paraben-free shampoos. This study found that a vast majority of the respondents preferred to have a medium level foam formation shampoo. It was found that 80% of the respondents use conditioners regularly or occasionally after using hair shampoos. The researchers conclude that it is evident that hair shampoo marketers need to give importance to packaging, ingredients, perfumes and level of foaming while manufacturing and marketing hair shampoos. Hair conditioners provide an attractive area for growth in the Indian market. Hair shampoo marketers have already introduced hair conditioner sachets but these are prevalent in the urban areas. Hair care brands need increase the awareness of rural consumers regarding use of hair conditioners. This can provide future path of growth for hair care products marketers in India.*

*Keywords: Hair shampoo, consumer perception, hair care, buying behaviour, packaging*

**INTRODUCTION**

The main purpose of hair shampoos is to cleanse the scalp and hair. They are made with a combination of different ingredients such as surfactants, foaming agents, conditioners, thickeners, opacifiers, sequestering agents, preservatives, special additives, and fragrance (Vinall, 2020, October 28). Shampoos have become an integral part of the personal care routine and habit. The market for shampoos around the world is flourishing due to a rising commonness and prevalence of disorders related to hair such as dandruff, hair fall, oily hair, dryness of hair and itchiness, and many others. The changing lifestyle and growing urbanization along with increasing environmental pollution initiated the growth of the shampoo market around the globe. The global shampoo market size is predicted to grow from USD 30.89 billion in 2021 to USD 39.58 billion by 2028 at a CAGR of 3.6% between 2021 to 2028 (Fortune Business Insights, 2021, August 26).

**REVIEW OF LITERATURE**

Vaish (2006) observed that women spending is higher on skincare and hair care products whereas men spend higher on perfumes. Ragavendran *et al* (2009) found that quality, packaging, and benefits offered were the main attributes influencing the consumers during the purchase of shampoos. Mohanty (2012) studied the positioning of Indian shampoo brands and based on the results of his study he recommended that shampoo industries should concentrate on three important attributes namely: brand image, hair care, and value for money. The findings of the study further emphasized that consumers gave most importance to brand image and hair care while choosing shampoo brands. Sharma & Mehta (2012) observed that the frequency of hair shampoo usage by males was much lesser than females. They found that consumers used shampoos to clean their hair and not to make their hair healthier and stronger. They indicated that the consumers did not show any special preference towards natural shampoos. The results of this study indicate that maximum consumers preferred television advertisements and that consumers were not satisfied with the quality of hair shampoos. This study also found that sachets are preferred over bottles by the majority of consumers.

Birjandi & Birjandi (2013) in their study focusing on Iranian consumers' hair shampoo buying behaviour found that consumers gave the highest rank to cleaning power whereas colour of the shampoo was given the least rank among all of the benefits listed by the researchers. Rahman & Kazi (2013) analyzed the expectations of the consumers concerning shampoo brands. Their research revealed that hair fall was the most preferred reason for using a shampoo brand. They found that the most preferred expectation of customers was hair cleaning. Also, the findings of their study indicated that moisturizer was considered as the least preferred expectation, and the

fragrance was termed as the least preferred reason stated by consumers for choosing a shampoo brand. Thapa (2013) found that the major factors that influence the switching behaviour of consumers with regards to shampoo are price rise of the current brand, packaging, impact of advertisement, peer group influence, and variety-seeking behaviour. Sudhakar & Rani (2013) conducted a comparative study among the respondents from two major Indian cities namely Hyderabad and Mumbai about the effect of demographic determinants on the purchase of personal care products. They found that age and income had no significant influence on the buying behaviour of consumers for hair shampoos in both cities. The results of the study indicated that occupation had an influence on the purchase of shampoos in Hyderabad but no significant influence in Mumbai. Also, the study indicated that education had an influence on the purchase of shampoos in Mumbai but no significant influence in Hyderabad. Rao, Karnam & Reddy (2014) found that the majority of the respondents use the shampoo once a week indicating the frequency of shampoo usage is low in South India. They also found that respondents are satisfied with their current shampoo brand.

## OBJECTIVES OF THE STUDY

The study tries to understand the consumer perception of Indian consumers concerning hair shampoo. The study also tries to analyze the buying behaviour of consumers and find out the major factors that influence consumers' buying decision of hair shampoo.

## DATA ANALYSIS

The data was collected using a structured questionnaire. The findings of the survey with descriptive charts are as follows:



It was found out that majority of the respondents did care about the visual attractiveness of the shampoo while choosing the product. This proves that the packaging of the product did have an influence on the consumer buying behaviour of the customer. More than 50% did care about the visual attractiveness of the package.
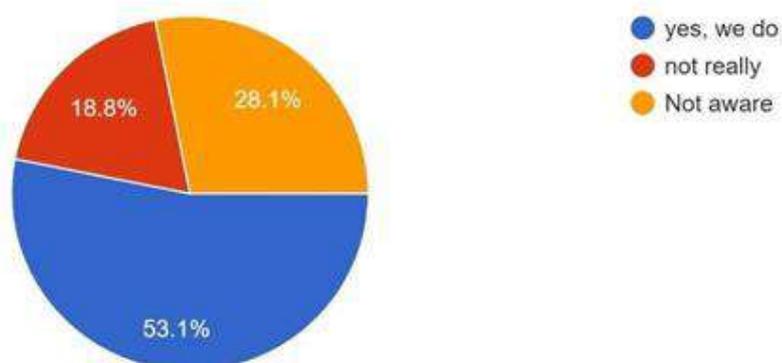


It was found out that majority of the respondents wanted their shampoo to be sulfate and paraben-free shampoos. This shows how aware consumers are about the product features. Sulfate and paraben-free shampoos reduce irritation and itchiness on the scalp and prevents dry hair formation. Hence, it's a feature that most shampoos must have in the current circumstances. It was also found that 28 percent were not aware what the term "sulfate and paraben-free" means.

**Do you give preference about the smell of the shampoo?**

32 responses



- always
- most of the time
- rarely
- I care about the brand more than its smell
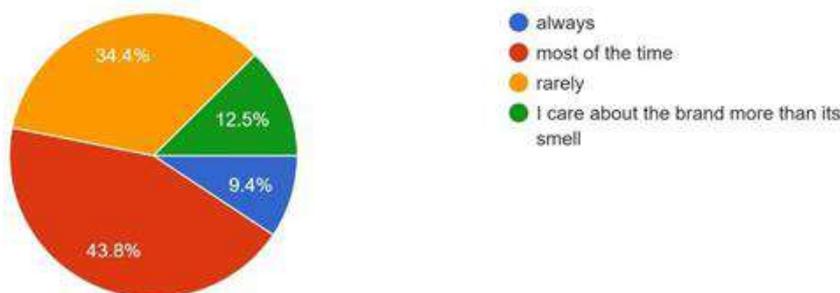
It was found out that majority of the respondents did care about the aroma and scent of the shampoo that they purchase. Hence, it is important for a shampoo to have good aroma in order to attract the customers and gain more sales. It was also found that 12 percent of the respondents cared about the brand image of the shampoo rather than its good smell.

**How would you like the foam level of the shampoo to be?**

32 responses



- Low foam
- medium foam formation
- high foam formation
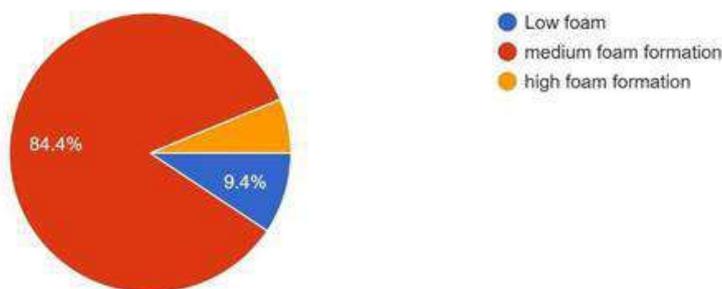
It was found out that a vast majority of the respondents preferred to have a medium level foam formation shampoo. Hence, Shampoo manufacturers should try and reduce its foam level from high foaming to medium foaming in order to gain more customers.

**Do you need to use conditioner after shampoo?**

25 responses



- Yes
- Maybe
- No
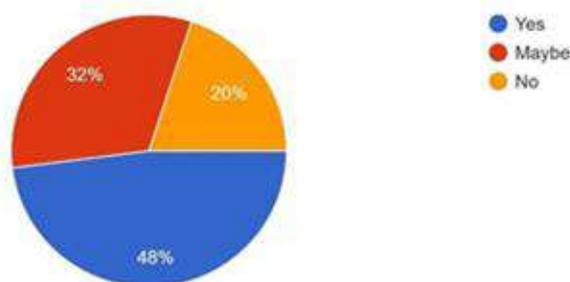
It was observed that majority of the respondents did use hair conditioner after shampoo. 48 percent of the customers used hair conditioner, 20 percent did not use hair conditioner and 32 percent were not regular users.

## DISCUSSION

The major findings of this study are that packaging plays an important role in the purchase of hair shampoos. Hence it is advisable for shampoo brands to have attractive visuals in the shampoo bottles and sachets. Also, the shape of the shampoo bottle is an important element of packaging attractiveness. The study found that smell of the shampoo is an important element for consumer preference towards hair shampoo. This finding is in line with consumer behavior literature which presents smell as one of the most basic senses of human beings having a huge impact on consumer preference and buying behaviour.

Sulphates are present in most of the hair shampoos in forms such as Sodium Laureth Sulphate (SLES), sodium lauryl sulphate (SLS), Sodium Lauryl Sulphate Sodium, Lauryl Sulfoacetate Sodium, Sodium Lauroyl Taurate, Laureth Sulphate Sodium, Lauroyl Isethionate etc. Sulphates, both sodium lauryl sulphate (SLS) and sodium

laureth sulphate (SLES), are considered effective when it comes to removing dirt and oil from hair. One of the major risks of using products containing sulphates is that it can lead to eyes, mouth, lungs and skin irritation (Sense, 2021, September 23). The findings of this study show that majority of the respondents prefer hair shampoo which do not contain sulphates. Hair shampoo brands can incorporate alternative ingredients which are safer for removing dirt and oil from hair. This can differentiate their products from the competitors and thus increase sales.

Traditionally Indian consumers liked high foaming soaps and hair shampoos, since foam was associated with strength of the soap. But the perception of the present generation has changed, Consumers now prefer medium foaming hair shampoos as they are environmentally conscious and also aware that foaming not directly associated with cleaning. The low foaming products for laundry washing machines and other domestic cleaning purposes might have changed this perception of consumers. High foaming products also consume more water and water is already a scarce commodity. Hence shampoo manufacturers need to reduce excessive foam and produce moderately foaming hair shampoos. 80% of the respondents use conditioners regularly or occasionally after using hair shampoos. This is a great opportunity to hair shampoo marketers for cross selling and product bundling. Shampoo brands need to provide adequate stock of hair conditioners along with hair shampoos because the consumers usually prefer the same brand of conditioner with same perfume as the hair shampoo.

## CONCLUSION

The researchers conclude that the Indian hair shampoo market is a constantly evolving market and provides immense opportunities to marketers. Most of the Indian consumers in rural and semi urban areas and also lower middle-class consumers in urban areas use hair shampoo sachets. Indian consumers are price sensitive but also quality conscious and display variety seeking behaviour. From this study it is evident that hair shampoo marketers need to give importance to packaging, ingredients, perfumes and level of foaming while manufacturing and marketing hair shampoos. Hair conditioners provide an attractive area for growth in the Indian market. Hair shampoo marketers have already introduced hair conditioner sachets but these are prevalent in the urban areas. Hair care brands need increase the awareness of rural consumers regarding use of hair conditioners. This can provide future path of growth for hair care products marketers in India.

## REFERENCES

- Fortune Business Insights. (2021, August 26). Shampoo Market to Hit USD 39.58 Billion by 2028; Custom Made Hair Cleanser to Augment Market Growth, Says Fortune Business Insights TM. GlobeNewswire News Room. https://www.globenewswire.com/news-release/2021/08/26/2287347/0/en/Shampoo-Market-to-Hit-USD-39-58-Billion-by-2028-Custom-Made-Hair-Cleanser-to-Augment-Market-Growth-Says-Fortune-Business-Insights.html

- Kashi, A. N. (2013). Exploring consumer purchase behaviour: Foreign versus local brands. *Global Business Review*, *14*(4), 587-600.

- Ragavendran, P. G., Devakumar, G., & Upadhyay, S. (2009). A Study on Brand Awareness of Shampoo Products for CavinKare Pvt. Ltd. SASTech-Technical Journal of RUAS, 8(2), 33-40.

- Sense, P. (2021, September 23). *Sulphate in Shampoo – What Does Sulphate Do To Your Hair*. Pure Sense. https://puresense.co.in/blogs/what-does-sulphate-do-to-your-hair/#:%7E:text=Asked%20Questions%20(FAQs)-,What%20is%20Sodium%20Laureth%20Sulphate%20for%20Hair%3F,a%20very%20effective%20foaming%20agent.

- Sharma, H., & Mehta, S. (2012). Customer Attitude Towards the Use of Shampoos. International journal of research in finance and marketing, 2(2), 276-277.

- Sudhakar, A., & Rani, T. S. (2013). Empirical Investigation of Demographic Determinants in Consumers' Preference of Personal Care Products. *Journal of Management Research, 13*(2), 89-104.

- Thapa, A. (2012). Consumer switching behaviour: A study of shampoo brands. *National Monthly Refereed Journal Of*, *370*(3).

- Vinall, M. (2020, October 28). Shampoo Ingredients for Different Hair Needs: What to Look For. Healthline. https://www.healthline.com/health/shampoo-ingredients-for-different-hair-needs

## A GENERATING FORMULA FOR HERMIT SEQUENCE OF POLYNOMIALS

**Hitesh**

Student, M.SC Mathematics, CRSU JIND

**ABSTRACT**

*It develops a formula that explicitly expresses the general term of a linear recurrent sequence, allowing us to generalize J. McLaughlin's original finding on powers of 2 matrices to the case of a square matrix of size $m \leq 2$ matrix. The identities of Fibonacci and Stirling numbers, as well as a variety of combinatorial relations, are deduced. It uses two-variable Hermite polynomials and their operational laws to derive integral representations of Chebyshev polynomials. Most of the Chebyshev polynomial properties can be obtained using the Hermite polynomials $H_n(x)$ definitions and formalism. They also show how to use these results to introduce valid generalizations of these polynomial groups and derive new identities and integral representations for them.*

*In Number Theory we work on numbers in mathematics many types of numbers for examples Even number, Odd number, prime number, complete square number etc. In Number Theory we want a solution in integers. Many basic theorems have proved in Number Theory. There many representations of Fermat and Pell polynomials in number theory we are also giving a special representation of Fermat and Pell polynomials.*

*Keywords: Sequence, recurrence relation, number theory, coefficient.*

## INTRODUCTION

A polynomial is a meaning that can be derived from constants and signs referred to as variables or indeterminate to a non-negative integer power. Two those terms that can be modified, one to another, if the normal characteristics of commutatively are used, the distribution and addition and multiplication's distributivity is considered as defining same polynomial. A polynomial within one indeterminate $x$ may always have to be generated (or rewritten) in the way:

$$a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0 \qquad \text{Eq. (1.1)}$$

Where $a_0, \ldots, a_n$ are constants and $x$ is the indeterminate. The word intermediate does not mean an x representative is any unique value; but that any value will have to be replaced by any value. The characterization that marks the product of this replacement to the substituted value is a feature called Polynomial function. This can be expressed more concisely by using summation notation:

$$\sum_{k=0}^{n} a_k x^k \qquad \text{Eq. (1.2)}$$

So that is, there can be either zero polynomials or that can be defined as the sum of the amount of nonzero. Each is a sum of the commodity of a numerical coefficient and several indeterminate conditions brought to non-negative integer powers.

In the elementary algebra methods are taught by the quadratic structure to solve all the polynomial equations in a single variable of the first and second degrees. There are also forms for the cubic and quartic equations. The theorem Abel-Ruffini states that, to higher degrees, a general formula does not exist in radicals. However, you can use root finding algorithms to find numerical approximations in any degree of a polynomial expression. The value of a polynomial equation with actual coefficients must not exceed a coefficient degree, equivalent to the degree upon which complex ones can be counted with multiple solutions. This was known by a basic theorem of algebra. If there is not an algebraic sense for the origins, and when there is an algebraic expression which is so strappy, a unique method of solving the finds is the sequence compute estimates for the solutions. For this, there are many approaches; some are concentrated on polynomials and some may be based on either continuous function MEA(Most Efficient algorithm) algorithms can be easily accessed on a computer to resolve polynomial equations greater than 1,000 degrees (Root-finding algorithm).

In the case of polynomials at times of greater than one indeterminate setting, the combination of values of the variables with the polynomial function having the value null is often referred to as zeros rather than root. The subject of algebraic geometry is to study the sets of Polynomial zero. For a series in multiple unknown polynomial equation of algorithms to determine if they have finite numbers of complicated remedies, and a solution computation for them, if its number is finite. As a single conversion of the acclaimed special polynomials, the hybrid clan of unique polynomials was added. The development or treatment approach used by replacement techniques or service techniques in which two different individual polynomials are combined is called polynomial hybridization, which means that the properties of noted parent polynomials background.

The special situation where all polynomials are of type one is defined as the linear equation structure with a range of various methods of fixing, including the conventional Gaussian elimination. A Diophantine equation is called a polynomial equation for which one is interested only in solutions that are total. It is usually an exceedingly difficult task to solve Diophantine equations. It was shown that no general algorithm can be implemented for their solution and even to determine whether the selection is blank (Hilbert). Diophantine equations such as Fermat's Last Theorem related to some of the most famous problems that have been addressed in the last fifties.

Sequences of polynomials play a significant part in the advancement of applied mathematics. The functionality generating sequence functions of pools can use the analysis of sequence function, recognition of a closed sequence formulation, the recurrence ratios of pocket formulas and differential complements. It can also exploit its creativity function to create alliances among sequences, to obscure the behavior of sequences, to prove the identities expressed in the sense of sequences and to resolve problem enumeration in combinatory and finds solutions with such charges. Sequence is often used in physics as an especially important and useful subject in mathematics. Some sequences with recurrence and initial terms are provided with several types of sequence. A significant subject in mathematics is a recurrent relationship. The relationships of recurrence are used in mathematics and economics, physics, and other topics. The key effects of the convergence of the series of recurrence depend on the recovery coefficient in this chapter. In a broad range of fields, speaking especially in mathematics and computational sciences, recursive parts occur effectively. The linear recursive sequences are one of the most widely studied groups. The series can be defined by a value of the initial k values elements, while any subsequent element can be achieved linear by the combination of the k values of the foremost elements.

Mathematicians have for a long time been using recurrent meanings and recurrences. Some things people use to identify them: There are several unique forms of Fibonacci sequence in numerical theory and Luca sequence are both special kinds of recurrence relationship with the original terms. Mathematical recurrence relationships are especially useful. The equation describes a series based on a method that provides a reference to the preceding terms for the next term. The relationship of recurrence in mathematics and economics is greatly beneficial. Via recurrence techniques, It can estimate economic growth. There must find all previous sequence terms in a recurrent relation to any sequence term, but with this theorem it can find any sequence term directly. Recurrence relationships in mathematics as well as economics are used; It can quantify growth in the economy through recurrence techniques and are especially useful for addressing real-life problems. A recurrence relationship can entail several issues in real life and can be resolved by a recurrence. Network marketing is often a special form of ongoing partnership, and recurrent procedures can address many network marketing issues.[1][2]It must find all previous sequence terms in recurrent relationships, but it can find any sequence term directly using the theorem. There are also particularly important identities in recurrence relationships, which are only true for two orders but are valid for all orders.

## Theorem on recurrence relation sequence

**Theorem 1**: - Let $c_1, and \ c_2$ are arbitrary real numbers and suppose the equation

$$x^2 - c_1 x - c_2 = 0 \quad \quad (1)$$ has $x_1, and \ x_2$ are

distinct roots. Then the sequence $< a_n >$ is a solution of the recurrence relation

$$a_n = c_1 a_{n-1} + c_2 a_{n-2} \quad n \geq 2 \quad \quad (2) \quad \quad \text{iff}$$

$$a_n = \beta_1 x_1^n + \beta_2 x_2^n$$

for n= 0, 1, 2, ………………where $\beta_1, and \ \beta_2$ are arbitrary constants.

**Proof**: - First suppose that $< a_n >$ of type $a_n = \beta_1 x_1^n + \beta_2 x_2^n$ we shall prove $< a_n >$ is a solution of recurrence relation (2). Since $x_1, and \ x_2$ roots of equation (1) so all are satisfied equation (1) so we have

$$x_1^2 = c_1 x_1 + c_2$$

$$x_2^2 = c_1 x_2 + c_2$$

Consider $c_1 a_{n-1} + c_2 a_{n-2} = c_1 (\beta_1 x_1^{n-1} + \beta_2 x_2^{n-1}) + c_2 (\beta_1 x_1^{n-2} + \beta_2 x_2^{n-2})$

$= \beta_1 x_1^{n-2}(c_1 x_1 + c_2) + \beta_2 x_2^{n-2}(c_1 x_2 + c_2)$

$= \beta_1 x_1^n + \beta_2 x_2^n + \beta_3 x_3^n = a_n$

This implies

$$c_1 a_{n-1} + c_2 a_{n-2} + c_3 a_{n-3} = a_n$$

So the sequence $< a_n >$ is a solution of the recurrence relation.

Now we will prove the second part of theorem

Let $a_n = c_1 a_{n-1} + c_2 a_{n-2}$ $n \geq 2$ is a sequence with $initial\ terms\ a_0 = A_1, a_1 = A_2$

Let $a_n = \beta_1 x_1^n + \beta_2 x_2^n$

So $\quad \beta_1 + \beta_2 = A_1$ (3) $\beta_1 x_1 +$
$\beta_2 x_2 = A_2$ (4)

from (3) we have $\beta_1 = A_1 - \beta_2$, putting this value in (4) we have

$\beta_2 = \frac{A_1 x_1 - x_2}{x_1 - x_2}$ and $\quad \beta_1 = \frac{A_2 - A_1 x_2}{x_1 - x_2}$

## Theorem on Hermit Polynomials
Let For any integer $n \geq 0$, the famous Pell polynomials $H_n(x)$ is defined as follows:

$H_0(x) = 1, H_1(x) = 2x$, and $P_{n+1}(x) = 2x H_n(x) - 2H_{n-1}(x)$ for all $n \geq 1$ then we can written

$H_n(x) = \frac{1}{2\sqrt{x^2+1}}[x + \sqrt{x^2 - 2}]^n - \frac{1}{2\sqrt{x^2+1}}[x - \sqrt{x^2 - 2}]^n$

**Proof: -** using above theorem (1) with $c_1 = 2x$ , $c_2 = 1$ and using T as variable then we have polynomial of above theorem (1)

$$T^2 - 2xT + 2 = 0$$

and roots of this polynomials are

$x + \sqrt{x^2 - 2}$ and $x - \sqrt{x^2 - 2}$

By above theorem we have

$H_n(x) = \beta_1[x + \sqrt{x^2 - 2}]^n + \beta_2[x - \sqrt{x^2 - 2}]^n$

Using initial terms we have

$\beta_1 + \beta_2 = 1$ (a)

$\beta_1[x + \sqrt{x^2 + 2}]^1 + \beta_2[x - \sqrt{x^2 + 2}]^1 = 2x$ (b)

**Solving** (a), (b) we have $\beta_1 = \frac{[x+\sqrt{x^2+2}]}{2\sqrt{x^2+2}}$ , $\beta_2 = \frac{[\sqrt{x^2+2}-x]}{2\sqrt{x^2+2}}$

So we can write

$H_n(x) = \frac{[x+\sqrt{x^2+2}]}{2\sqrt{x^2+2}}[x + \sqrt{x^2 + 1}]^n + \frac{[\sqrt{x^2+2}-x]}{2\sqrt{x^2+2}}[x - \sqrt{x^2 + 1}]^n$

## CONCLUSION
Recurrence relation is very useful topic of mathematics many problems of real life many be solved by recurrence relations but in recurrence relation there is a major difficulty in the recurrence relation if we want find 5000th term of sequence then we need to find all previous 999 terms of given sequence then we can get 500th term of sequence but above theorem is very useful if coefficients of recurrence relation of given sequence are satisfied the condition of the above theorem then we can apply above theorem and we can find direct value of any term of Pell and Fermat polynomials sequence at any value of variable x which satisfied above condition.

## REFERENCES
[1] M. Crampin, Piecewise linear recurrence relations, *The Mathematical Gazette*, 76 (477),1992, pp. 355–359.

[2] Vipin Verma , Mannu Arya , "Generalized Relation between the Roots of Polynomial and Term of Recurrence Relation Sequence," Mathematics and Statistics, Vol. 9, No. 1, pp. 54 - 58, 2021. DOI: 10.13189/ms.2021.090109.

[3] W. Zhang, "Some identities involving the Fibonacci numbers and Lucasnumbers,"TheFibonacciQuarterly,vol.42,no.2,pp. 149–154,2004.

[4] M.Arya & V.Verma,A Special Representation of Chebyshev Polynomials, jour Adv Research in Dynamical & Control Systems, vol.11,Issue-07,2019.

[5] A. F.Horadam" The Generalized Fibonacci Sequence" The American Math. Monthly, Vol. 68(1961), No. 5, pp. 455-459.

[6] M.arya & V.verma, Relation Between The divergence of a recurrence relation sequence and coefficient of Recurrence Relation issue-67 vol.-2 july-december-19.

[7] K.Ozeki,"OnMelham'ssum,"TheFibonacciQuarterly,vol.4647,pp.107–110,2008.

## ASSESSING TALENT MANAGEMENT STRATEGIES IN PUBLIC AND PRIVATE SECTOR BANKS

**Poornima Thakur[1] and Dr. (Mrs.) Archana Agrawal[2]**
[1]Ph.D Scholar, Dr. C.V. Raman University kota Bilaspur 495001 (C.G.)
[2]Associate Professor, Commerce & Management, Dr. C.V. Raman University Kota Bilaspur 495001 (C.G.)

**ABSTRACT**
*Usually the bank job is considered safe and secure, but not very demanding in terms of work output. It is difficult to fire an employee for non-performance. Banking is like any other business and the staffs have to carry out multifarious activities. Some of these activities are specialist in nature. At the same time some of the activities are in no way related to banking competencies and could be outsourced. Banks need to make some institutional changes to adapt to the markets. In this study various programmes and strategies framed by the banks for attracting, hiring and retaining the employees have been discussed. Further, the role of government in this area has also been explored.*

*Keywords: Talent management, Strategies, Public banks, Private Banks, Banking programmes.*

## 1. INTRODUCTION
1.1 Talent management Talent management is the systematic attraction, identification, development, engagement/ retention and deployment of those individuals with high potential who are of particular value to an organization (CIPD, 2006, 2008). Talent management referring to an organization's effort to attract, select, develop and retain talented key employees (Stahl et al., 2007). "Talent management, which is _the implementation of integrated strategies or systems designed to increase workplace productivity by developing improved processes for attracting, developing, retaining, and utilizing people with the required skills and aptitude to meet current and future business needs‖ (Lockwood, 2006). "Talent management can be defined as the implementation of integrated human resource strategies to attract, develop, retain and productively utilize employees with the required skills and abilities to meet current and future business needs.‖ (Kontoghiorges and Frangou, 2009). TM is aimed at the systematic attraction, identification, development, engagement/retention and deployment of high potential and high performing employees, to fill in key positions which have significant influence on organization's sustainable competitive advantage. In brief talent management is a process which starts from attracting the employees to managing and retaining them in organization.

## 2. OBJECTIVES
To explore the various Talent Management strategies and programmes framed by various banks.

## 3. NEED AND IMPORTANCE OF TALENT MANAGEMENT
Till date, the research on talent management has mostly focused on current organizational practices, but it often lacks a theoretical perspective. Recent reviews have come to the conclusion that the academic field of TM is characterized by a lack of definitions and theoretical frameworks (Lewis & Heckman, 2006; Nijs, GallardoGallardo, Dries, &Sels, Meyers & van Woerkom, 2014). In fact, the lack of consistent definitions appears to be the reason why there are at least three different ways of interpreting TM in practice: (1) TM is often used simply as a new term for common HR practices (old wine in new bottles), (2) it can allude to succession-planning practices, or (3) it can refer more generically to the management of talented employees (Lewis & Heckman, 2006). In short, neither a uniform understanding of the term _talent management' is there, nor of its aims and scope. Basically the term talent management has no universal or specific meaning or definition. It can be different from person to person and organization to organization as their own perception and requirements of the organization. Some organization sets their specific set of standards or yardstick to measure talent. The employees who attain those specific tasks and standards in the given time along with some additional tasks are considered as talented employees of organization. In a nutshell, there is no one way to measure and identify talent. Now a days managing talent in an organization is itself is a challenging task. No such industry is there which has not been affected by it. The banking sector is one among them. To hire the talented personnel is a challenging task, but to manage them is the most difficult one. In order to make a balance banks started conducting various programme in order to attract and retain the talented employees.

## 4. TALENT MANAGEMENT IN BANKING
Almost all the literature recognizes that talent provides companies with a competitive advantage, and it shares a common concern that not only the talent is scarce, but also most of the companies are not doing enough to manage and retain whatever they have. Human resources as the greatest source of competitive advantage for any organization, human resources deserves the attention and time of managers more than any other

organizational resource or asset (Pfeffer, 1998). The banking sector in India has been largely resilient though the crisis of 2008-09 and are ahead in terms of prudential norms which enabled the Indian banks to weather the crisis. However of late, problems are creeping in - weak appraisals, poor asset quality, frauds, increase in customer grievances, poor risk management, inadequate understanding and leveraging of IT resources, manpower shortages, etc. The fallout of not having adequate talent / organization structure is that one creates a vast network of intermediaries - good, bad or ugly. Either they can coexist or may need to be banished. If they are to coexist, codes of conduct should be laid down, or own structures should be created so that one does not depend on these intermediaries. These are the challenges being faced by Indian banks now

## RSETI (RURAL SELF EMPLOYED TRAINING INSTITUTE): AN INITIATIVE TAKEN BY GOVERNMENT

In the context of the need for promoting self-employment for the unemployed rural youth, especially those below the poverty line, and periodic skill up gradation to keep them abreast of latest technologies, need not be overstated. Once trained appropriately, the youth will contribute to the overall national economy by launching profitable microenterprises and enhancing their own standards of living. Appreciating the rationale to up-scale such development support to rural BPL youth country wide, the Ministry of Rural Development (MoRD) has proposed a new, national scheme called RSETI. Under this, the MoRD will provide Rs. One Crore to the lead bank as a one time grant to set up one RSETI in every district. These institutions will be run by public sector / private sector banks which will be setup for this purpose along with the active support from state government. The RSETIs will provide intensive short-term residential training in trades that enjoy market-acceptance and extend them hand holding support in availing bank credit (Nird RSETI) . On the contrary, banks are also facing challenges in attracting and maintaining talent. Due to rise in competition keeping talented force in an organization is a tough task. To overcome this Bank continues its focus on engagement and retention through initiatives that provides a holistic environment where employees get opportunities to realize their potential. Talent management as an integral part of the overall performance management process in the Bank aims to provide long term, sustained and meaningful careers to employees across the organization. Various programmes is being designed and strategies has been framed by the banks for attracting, hiring and retaining the employees. Please refer Table 1 and Table 2.

## 3. REVIEW OF LITERATURE

**Behera ( 2016),** The author has explained investigate the interrelationship that exists between talent management and employee engagement in Indian Banking sector and also determine the contribution of the talent management as a strategic tool for the organizational development. A survey method was conducted in all the public sector banks of India. Author concluded that the major challenge now for banks as well as any other organization is therefore how to develop their social architecture that generates intellectual capital as the quintessential driver of change.

**Gallardo-Gallardo, Nijs, Dries, & Gallo, (2015),** The author are adopts methods derived from bibliometrics and content analysis to evaluate the state of the field of talent management and to derive implications for research and practice unbiased towards a-priori assumptions of which frameworks or methods are most adequate. Based on their analyses of publication volume, journals and their impact factors, most cited articles and authors, preferred methods, and represented countries, the authors assess whether TM should be approached as an embryonic, growth, or mature phenomenon, and examine dominant (i.e., resource-based view, international human resource management, employee assessment, and institutionalism) versus _alternative' (i.e., knowledge management, career management, strength-based approach, and social exchange theory) theoretical frameworks.

**Deery & Jago, (2015),** The Author are explained employee turnover literature to underpin a discussion of successful talent management. The literature is divided into four themes, namely, employee attitudes, personal employee dimensions, work-life balance (WLB) and organizational strategies for employee retention. These themes are based on Deery's (2008) framework, which provides the boundaries for the search. The search was also limited to literature from the period 2009 to 2013 so that the paper presents an update on the relevance of the framework from 2008. The review conducted of the more recent literature in the field of employee retention and talent management confirmed that the issues identified in earlier literature as being the key drivers of staff retention remain important. However, the literature indicates that WLB is now a prominent factor in determining talent retention, there is still much to be done to assess the relative importance of various strategies that can be implemented to reduce WLB problems.

**Mourougan (2015),** The author has explained that talent management practices implemented with robust technology applications can effectively identify and develop, from all levels of the workforce, the leaders who

will best drive business performance. By identifying people within the organization who have the potential to become leaders and then working with them to fill any gaps in their skills, the organization will be able to build a strong bench of talent. Although there is much to consider when seeking broadening the organization's focus toward fully integrated assessment development architecture, starting with a broad, strategic foundation will pay dividends in leadership growth and business outcomes.

**Nagpal (2014),** The author has explained, reasons for importance for employees as well as organization, benefits to employees and organization, elements of talent management, challenges, strategic talent management has been defined in detail. Author concluded that it has been agreed by almost all top management executives of big companies that it is the human resource - a talented one - that can provide them competitiveness in the long run to achieve the organizational objectives. Hence, it is the duty of the HR department to nurture a brigade of talented workforce, which can win them the war in the business field.

## 3. RESEARCH METHODOLOGY
The present study is based on the secondary data and the data were collected from journals, books, newspapers, and websites.

## 4. Data and Interpretation
### Table-1 Banks for Attracting, Hiring and Retaining the Employees

| | | | **Public Bank** |
|---|---|---|---|
| 1 | Bank of Baroda Baroda | Swarojgar Vikas Sansthan | Launched a scheme for appointing Retired Bank Officers, ASHA workers, Anganwadi workers, fair price shop owners etc as Direct BCs , Banks' in-house trust Baroda Swarojgar VikasSansthan (BSVS) is conducting various types of financial literacy programme, training and skilling programme for villagers , Baroda Swarojgar Vikas Sansthan (Baroda RSETI)<br>• Identifying the need for imparting skill to rural youth and engaging them in self employment ventures  Established 49 centers all over the country to provide free of<br>• Cost vocational training to unemployed youth.  Centers are also providing handholding support to the trained<br>• Youth in availing bank credit and in the establishment of their ventures.  Bank has trained 263378 candidates under this activity out of<br>• Which 159731 have established their ventures successfully up to March 2016. |
| | | Anubhuti programme | This program is an Employee Engagement program for enhancing the employee experience at the workplace with initiatives such as Employee of the Month, Spot recognition, capturing ´WoW moments, ´Zero Hour (Fun hour) at all our branches/ offices, local ´community service / social activity by employees, sports and wellness activities. |
| | | Sparsh Plus | The Bank has launched _Sparsh Plus'with the objective of revamping the performance and talent management systems in Bank. It is aided by the best-in-class technology and digital tools. Bank's intent is to ensure that our people processes and systems provide the staff with role clarity and empower employees to perform their role more effectively, help employees in their development and enable them to enhance their overall contribution. |
| 2 | Indian Bank | Dr. APJ Abdul Kalam Skill Development Training Institute: | Bank along with Swarna Bharat Trust, a service oriented NonGovernmental Organization (NGO) in Vijayawada, Andhra Pradesh and Koneru Lakshmaiah University (KLU), an autonomous University established a —Skill Development Training Institute‖ by the name Dr. A PJ Abdul Kalam Skill Development Training Institute at Kur Village, Krishna District, Andhra Pradesh for training and developing people and improving the skilled man power position by imparting quality training. |
| 3 | Bank Of | Mahabank Self | Bank has set up the institute for providing training to the women for |

| | Mahar ashtra | employment training institute | self employment. |
|---|---|---|---|
| 4 | Canara Bank | Centre for entrepreneurship Development (CED) | CED for Women caters to all training needs of women aspiring to become entrepreneurs. |
| 5 | BOI | Star Swarojgar Prashikshan Sansthan (RSETIs) | It has been set up for providing self employment training e.g. Dairy, Goat Rearing, Poultry, Dress Designing, Beauty parlor, Mobile Repairing, etc with free of cost. |
| 6 | PNB | RSETI | The Bank has 56 PNB Rural Self Employment Training Institutes (RSETIs) across the country wherein free vocational training are provided. |
| 7 | Vijaya Bank | Happiness Programme | Happiness Programme run by bank<br>• To achieve business goals by increasing the happiness quotientof the individuals (staff), the Bank has decided to include a session on Happiness in all it's regular training programme at Staff College-Bangalore.<br>• Aim of this programme is to inculcate and induce the attitude of _deriving and delivering happiness at work place'. If _Serving with smile is imbibed in the culture of our organization, it can manifest into quantifiable quality business in a long run. |

Source: All the program related information has been taken from the respective bank's website.

**Table-2 Banks for Attracting, Hiring and Retaining the Employees**

| | | | **Private Banks** |
|---|---|---|---|
| **S.No.** | **Bank** | **Programme Name** | **Details** |
| 1. | Kotak Bank | KEF | Kotak Education Foundation (KEF)<br>• Works in the area of providing education and livelihood for the underprivileged.<br>• It reached out to approximately 50,000 children and youth through various interventions to empower them, enhance employable skills and improve access to higher education.<br>• Pre-trained manpower acquisition channels such as Kotak Sales Officer (KSO) and Junior Sales Officer (JSO) programme have been further strengthened to create a sustainable workforce pipeline. |
| 2. | Yes Bank | YES School of Banking. | Key Human Capital, Organizational Development and Learning initiatives at YES BANK are domiciled under the aegis of YES SCHOOL OF BANKING (YSB), institutionalized in 2007 with a vision to create a Centre of Excellence for learning solutions in banking and related areas. Training Programme fall under the following broad categories: 1. Behavioral & Leadership skills, Employee Induction (includes Know Your Customer and Anti Money Laundering), Mandatory Policies and compliance, Process training, Product training Through various training programme under the above categories, the Bank seeks to impart lifelong learning to its employees and provide them skills that can benefit them beyond their role as YES Bankers. |
| 3. | Axis Bank | Axis Bank Reconnect | Axis Bank Reconnect is a unique program that intends to bring back on board Axis Bank Women Alumni. |
| 4. | HDFC Bank | HDFC Bank's Khoj | Through this programme bank is looking for the bank alumnus who want to join the bank again. |
| 5. | ICICI Bank | Sales Officers Programme | ICICI Bank hires young graduates to join its dynamic front line Sales Force. The selected applicants are trained at ICICI Bank Sales Academy. This training ensures that the applicants are well equipped in Selling Skills, Product Knowledge and Rules and Regulations pertaining to the job |

| | | | responsibility. The Sales Academy is one-of-its kind in the world and confers on its participants a Certification in Sales Management. |
|---|---|---|---|

Source: All the programme related information has been taken from the respective bank's website.

## 5. RESULT, DISCUSSION AND CONCLUSION

In the era of cut throat competition banks have started paying attention towards attracting and retaining the new and existing talented employees by offering them various growth options attractive hikes in their career. They are designing various training and leadership programme for different managerial level in order to update the skills of employees. For this purpose various latest technologies is being used to design training modules for employees in the organization. Things have also started changing with the entry of numerous non-banking financial companies as well as private and foreign banks. Similarly, the nature of business of the banking sector has also undergone a lot of changes over a period of time. As a result the demand for specialized manpower is also increasing. In a competitive environment attracting and retaining right kind of talents are very crucial. Banks are framing their strategies in order to manage the talent. As a result, Human Resource Management function of a bank becomes extremely significant.

## REFERENCES

➢ Anwar, A., Nisar, Q. A., Khan, N. Z., & Sana, A. (2014). Talent Management: Strategic Priority of Organizations. International Journal of Innovation and Applied Studies , 9 (3), 1148-1154.

➢ Axis bank. (n.d.). Retrieved December 15, 2016, from Axis Bank careers: https://www.axisbank.com/careers/index

➢ Ashton, C., & Publishing, C. R. F. (2005). M a n a g i n g talent for c o m p e t i t i v e a d v a n t a g e, 4(5).

➢ Al Ariss, A., Cascio, W. F., & Paauwe, J. (2014). Talent management: Current theories and future research directions. Journal of World Business. http://doi.org/10.1016/j.jwb.2013.11.001.

➢ Bagchi, S. (2013, March 08). Can Women's Bank in India take banking to the next level? Retrieved September 14, 2016, from CXO Today: http://www.cxotoday.com/story/can-womens-bank-in-india-take-banking-to-thenext-level/.

➢ Bank of Baroda. (n.d.). Retrieved December 12, 2016, from Bank of Baroda: http://www.bankofbaroda.co.in/

➢ Bank Of India. (n.d.). Retrieved December 11, 2016, from Bank of India: http://www.bankofindia.co.in/english/home.aspx

➢ Bank of maharshtra. (n.d.). Retrieved December 12, 2016, from Bank Of Maharashtra:

➢ Balanagagurunathan, D. R. V. K., & College, K. S. R. (2012). Talent in Organizations – Need of the Hour Keywords : Building blocks of Talent , War for Talent , Principles of Talent Management , Talent attraction, Talent retention, (December), 68–69.

➢ Behera, R. (2016). Talent Management Practices in the Indian Banking Sector: a Step Towards the Growth of Indian Economy. Journal of Chemical Information and Modeling, 5(3), 41–48.

➢ Boudreau, J. W., & Ramstad, P. M. (2005). Talentship talent segmentation, and sustainability: A new hr decision science paradigm for a new strategy definition. Human Resource Management, 44(2), 129–136. http://doi.org/10.1002/hrm.20054

➢ Cappelli, P. (2008). Talent management for the twenty-first century. Harvard Business Review, 86(3), 74–82. Collings, D. G., & Mellahi, K. (2009). Strategic talent management: A review and research agenda. Human Resource Management Review, 19(4), 304–313.

➢ Cooke, F. L., Saini, D. S., & Wang, J. (2014). Talent management in China and India: A comparison of management perceptions and human resource practices. Journal of World Business, 49(2), 225–235. http://doi.org/10.1016/j.jwb.2013.11.006

➢ Canara Bank. (n.d.). Retrieved December 12, 2016, from Canara bank: https://www.canarabank.in/

➢ [16]Donald, D. U. (2014). Talent Management and Human Resource Practices. International Journal of Innovation and Applied Studies, 6(4), 1011–1018. Retrieved from http://www.ijias.issrjournals.org/abstract.php?article=IJIAS-14-146-08

➢ [17]Dries, N. (2013). The psychology of talent management: A review and research agenda. Human Resource Management Review. http://doi.org/10.1016/j.hrmr.2013.05.001

➢ Deery, M., & Jago, L. (2015). Revisting talent management, Work life balance and retention strategies. International Journal of contemporary hospitality management , 27 (3), 1-34.

➢ Festing, M., & Schäfer, L. (2014). Generational challenges to talent management: A framework for talent retention based on the psychological-contract perspective. Journal of World Business, 49(2), 262–271. http://doi.org/10.1016/j.jwb.2013.11.010

➢ Gupta, V. (2016, August 1). Essay on Women Empowerment In India. Retrieved September 12, 2016, from IAS Paper: https://www.iaspaper.net/women-empowerment-in-india/

➢ Gallardo-Gallardo, E., Nijs, S., Dries, N., & Gallo, P. (2015). Towards an understanding of talent management as a phenomenon-driven field using bibliometric and content analysis. Human Resource Management Review, 25(3), 264–279. http://doi.org/10.1016/j.hrmr.2015.04.003

➢ Gelens, J., Dries, N., Hofmans, J., & Pepermans, R. (2013). The role of perceived organizational justice in shaping the outcomes of talent management: A research agenda. Human Resource Management Review, 23(4), 341–353. http://doi.org/10.1016/j.hrmr.2013.05.005

➢ Gupta, M., & Aggarwal, K. (2012). Talent Management Strategy : a Study of Private Banks in India. Asian Journal of Management Research, 1(4).

➢ HDFC Bank. (n.d.). Retrieved December 14, 2016, from HDFC Bank careers: http://www.hdfcbank.com/aboutus/careers/default.htm

➢ ICICI Bank careers. (n.d.). Retrieved December 20, 2016, from ICICI Careers: https://www.icicicareers.com/Website/default.aspx

➢ ICICI Bank. (2014, March 08). ICICI Bank crosses milestone of supporting one million women beneficiaries through its Self Help Group (SHG) programme. Retrieved September 14, 2016, from Icici Bank: https://www.icicibank.com/aboutus/article.page?identifier=news-icici-bank-crosses-milestone-of-supportingone-million-women-beneficiaries-through-its-self-help-group-shg-programme-20141103164737215

➢ Iles, P., Preece, D., & Chuai, X. (2010). Talent management as a management fashion in HRD: towards a research agenda. Human Resource Development International, 13(2), 125–145.

➢ josh, J. (2016, February 19). Role of Banking Sector in Women Empowerment. Retrieved September 12, 2016, from Jagran Josh: http://www.jagranjosh.com/articles/role-of-banking-sector-in-women-empowerment1450432819-1

➢ josh, J. (2016, June 7). Working Conditions of Women in Public Sector Banks: A Detailed Study. Retrieved September 12, 2016, from Jagran Josh: http://www.jagranjosh.com/articles/working-conditions-of-women-inpublic-sector-banks-a-detailed-study-1465294949-1

➢ Kotak bank. (n.d.). Retrieved December 13, 2016, from Kotak Bank Careers: http://www.kotak.com/bank/careers/kc_bank_home.html

➢ Kumar, A. (2014, September 15). Talent Management. White paper , pp. 1-9.

➢ Kumudha, D., & Kumar, S. (2012). Talent Managemnt: Importance, process, retention and strategies for business organization. International Journal of Research in Commerce, Economics & management , 2 (6), 78- 84.

➢ Lewis, R. E., & Heckman, R. J. (2006). Talent management: A critical review. Human Resource Management Review, 16(2), 139–154.

➢ Manisha, D., & Singh, R. K. (2016). Problems Faced by Working Women in Banking Sector. International Journal of Emerging Research in Management & Technology , 5 (2), 41-47.

## STUDY OF EMPLOYEE ATTRITION AND PERFORMANCE: HR ANALYTICS APPROACH

**Dr. R. S. Kamath**

Associate Professor, Department of Computer Studies, Chhatrapati Shahu Institute of Business Education and Research, Kolhapur India

**ABSTRACT**

*Human resource (HR) analytics refers to applying analytic procedures to the human resource department of an organization in the hope of improving employee performance and thusly getting a better improvement rate of profitability. Employee attrition is one of the central points that influence overall business execution. This paper portrays the study of employee attrition and performance using HR analytics approach. The secondary dataset considered for the study which was generated by IBM Kenexa talent analytics tool. It includes the details of 1470 employees with 35 features. The dataset includes features like Age, Employee Role, Daily Rate, Job Satisfaction, Years At Company, Years in Current Role etc.*

*Data analysis is carried out and thus explored the current status of employees, how the different factors affect attrition and remedy the situation to prevent attrition. Statistical Analysis applied to validate the assumptions, hypothesis and test those using standard statistical models. The exploratory data analysis and visualization carried out in Microsoft Excel and R. Following are the key findings of the present study:*

*i) The attrition rate of male employees' higher as compared to female.*

*ii) As compared to attrition rate of single employee, married employee attrition rate is less.*

*iii) Attrition is maximum in lowest job level.*

*iv) The employees who have either spent more time on same company tend to leave more.*

*v) The attrition rate is less for employees whose daily rate is high.*

*Keywords: attrition, HR analytics, job satisfaction, IBM attrition data, key factors*

## INTRODUCTION

Attrition is said to be gradual reduction in number of employees through resignation, demise and retirement. A noteworthy issue in high employee attrition is its expense to an organization [1]. Job postings, procuring procedures, paperwork and new hire training are some of the basic costs of losing employees and replacing them. Dobhal and Nigam have reported the HR practices on employee attrition in Defence PSUs in India [2]. This investigation uncovered the relationship between Designation Level and the Hiring Practices. Sharma and Berger have proposed a model for recognizing key factors to distinguish ahead of time which workers may leave an organization soon [3]. This investigation has recorded the key factors of the model and the measurements to measure each factor. Mahopatra et al reported a study aims at finding the reasons of attrition in an apparent sales organization with its presence in all major cities in India [4]. After the data analysis, it was investigated that workplace politics, job pressure, boss related issues, better working chances and individual issues like migration overwhelmingly add to work disappointment.

The effect of attrition on a business can be inconvenient to both the bottom line and morale. So there is a need of employee attrition analysis and improve retention of valuable employee, thereby saving the HRM cost. Many research teams have carried out study on employee attrition and designed the predictive analytics model for the same. In the backdrop of the research rendered here, the present study explores analysis of IBM HR employee attrition data.

## METHODOLOGY

The intent of this study is to analyse IBM employee attrition data to identify trends and patterns. It is a comprehensive case study in Human Resource area of specialization. Following are the key objectives of the present research:

- To analyse IBM HR employee attrition data
- To uncover the factors that lead to employee attrition via various visualization techniques
- To find most effective factors for employee retention
- To draw graphs to know the reasons for people are leaving the organization

IBM has developed a Talent Management tool called "Kenexa" and is utilized to forecast the employee attrition with the employee data which is input manually by HR Managers [5]. It is an integrated suite of recruitment solutions powered by Watson Analytics to find, hire, on-board and nurture the right talent [6]. The sample data set created by IBM data scientists using IBM Kenexa is chosen for the present study to uncover the factors that lead to employee attrition and explore various questions [7]. This dataset includes variables such as employee satisfaction, demographics, income, seniority, attrition etc.

This data set presents an employee survey from IBM, indicating if there is attrition or not. The data set contains 1470 entries. Data handling and analysis comprising following steps:

- Data loading and data pre-processing

- Exploratory data analysis to identify trends and patterns

- Various plotting techniques used to show the outcome of what all factors could be contributing to employee attritions

- Based on plots, observations and conclusions will be drawn

## DATA ANALYSIS AND FINDINGS OF THE STUDY

Table 1 summarizes the simple analysis such as minimum, maximum, mean and standard deviation of numeric variables.

**Table 1: Simple Analysis of Numeric Variables**

| Attribute | Simple Analysis | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | Standard Deviation |
| Age | 18 | 60 | 36.8 | 9.13 |
| Daily Rate | 103 | 1499 | 805 | 403.50 |
| Distance From Home | 1 | 29 | 9.13 | 8.106 |
| Hourly Rate | 30 | 100 | 66.75 | 20.32 |
| Monthly Income | 1051 | 19943 | 6531 | 4707.95 |
| Monthly Rate | 2097 | 26997 | 14556 | 7117.78 |
| No. companies worked | 1 | 9 | 3 | 2.49 |
| Percent Salary Hike | 11 | 25 | 15 | 3.65 |
| Total Working Years | 0 | 40 | 11.34 | 7.78 |
| Years At Company | 0 | 40 | 7 | 6.12 |
| Years In Current Role | 0 | 17 | 4.2 | 3.62 |
| Years Since Last Promotion | 0 | 15 | 2.15 | 3.22 |

This section however enlists the findings of the present study. Following are the general findings about IBM employees' attrition and performance data are surfaced out of the present investigation:

1. The attrition rate of male employees' higher as compared to female. The investment in developing skills of female employees are more likely to retain their talent. There might be some personal issues due to which female employees are significantly stable.

2. As compared to attrition rate of single employee, married employee attrition rate is less. Unmarried employees are more likely to search for higher opportunities since they face family related problems less.

3. Younger workers are more prone to job hopping than their older counterparts. For younger workers, employment tends to be in low-skill, low-paying jobs that have little to no room for advancement. The

employers who provide meaningful work with a flexible, project-based structure will have more success retaining youngsters.

4. Majority of the employees who are not leaving the company has distance from home less than 8KM. Most of the employees live in close proximity to the office. This prompts that the offering employees housing options closer to the company could motivate them to stay.

5. Most attrition happens in Sales department. This is the loss of the funds invested in sales training. Could be the company do not have good policies for sales representative.

6. Attrition is maximum in lowest job level. Entry level employees are tend to leave more. The entry level employees who don't plan to stay in the position for very long. A better might may be investing more on employee training programs so low level employees get adapted faster to the environment and move to higher levels.

7. Most of the employees are highly engaged with job. The employees with high involvement tend to leave less. May be reducing workload little bit and giving them some free time to think on some innovation activities will reduce the attrition rate.

8. The attrition rate is high for employees who work overtime. It could be due to workload. Discussion on regular basis about the workload, may solve this problem.

9. The employees who have either spent more time on same company tend to leave more. Having regular discussion with both kind of employees could help to figure out the problem and reduce the attrition.

10. Most of the employees' total working years is less than 10 years. The employees who have less experience are likely to leave more. The entry level employees who don't plan to stay in the position for very long. It could be they do not see future opportunities within the company.

11. Most of the employees have been in the same role for long period. High attrition rate is observed among employees who have more number of years in current role. Reason could be company's promotion policy has become outdated. Need to relook into it.

12. The attrition rate is high for the employees who have less number of numbers of years with current manager. People who spent less years with current manager indirectly same kind of role are tend to leave more. Reason could be they do not like the team and wanted to change.

13. High attrition rate is observed among employees whose promotion is pending. Employees who do not get promoted in last three years have more attrition rate. Company's promotion policy need to be relooked.

14. The attrition rate is high for the employees whose monthly income less than 5000. The competitive pay, reduces the likelihood an employee will find the grass greener elsewhere. The employees prefer to continue provided the pay matches to their contributions. Increasing salary with some factor could motivate employees to stay.

15. The attrition rate is less for employees whose daily rate is high. This indicates that payment will align employees' interest with the company.

16. The employees with positive opinion towards environment satisfaction are less likely to leave the organization. Through low satisfaction level has little more attrition but not major difference. Thus environment satisfaction alone does not play major role in attrition.

17. The attrition rate is less for employees with positive opinion towards Job Satisfaction. It is also observed that job satisfaction really not playing any role in attrition rate directly. However, most of the companies give more importance to job satisfaction which implies ignorance in other factor.

18. Relationship satisfaction is high in this company. There is no high correlation between Relationship Satisfaction and Attrition rate. Still people with low relationship satisfaction are likely to leave more but percentage is not significant.

19. Work life balance is better in IBM. Most of the employees vote it good or better. Employees who think it is better but not the best place are likely to leave

20. Education, Education field, Employee count, Employee number are all insignificant for the attrition analysis.

## SUGGESTIONS AND CONCLUSION

Retaining skilled employees is imperative to the success of a business. Employee retention is a critical issue as organizations compete for talent in a tight economy. Making a positive working environment begins with developing a solid set of effective employee retention strategies. The present study sought to know the factors affecting attrition and performance of employees. In light of the findings and in order to better prepare for the steps, suggestions are highlighted here as necessary for the improvement of the organization.

Employees might not have clear thought on what the business depends on and in which direction it is going. It's required to impart employer's vision, business goals with employees. It procures their dedication and commitment. The robust development programs, exceptional advantages not only for employees but also to their families, and fun work cultures could boost the performance of employees. When an organization knows to address the issues of their workers beyond the office, company benefit more from their employees. The work conditions could be improved by offering adaptable work routines that help advance a work-life balance. A person's prosperity influences his profitability and work execution, so it is good judgment to accommodate such. There ought to be spaces for collaboration, for learning, for socialization, and for progressively engaged work or activities.

Salary package and hikes are the well-known reason for employee attrition. These should be dominant with the current range of contenders. An incredible expansion to any pay bundle are the advantages. It could be paid downtime, investment opportunities, and even training help. Company could also offer added perks like flexible schedules, remote work benefits, and assistance programs for employees.

**REFERENCES:**
1. Radha Krishna Murthy Gollapudi, Sowjanya T, Employee Attrition is Messy for Organizations – My experience at DRF, Research Journal of Social Science and Management

2. RuchiraDobhal, Akankssha Nigam, Employee Attrition and Employee Satisfaction: A Study of H.R., Performance Appraisal & Training Practices in Defence PSUs in India, IOSR Journal of Business and Management Volume 20, Issue 2. 2018, pp 01-27

3. Shipra Sharma, Paul D. Berger, A Predictive Workforce-Analytics Model For Voluntary Employee Turnover In The Banking/ Financial-Service Industry, Global Journal of Human Resource Management , Vol.5, No.1, 2017, pp.47-59

4. MamtaMohapatra, Amisha Gupta, Nikita Lamba, Attrition Analysis in a Leading Sales Organisation in India, Amity Journal of Training and Development 2 (1), (19-25), 2017

5. IBM Kenexa, https://www.ibm.com/us-en/marketplace/talent-acquisition retrieved on 6th Feb, 2019

6. IBM Watson Talent, https://www.ibm.com/watson/uk-en/talent/insights/retrieved on 6th Feb, 2019

7. SAMPLE DATA: HR Employee Attrition and Performance, https://www.ibm.com/communities/analytics/watson-analytics-blog/hr-employee-attrition/retrieved on 6th Feb, 2019IBM Kenexa, https://www.ibm.com/us-en/marketplace/talent-acquisition retrieved on 6th Feb, 2019

## A COMPLETE STUDY ON PHYTOCHEMICAL SCREENING, GC-MS ANALYSIS, ANTIBACTERIAL AND ANTIOXIDANT ACTIVITY FROM THE COMBINE EXTRACT OF ZINGIBER OFFICINALE AND AEGLE MARMELOS.

**Lance Rohit. J, Vishnu Vardhan. E, Aadhith. R, Sharath. S and Dr. P. Vivek[*]**

Department of Bio-engineering, Vels Institute of Science, Technology, and Advanced Studies, Chennai, Tamilnadu, India

**ABSTRACT**

*The medicinal plant Zingiber officinale are widely used in treating arthritis, blood thinning, lowering cholesterol and heart and lung disease. The Aegle marmelos are also widely used for treating jaundice, cancer, gastrointestinal and cardiovascular disorder. The aim of the present study is to extract the bioactive compounds with ethyl acetate. The extracted samples are characterised using GC – MS for the identification of different bioactive compounds present in which 41 compound were retrieved. The extracted samples were tested for the presence of phytochemical which resulted in the presence of alkaloids, sugar, quinones, glycoside, flavonoids, phenol. Antibacterial activity of was performed with the combined extract in different concentration from 0.5 – 2 mg and treated against four bacterial species such as Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus using agar well diffusion method. The extract at 2mg concentration showed significant antibacterial activity with 14mm zone of inhibition for Klebsiella pneumoniae then 20mm zone of inhibition for Pseudomonas aeruginosa.*

*Keywords: GC-MS analysis, Phytochemical, Antioxidant property, Antibacterial activity.*

**INTRODUCTION:**

Medicinal plants as indicated by World Health Organization (WHO) characterizes as natural arrangements made by acquainting plant materials with extraction, fractionation, purification, fixation, or other physical or organic cycles which might be delivered for reason for herbaceous compounds or for the prompt utilization processes[1]. Plants are wealthy source of nourishment and they are the principle wellspring of edible material. Plants are additionally wealthy in intensifies which have pain relieving and recuperating capacities. From soonest times itself, without the information about the mixtures present in the plants and their method of activity, plants were utilized for the treatment of sickness. Throughout the long-term social orders all over the planet have fostered their own practice to sort out therapeutic plants and their employments. The wide spread utilization of home-grown cures and medical care arrangements acquired from usually utilized customary spices and therapeutic plants have been raised because of the event of natural products with medicinal properties[2]. Medicinal plants broadly utilized by an ever-increasing number of individuals searching for medications and wellbeing approaches liberated from secondary effects brought about by manufactured synthetics. All the more as of late, consideration has been paid to utilizing Eco-accommodating items and plant-accommodating detailing to forestall and fix various infections of man. As per the records, 80% of the total populace have faithfulness in customary medication, particularly plant-based medications for their essential medical care [3].

Plants with medicinal characters are significant hot-spots for the affirmation of pharmacological properties and can be natural composite sources that go about as new anti-infectious agents. For the restorative purposes distinctive plant parts are utilized model bulb, gel, leaves, roots, barks, strips [4]. All plants have some medicinal value. It is usually possible to extract active components from all plant parts, however, they differ in amounts from one structure to another.

In therapeutic applications, parts with the highest percentage of active principle are preferred [5]. The utilization of plants in treating the disease is found all through human culture. The constant development of bacterial resistance against antibiotics that accessible in most recent time has required the quest for novel and viable antimicrobial mixtures. For antibacterial, antifungal and antiviral activities, universally, the concentrate of plant is utilized. Therapeutic properties of in excess of 400,000 types of tropical blossoming plants have been known. Because of this reasons, customary medication less expensive when contrast with present day medication [4].

The bacterial resistance against the anti-microbials has made gigantic issues in medical services industry. On a very basic level, there are three different ways bacterial protections can happen that are keeping the medication from arriving at its objective, target change and anti-infection agents' inactivation [6]. As a general rule, microbes have the hereditary capacity to convey and acquire protection from drugs, which are utilized as restorative specialists. Bacterial obstruction is a reality where concern should be given in light of the quantity of patients in clinics with smothered invulnerability, and because of new bacterial strains, which are multi-safe.

Thus, new diseases happen in emergency clinics which is causing in high mortality [7]. A portion of the dynamic compound independently or in mix impede incredibly the existence cycles of microorganisms, particularly the organisms which are known as infection causing ones. They can accomplish this by restricting their protein atoms, going about as chelating specialists (specific restricting polyvalent metal particles with the goal that the last option loses its natural exercises), modifying their biochemical frameworks, forestalling use of accessible interests to the microorganisms, different causes aggravation investigation of microbial cells [5].

A stimulant as well as a carminative, Ginger is scientifically known as *Zingiber Officinale*. Among the components of ginger root are gingerols, gingerone, and shoagoles, which gives it a pleasant scent and flavor. There are many uses of ginger in daily life, including reducing morning sickness, nausea and chemotherapy. Furthermore, they are used for treating diabetes and rheumatism, as well as colds and heat cramps [8].

The leaves of the bael plant have a medicinal value called *Aegle marmelos*, which is the scientific name. There is a great deal of phytochemical compound in the plant that can be used to isolate many compounds including phenols, flavonoids, alkaloids, cardiac glycosides, saponins, terpenoids, steroids, and tannins [9]. Various therapeutic purposes can be achieved through the use of Bael leaves. They can also be used for a number of conditions, including jaundice, wound healing, anaemia, asthma, and high blood pressure. Opthalmia can be treated by converting the leaves into a poultice [10].

## MATERIALS AND METHODOLOGY:
## COLLECTION OF SAMPLE AND PREPARATION OF EXTRACT:
Double distilled water was used in order to wash the collected plant samples. Thus, the plant sample was then surface sterilized using 70% of ethanol. The sample was again rinsed with distilled water. The plant parts were then grounded in a mixer. 50gms of powdered extracts of dry ginger was taken and then 50gm of powdered extract of bale leaf was taken and then soaked in 500 ml of ethyl acetate and it is kept in shaking incubator for 48 hours. A magnetic stirrer rotating at 100 rpm was used to extract the crude extract after it was filtered on whatman.No.4 filter paper. Then finally the sterile extract was collected and then stored in 4°C for the future use.

## ANALYSIS OF GC-MS:
The analysis of GC-MS is done with ethanol which is a combined process of coupled mass detector and chromatograph. Which is processed with capillary column of 30m×0.25mm ID×1um. The ionization energy is 70eV that are due to the operation of electron that are done in a impact mode with ionization method. Each of these processes is done in 110°C for two minutes. A temperature increase of 5°C/min at a rate of 9 minutes was achieved by transferring the process to 280° C at the end. The inserted a 2ul volume helium gas i.e. carrier gas for constant flow of medium. A scan had been done in a interval rate of 0.5s that are 70eV mass spectra and partition are based on 45 to 450 Da. The complete process GC-MS is done for 36min and there is a delay in process from 0 to 2min. They are done in an interval of 10:1 ratio from the samples injected. The scan done is at the range of 45 to 450(m/z). The turbo mass are used for analyzing the mass spectral and the software process are done to maintain mass spectra and chromatograph [11].

## ANALYSIS OF PHYTOCHEMICALS
The medicinal plant is used in curing the human disease due presence of some phytochemical property. The phytochemical is naturally occurring in the medicinal plant parts like leaves, fruits, vegetable, and roots which defence from various disease. There are some of the qualitative test for analysis phytochemical that are present in medicinal plant.

## TEST FOR FLAVONES
Alkaline reagent test - The sample was mixed 10% of sodium hydroxide solution or with ammonia. The appearance of Dark yellow colour indicates the presence of flavones.
## TEST OF PHENOLIC COMPOUND

Ferric Chloride Test: Approximately 3 to 4 drops of ferric chloride solution were added to the sample. The presence of phenol was indicated by bluish green or bluish black.

## TEST FOR GLYCOSIDES
Anthrone Test: Using a water bath, one drop of concentrated $H_2SO_4$ was added to the sample, and then the glass was gently warmed up with a few drops of Anthrone. The presence of glycosides is therefore indicated by the dark green color.

## TEST FOR REDUCING SUGAR
Fehling's Test: A red colour indicates the presence of sugars in the sample when it was mixed with Fehling's solution I and II.

## TEST FOR STEROIDS
Ferric Chloride-Acetic acid Test: Few mg of sample was dissolved in a 3 to 4 drops of chloroform. 2ml of $FeCl_3$-acetic acid reagent and 1ml of Concentrated $H_2SO_4$ were added to the chloroform extract. The reddish pink color of steroids is an indication of their presence.

## TEST FOR ALKALOIDS
Wagner's reagent: Wagner's reagent and acetic acid were added to the sample and shook well. The presence of alkaloid is indicated by the appearance of a reddish brown precipitate.

## TEST FOR QUINONES
In order for the sample to be tested, sodium hydroxide was added. The presence of quinones is indicated by blue, green, and red coloration [12].

## DPPH Assay:
Standard:1mg of Ascorbic acid was weighed and dissolved in the respective solvent to prepare 1mg/ml concentration. This sample was serially diluted to get different concentrations (1000 µg/ml). Sample 1 mg of extract/fraction was weighed and different concentration was prepared similar to that of standard. 2,2-Diphenyl-1-picrylhydrazyl (DPPH) 150µM dissolved in 100% ethanol. About 50µl of each concentration from each sample was added in 96 well plate and 500µl of DPPH was added to each well. After vortexing, the sample was incubated for 30 minutes in room temperature. Control blank contains DPPH and solvent without extract. Sample blank was also prepared without DPPH. After incubation absorbance was measured at 517nm. Experiment was repeated in triplicates and the % of inhibition was calculated [13].

$$\text{Percentage of inhibition} = \frac{\text{Absorbance of control}}{\text{Absorbance of test}} * 100$$

## TOTAL ANTIOXIDANT:
The plant extract and fractions were estimated by Phosphomolybdenum assay . An acidic pH produces a bluish green phosphate complex in response to the reduction of Phosphomolybdenum (VI) to Phosphomolybdenum (V). Standard vitamin E solution 1mg/ml. Sample 1mg/ml of extract or fraction. To 100µl of the samples, 1ml of molybdate reagent solution (sodium phosphate and ammonium molybdate was dissolved in 0.6 M $H_2SO_4$) was added and incubated in a boiling water bath at 95°C for 60-90 minutes. Incubation taking place at 695 nm using standard α-tocopherol as a reference solution led to the measurement of absorbance at 695 nm.

## ANTIBACTERIAL ACTIVTY:
The antibacterial activity of ethyl acetate was done using agar well diffusion method**.** The compound was prepared as a stock solution (1 mg/ml) in ethyl acetate, and then diluted to quantities of 0.5, 1.0, 1.5, and 2.0 mg/ml. Testing strains were used of *Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella pneumoniae* of Gram-negative and Gram-positive bacteria, respectively. To the McFarland scale 0.5, bacterial inoculums were prepared for each strain. Muller Hinton Agar (MHA) plates were used to culture bacterial lawns. Prepared various concentration of the compound were loaded in well made on a MHA plate. As standard reference drugs, Amikacin (30 µg) was utilized.A zone of inhibition was measured in millimetres on the plates after they were incubated at 37°C for 18 - 24 hours and compared with standard antibiotic discs. The Na4NP⁻ 4NP showed the zone of inhibition none against Escherichia coli, 9,11,12,14mm against *Klebsiella pneumonia*, none against *Proteus mirabilis* and 15,16,18,20mm against *Staphylococcus aureus* and none against *Pseudomonas aeruginosa* at the concentration of 0.5, 1, 1.5 and 2mg respectively. Ethyl acetate demonstrated the highest level of antibacterial activity against both Gram-positive and Gram-negative bacteria in the present study compared to the standard antibiotic Amikacin [14].

## RESULTS AND DISCUSSION:
## CHARACTERIZATION STUDY OF GC-MS
*Zingiber officinale* and *Aegle marmelos* was extracted using ethyl acetate. The extracted samples are characterized using GC – MS for the identification of different bioactive compounds present in which 41 compound were retrieved are shown in given Table 1.
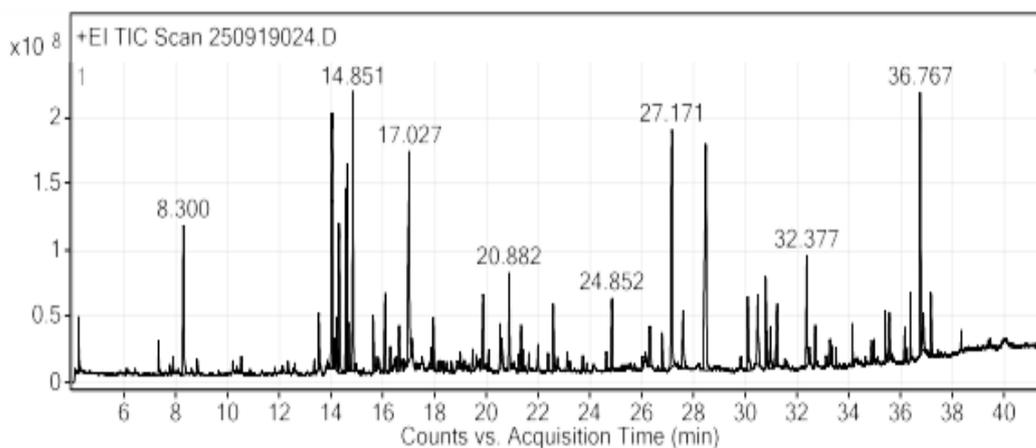
**Figure 1: CHROMATOGRAM OF GC-MS**

**Table 1: GC-MS ANALYSIS**

| S.NO | $R_T$ | COMPOUND NAME | AREA% | MOLECULAR FORMULA | ACTIVITY |
|---|---|---|---|---|---|
| 1. | 4.26 | Octanal | 1.08 | $C_8H_{16}O$ | Antioxidant activity and anti-inflammatory |
| 2. | 7.34 | Endo-Borneol | 0.93 | $C_{10}H_{18}O$ | anti-inflammatory and antinoci-ceptive activities |
| 3. | 8.30 | Decanal | 3.89 | $C_{10}H_{20}O$ | Anti-salmonella and antioxidant activity |
| 4. | 13.54 | Spiro[5.5]undec-2-ene, 3,7,7-trimethyl-11-methylene-,(-)- | 1.20 | $C_{15}H_{24}$ | Carbobicyclic compound. |
| 5. | 14.04 | Benzene, 1-(1,5-diethyl-4-hexenyl)-4-methyl- | 7.33 | $C_{15}H_{22}$ | Anti-microbial and anti-inflammatory |
| 6. | 14.13 | Napthalene, 2,3,4,4a,5,6-hexahydro-1,4a-dimethyl-7-(1-methylethyl)- | 0.61 | $C_{15}H_{24}$ | Antifungal activities |
| 7. | 14.22 | .gamma.-muurolene | 1.34 | $C_{15}H_{24}$ | Unknown |
| 8. | 14.32 | 1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-,[s-(R*,S*)]- | 4.16 | $C_{15}H_{24}$ | Anti-microbial, anti-inflammatory and antinoci-ceptive activities |
| 9. | 14.58 | beta.-Bisabolene | 4.47 | $C_{15}H_{24}$ | Unknown |
| 10. | 14.62 | alpha.-Farnesene | 5.29 | $C_{15}H_{24}$ | Flavouring ingredient. |
| 11. | 14.67 | Phenol, 2,4-bis(1,1-dimethylethyl) | 5.29 | $C_{15}H_{22}O$ | Antimicrobial, antioxidant activity. |
| 12. | 14.85 | Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [(R*,S*)]- | 7.59 | $C_{15}H_{24}$ | Constituent of the oil of ginger. |
| 13. | 15.64 | 1,6,10-Dodecatrien-3-ol, 3,7,11- | 1.47 | $C_{15}H_{26}O$ | Antidiabetics, hepatoprotective, anti inflammatory activities |
| 14. | 16.09 | Diethyl phthalate | 2.15 | $C_{12}H_{14}O_4$ | Used in cosmetics, insecticides. |
| 15. | 16.63 | 2-Napthalenemethanol, | 1.33 | $C_{15}H_{26}O$ | Unknown |

| | | 1,2,3,4,4a,5,6,8a-octahyro-.alpha.,.alpha.,4a,8-tetramethyl-,[2R-(2.alpha.,4a.alpha.,8a.beta.)] | | | |
|---|---|---|---|---|---|
| 16. | 17.03 | Bu1tan-2-one, 4-(3-hydroxy-2-methoxyphenyl)- | 8.20 | $C_{11}H_{14}O_3$ | Anti inflammatory, Anti diabetics, Anti polytic, Anti diahorrea |
| 17. | 17.88 | 7-Epi-cis-sesquisabinene hydrate | 0.64 | $C_{15}H_{26}O$ | Antimicrobial activity |
| 18. | 17.96 | 6,10-Dodecadien-1-yn-3-ol, 3,7,11-trimethyl- | 1.24 | $C_{15}H_{24}OO$ | It is also used for destroying worm in the wound of cattle. |
| 19. | 19.48 | 3-(1/5-Dimethyl-hex-4-enyl)-2,2-dimethyl-cyclopent-3-enol | 0.66 | $C1_5H_{26}O$ | Antifungal activity |
| 20. | 19.87 | Spiro[4.5]dec-6-en-8-one, 1,7-dimethyl-4-(1-methylethyl) | 1.89 | $C_{15}H_{24}O$ | Antioxidant activity |
| 21. | 20.53 | cis-Z-,alpha,-Bisbolene epoxide | 1.10 | $C_{15}H_{24}O$ | Antifungal activity |
| 22. | 20.60 | spiro[4.5]dican-7-one, 1,8-dimethyl-8,9-epoxy-4-isopropyl- | 0.64 | $C_{15}H_{24}O$ | Anti immflamatory Activity |
| 23. | 20.88 | Phthalic acid, butyl tetradecyl ester | 2.59 | $C_{26}H_{24}O_4$ | Antibacterial activity |
| 24. | 21.34 | cis-Z-,alpha,-bisabolene epoxide | 1.26 | $C_{15}H_{24}O$ | Antimicrobial activity |
| 25. | 21.41 | Spiro[4.5]decan-7-one, 1,8-dimethyl-8,9-epoxy-4-isopropyl- | 0.53 | $C_{15}H_{24}O_2$ | Anti immflamatory Activity |
| 26. | 21.99 | Limonen-6-ol, pivalate | 0.64 | $C_{15}H_{24}O_2$ | Antioxidant, anti-inflammatory and antimicrobial *activity* |
| 27. | 22.39 | Phthalic acid, butyl tridec-2yn-1-yl ester | 0.62 | C25H36O4 | Antimicrobial activity |
| 28. | 22.59 | (6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl ethyl carbonate | 1.67 | $C_{13}H_{20}O_3$ | Antioxidant activity |
| 29. | 23.13 | phen-1,4-diol, 2,3-dimethyl-5-trifluoromethyl- | 0.62 | $C_9H_9FO_2$ | Antimicrobial activity |
| 30. | 24.64 | - 2,7-Naphthalenediol, decahydro- | 0.53 | $C_{10}H_{18}O_2$ | Anti plasmodial and cytotoxic *activities*. |
| 31. | 24.85 | Phytol | 1.74 | $C_{20}H_{40}O$ | Anti cholinesterase activity |
| 32. | 26.32 | - 7-Oxabicyclo[4.1.0]heptane, 1-(2,3-dimethyl-1,3-butadienyl)-2,2,6-trimethyl-,(E)- | 1.61 | $C_{15}H_{24}O$ | Unknown |
| 33. | 26.80 | -8 Spiro[4.5]decan-7-one, 1,8-dimethyl-8,9-epoxy-4-isopropyl | 0.91 | $C_{15}H_{24}O_2$ | Biological activity including anti flammatory |
| 34. | 30.48 | 3-(6-Hydroxy-3,7-dimethyl-octa-2,7-dienyl)-4-dimethoxy-phenol | 2.39 | $C_{17}H_{24}O_3$ | Antifungal activity |
| 35. | 30.80 | Bis(2-ethylhexyl)phthalate | 2.50 | $C_{24}H_{38}O_4$ | Anti fungal activity |
| 36. | 30.85 | 2-(3,7-Dimethyl-octa-2,6-dienyl)-1,4-dimethoxy-benzene | 0.66 | $C_{18}H_{26}O_2$ | Anti perspirant activity |
| 37. | 30.98 | Glutaric acid,ethyl tridec-2-ynyl ester | 1.26 | $C_{20}H_{34}O_4$ | Peptidase activity. |
| 38. | 34.15 | Octadecane, 1-bromo- | 0.94 | $C_{18}H_{26}Br$ | Anti microbial activity |

| 39. | 35.42 | Acetic acid, 1-methyl-3-(2,2,6-trimethyl-bicyclo[4.1.0]hept-1-yl)-propenyl ester | 1.10 | $C_{16}H_{26}O_2$ | Anti microbial activity |
| 40. | 35.58 | Octadecane, 1-bromo- | 1.09 | $C_{18}H_{37}Br$ | Anti microbial and Anti bacterial |
| 41. | 35.58 | Campesterol | 0.83 | $CH_{28}H_{48}O$ | May act in cancer prevention. |

**PHYTOCHEMICAL ANALYSIS OF EXTRACT:**

The combined extract of *Zingiber officinale* and *Aegle marmelos* were analysed of various test like Alkaloids, Glycoside, Phenol, Flavonoids, Steroids, Quinones, Carbohydrate. Presence of phytochemical such as alkaloids, Glycoside, phenol, Flavonoids, Steroids, Quinones were confirmed from the combined ethyl acetate extract of *Zingiber officinale* and *Aegle marmelos.*

**TABLE 2: Phytochemical analysis of combined extract of *Zingiber officinale* and *Aegle marmelos***

| Tests | Ethyl acetate |
|---|---|
| Alkaloid | + |
| Carbohydrate | - |
| Glycosides | + |
| Phenol | + |
| Flavonoids | + |
| Steroids | + |
| Quinones | + |
| Reducing sugar | + |

**ESTIMATION OF ANTIOXIDANT**

DPPH assay was used for analysis of antioxidant property. The colour change into yellow indicates the free radicals are being expressed. The absorbance was taken at 517 nm. Result was observed at 935 ug/ml. With increasing concentration of sample, the inhibition of the DPPH increased linearly. The result showed the anti-oxidant properties being exhibited by the combinatorial sample of the two plants; *Zingiber officinale* and *Aegle marmelos* are mentioned in table 3.

**Table 3: DPPH assay**

| Concentration | % inhibition of DPPH | Absorbance |
|---|---|---|
| 100 | 18.73% | 0.47 |
| 200 | 28.96% | 0.366 |
| 300 | 36.54% | 0.327 |
| 400 | 55.64% | 0.2285 |
| 500 | 68.75% | 0.371 |
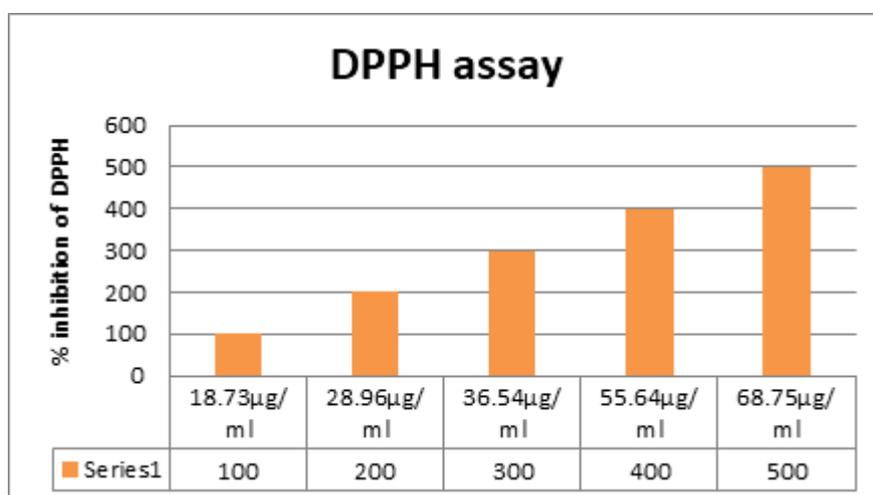


**Figure 2: DPPH assay**

**ANTIBACTERIAL ACTIVITY:**
By agar-well diffusion, this combination extract displayed significant antibacterial activity against E. coli, Proteus mirabilis, P. aeruginosa, Klebsiella pneumonia, and S. aureus. The inhibition of standard Amikacin 0.5 mg/ml, 1 mg/ml, 1.5 mg/ml, 2 mg/ml is showed by comparison with different concentrations and the result shown in table 4. *Klebsiella pneumonia* and *Staphylococcus aureus* showed maximum zone of inhibition in 2mg/ml which was 14 mg/ml and 20 mg/ml.

**Table 4: Antibacterial activity of ethyl acetate against Gram-positive and Gram-negative bacteria by agar well diffusion method.**

| Organism | Zone of inhibition (in mm) | | | | |
|---|---|---|---|---|---|
| | Amikacin-30µg (Standard) | 0.5 mg | 1 mg | 1.5 mg | 2 mg |
| *Escherichia coli* | 25 | - | - | - | - |
| *Klebsiella pneumoniae* | 22 | 9 | 11 | 12 | 14 |
| *Proteus mirabilis* | 27 | - | - | - | - |
| *Staphylococcus aureus* | 18 | 15 | 16 | 18 | 20 |
| *Pseudomonas aeruginosa* | 20 | - | - | - | - |
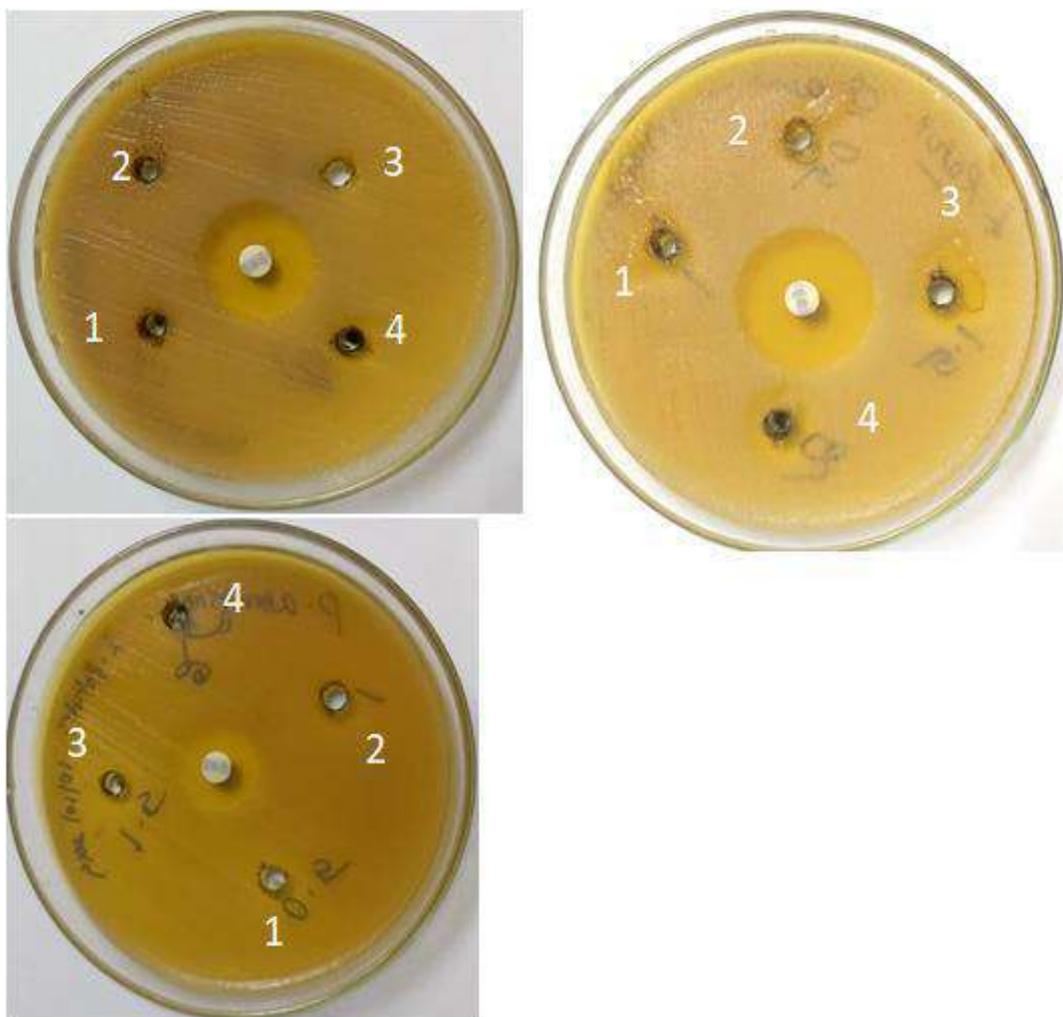


*Klebsiella pneumoniae   Staphylococcus aureus        Pseudomonas aeruginosa*

**Figure 3. Antibacterial activity**

**CONCLUSION**

Our research aims to perform phytochemical screening, Identification of bio active compound using GC-MS, Evaluation of antioxidant property and antibacterial activity. Rhizome of *Zingiber officinale* and leaf of *Aegle marmelos* are combined together and extracted with the solvent ethyl acetate. The extracted samples are characterised using GC – MS for the identification of different bioactive compounds present in which 41 compound were retrieved and active compounds were identified with structure. combined extract is analysed in which Alkaloids, Glycoside, Phenol, Flanvoids, steroids, Quinones, Reducing sugar were confirmed the presence of phytoconstituents. With different species of gram positive and gram negative bacteria, Klebsiella *pneumonia* and *Staphylococcus aureus* showed maximum zone of inhibition in 2mg/ml which was 14mg/ml and 20 mg/ml concentration. When compared with individual plant extract, more active components are present in the combined extracts of *Zingiber officinale* and *Aegle marmelos*.

**REFERENCE**

1. Alo M, Eze UA, Anyim C. In vitro antimicrobial activities of extracts of Mangifera indica, Carica papaya, and Psidium guajava leaves on Salmonella typhi isolates. World Journal of Public Health Sciences. 2012;1:1-6.

2. Tiwari P, Jain R, Kumar K, Panik R, Sahu PK. An evaluation of antimicrobial activities of root extract of Calendula officinalis (LINN). Pharmacology online. 2011;2:886-92.

3. Sivananthan M, Elamaran M. In vitro evaluation of antibacterial activity of chloroform extract Andrographis paniculata leaves and roots, Durio zibethinus wood bark and Psidium guajava leaves against selected bacterial strains. Int J Biomol Biomed. 2013;3(1):12-9.

4. Naz S, Jabeen S, Ilyas S, Manzoor F, Aslam F, Ali A. Antibacterial activity of Curcuma longa varieties against different strains of bacteria. Pak J Bot. 2010 Jan 1;42(1):455-62.

5. Anibijuwon II, Udeze AO. Antimicrobial activity of Carica papaya (pawpaw leaf) on some pathogenic organisms of clinical origin from South-Western Nigeria. Ethnobotanical Leaflets. 2009;2009(7):4.

6. Sivananthan M, Elamaran M. Medicinal and pharmacological properties of Andrographis paniculata. Int J Biomol Biomed 2013b. 2013;3(2):1-2.

7. Tiwari P, Kumar K, Panik R, Pandey A, Pandey A, Sahu PK, Raipur CG. Antimicrobial activity evaluation of the root of Carica papaya Linn. Int J PharmTech Res. 2011;3(3):1641-48p.

8. Malu SP, Obochi GO, Tawo EN, Nyong BE. Antibacterial activity and medicinal properties of ginger (Zingiber officinale). Global Journal of pure and applied Sciences. 2009;15(3-4).

9. Mujeeb F, Bajpai P, Pathak N. Phytochemical evaluation, antimicrobial activity, and determination of bioactive components from leaves of Aegle marmelos. BioMed research international. 2014 May 11;2014.

10. Sharma GN, Dubey SK, Sharma P, Sati N. Medicinal values of bael (Aegle marmelos)(L.) Corr.: A review. Int J Curr Pharm Rev Res. 2011;2(1):12-22.

11. Jasim H, Hussein AO, Hameed IH, Kareem MA. Characterization of alkaloid constitution and evaluation of antimicrobial activity of Solanum nigrum using gas chromatography mass spectrometry (GC-MS). Journal of Pharmacognosy and Phytotherapy. 2015 Apr 30;7(4):56-72.

12. Das S, Saraf A, Sharma D, Sohal JK. Qualitative screnning of bioactive secondary metabolites present in Withania somnifera and Rauwolfia serpentina root and stem extract with pharmacological importance. Int J Res Ana Rev. 2019;6:69-74.

13. Siddique NA, Mujeeb M, Najmi AK, Akram M. Evaluation of antioxidant activity, quantitative estimation of phenols and flavonoids in different parts of Aegle marmelos. African Journal of plant science. 2010 Jan 31;4(1):001-5.

14. Bauer AW. Antibiotic susceptibility testing by a standardized single disc method. Am J clin pathol. 1966;45:149-58.

## THE SIGNIFICANCE VANET IN INTELLIGENT TRANSPORTATION AND ITS NEED FOR INDIA

**Gagan Deep Singh**

University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

**ABSTRACT**

*The new area of research has been evolved through Vehicular Adhoc Network (VANET) in the domain of network performance and routing. This domain of dynamic network arise with network performance issues and routing challenges The paper also discuss some of the Swarm Intelligence based routing algorithm . This paper focus on VANET routing significance over the mobile ad-hoc network (MANET). The paper presents the statistical reports of road accidents that took place in India. Then, the major issues has been highlighted that caused due to bad roads and transportation system. This paper aims to analyze and focus on the status of the road conditions and accidents that took place in India. It also discussed that the Intelligent Transportation System (ITS) and VANET shall be implemented in near future that may help for smoother transportation facility and lowering the rate of accidents. The paper shows that the*

*Keywords VANET, MANET, India, Swarm Intelligence, road accidents, Intelligent Road Transportation ITS*

## 1. INTRODUCTION

The advancements in wireless communication technology and devices have opened a new dimension of research which is capable to repair and organize, rearrange the networks without the need for any centralized authority or infrastructure. Recent enhancement in wireless adhoc technologies and dedicated short-range communication devices have made vehicle-to-vehicle communications (V2V) and road vehicle communications (RVC) developed using Mobile Ad hoc Networks (MANET). From this entirely a new network has been evolved and called as Vehicular Ad hoc Network (VANET). This emerged new technology of VANET is a subset of Intelligent Transportation System (ITS) architecture, which aims to improve road safety, optimize traffic flow, reduce congestion, and so on. VANETs are a special case of MANETs [1].

VANET can be used as a driver's assistance for communication and coordination among each other to avoid any critical situation through V2V communication e.g. random braking, obstacles, accidents on road, bumper to bumper jams, random increase in speed, pathways for emergency vehicles like fire, police, and ambulance, etc. Along with these precautionary applications, VANETs are also useful for comfort applications to the drivers and passengers. For example, multimedia applications, internet connectivity, weather forecast, and infotainments during drives. The "Crash Avoidance Matrices Partnership (CAMP), Advance Driver Assistance System (ADASE), FLEETNET and CARTALK" are some of the famous applications which as developed by various automobile manufacturers and governments through Public-Private Partnerships [2]. Figure 1, shows the overall working structure of VANET.
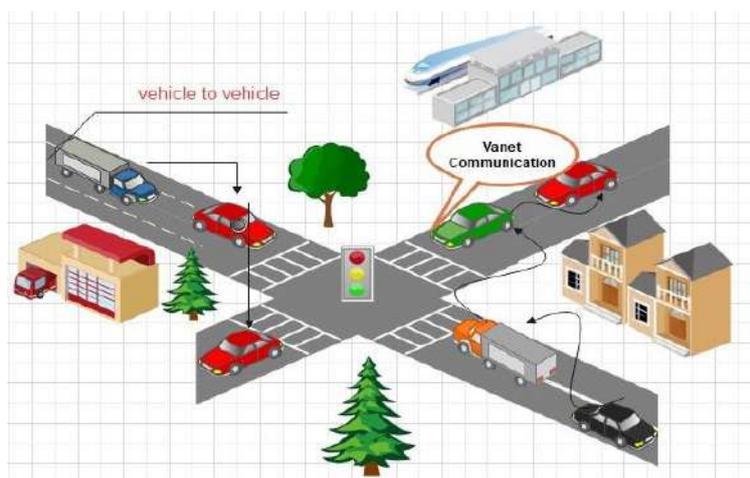


**Fig 1 VANET Structure**

The era of ITS is yet to come. Presently, VANET is in its evolving stage, so industry and researchers focusing their interest in this domain. VANET has its own issues and challenges, like multipath fading and road obstacles, traffic congestion, random change of vehicle speed and its mobility, road topology, traffic diversion model, driver's unpredictable driving behavior, etc.

VANET mobility is not as same as that of MANET (mobile ad-hoc network) since in VANET the vehicle has to strictly follow the rules of traffic laws and node movement sometimes becomes too complex. To achieve the best results through VANET simulation, it is necessary to create a realistic mobility model similar to the real road traffic scenarios. There are many limitations in VANET and these challenges have to be solved in order to provide reliable services in a network. Hence, reliable and stable routing is one of the major issues in VANET. So, dedicated research in this field is required to implement accurate methods in realistic environments. The vehicles have dynamic behaviour and high mobility speed makes routing in VANET even more challenging.

VANET routing has evolved from traditional MANET routing protocols like DSR (Dynamic Source Routing) and AODV (Ad hoc on Demand Distance Vector Routing). DSR and AODV are best suited for Multihop wireless ad hoc networks [3].

Vehicular Ad hoc Network (VANET) uses wireless communications to communicate among themselves and other vehicles just like that of Mobile Ad hoc Network (MANET). MANET works on Optimized Link State Routing (OLSR) protocol but the characteristics of OLSR are not best in resources like energy consumption and other hardware [4]. It takes data packets from source to destination while traveling in OLSR protocol. But if consider the same for VANET then QoS decreases during routing while applying the OLSR protocol in the predefined model and scenarios of Urban mobility environments. Hence, to get the best routing process this need to revise the configuration setup of OLSR to meet the features of VANET. To reconfigure the parameters like bandwidth, delay, routing network to optimize QoS in VANET using OLSR [5]. Due to the unpredictable nature of vehicles and driver's driving habits, it is almost impossible to apply MANET solutions for it as this will result in routing and link failures in an environment like of Urban traffic conditions. Such aspects make it more challenging for eager researchers to develop the best suitable, optimized, and efficient routing protocols for VANET. In VANET vehicle nodes uses the wireless communication system to disseminate the information among vehicle-to-vehicle, vehicle to infrastructure as in figure 2, and infrastructure-to-infrastructure communications [6].
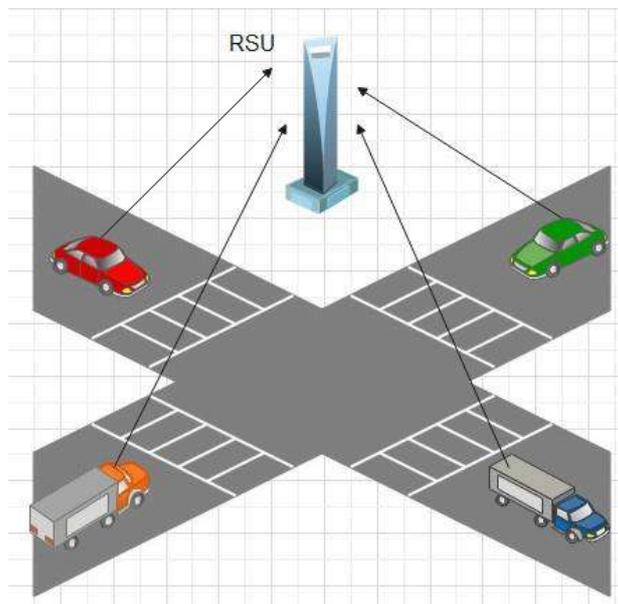


**Fig 2 Vehicle to Infrastructure (V2I)**

The working and framework of VANET are completely different from the MANET. In VANETs, vehicular environments manipulate new issues and need like artificial road topology, traffic flow system, trip models, roadside obstacle, traffic rush, and behavior of drivers. There are many points from which VANETs differ from MANETs such as dynamic topology changes and high node mobility. VANETs also vary from various ad hoc networks by compound network architectures, unstable topology, suddenly disconnected network, and communication [7].

Generally, vehicle nodes mobility patterns are difficult to determine as they move on different traffic scenarios, lights, road or highway structures, and driving behaviour and experience of the person of seated at driver's seat [8]. These days all the vehicles are come with the features of Global Positioning System, and other equipped devices/sensors that support to provide various information such as signal timings, traffic estimation, fuel consumption, routing decisions best path, shortest route etc. VANET with intelligence would enhance the road

safety, fuel efficiency and even comfort for the drivers as well as for commuters [9]. Intelligent VANET has made entirely new area of research for Intelligent Transport System to design new, automate, and smart transportation system [10]. Now, every theory suggests that travel time can be reduced through using the shortest path between sources to the destination, but what happens if all the vehicle nodes opt for the shortest routing path, then; this solution will itself become a problem and results in congestion of opted route. Hence, it is always not true that the shortest path is the optimal route [11]. Therefore, commuters can also choose a longer path because they want to avoid congestions through less frequency of traffic signals and waiting time for much smoother mobility of vehicle nodes. Hence, the devised a new routing algorithm that binds the features of the Ant Colony Optimization (ACO) technique with genetic characteristics of the Genetic Algorithm (GA). During this research the other bioinspired algorithmic techniques are also reviewed, but ACO is best suited for VANET because the mobility pattern and behaviour of ants movement in ACO is mostly matched with VANET. Hence, incorporated the methodology through swarm intelligence in VANET to devise a fresh new algorithm.

## 2. THE NEED FOR INTELLIGENT TRANSPORTATION SYSTEM

The "World Road Statistics" (WRS) 2019 [12], issue published by the International Road Federation, (IRF) Geneva, reported that the maximum number of accidents i.e. 16,30,000 injured in USA followed by Japan at 7,66,147 and India at 4,84,704 in the year 2018. Whereas India reported the maximum number of fatalities (1,19,860) in road accidents, followed by China (73,484) and United States of America (37,261) for the year 2018.

As per the data analysis of road accidents reported by the States/UTs shown that drivers' fault is the major factor for road accidents (78%). Some other important factors causing the road accidents are as shown in table 1 [13].

**Table I Factors Responsible for Road Accidents with their share**

| | |
|---|---|
| Cyclist fault | 1.2% |
| Pedestrian fault | 2.7% |
| Road conditions | 1.2% |
| Fault in motor vehicle mechanics | 1.7% |
| Non suitable weather condition | 1% |
| All other causes* | 14.2% |
| **\*Includes other vehicle's fault (driver/vehicle), passenger's faults, poor lighting system, boulders, neglect of civic bodies, stray animals, and causes not known.** | |

The Ministry of Road Transport & Highways (Government of India) collects information on Road Accidents. This data is analyzed for an annual publication titled "Road Accidents in India' that is published each year periodically. This data is collected from state police departments frequently. Transport Research Wing is responsible to collect this data and compiles to publishes in 'Road Transport Year Book (RTYB)'. The recent published issue of RTYB reflects the data till 31st March, 2018 [14].

The report of MOSPI, GoI, reveals that there were 4,64,910 unfortunate incidences of road accidents during 2017 which claimed 1,47,913 lives and caused injuries to 4,70,975 persons. The national highways, which constitute approximately 2% of the total road network of the country accounted for 30.4% of the total accidents and 36.0% of deaths in 2017. Among vehicle categories, two-wheelers accounted for the highest shares (33.9%) in total road accidents and fatalities (29.8%) in 2017. Most, unfortunately, young adult age group 18 – 45 comprise of 72.1% of road accident death victims [15]. http://mospi.nic.in/statistical-year-book-india/2017/189 (Ministry of Statistics and Programme Implementation, GoI)

The table 2 indicates the statistics of road accidents, persons killed and injured on all the roads of National Highways in the country [14].

**Table 2 Road Transport Year Book Data 2018**

| Road Category | 2016 | | | 2017 | | |
|---|---|---|---|---|---|---|
| | No. of accidents | Persons killed | Persons Injured | No. of accidents | Persons killed | Persons Injured |
| **National Highway** | 1,42,359 | 52,075 | 1,46,286 | 1,41,466 | 53,181 | 1,42,622 |
| **State** | 1,21,655 | 42,067 | 1,27,470 | 1,16,158 | 39,812 | 1,19,582 |

| Highways | | | | | | |
|---|---|---|---|---|---|---|
| **Other roads** | 2,16,638 | 56,643 | 2,20,868 | 2,07,286 | 54,920 | 2,08,771 |
| **Total** | **4,80,652** | **1,50,785** | **4,94,624** | **4,64,910** | **1,47,913** | **4,70,975** |

Since the independence of India, these automobile population has raised around 170 times but the road infrastructure has expanded only nine times. The country's vehicle population is over 5.5 crore and growing at a phenomenal rate of 25 lakh every year. Roads make up 4% of Kolkata city as compared to 25% in Delhi and 30% in some other cities. Outside the metros, the main roads and other roads are poorly maintained and congested.

Road fatalities are expected to become the world's fifth largest killer by 2030, thousands of times more than terrorism or rail/air accidents.

It is alarming that the rate of death due to road accidents is highest in India than in any other country in the world. This was highlighted in the World Health Organizations' Global Status report on road safety [16]**.** Figure 3 shows the deaths caused by road user category in India, 2019.
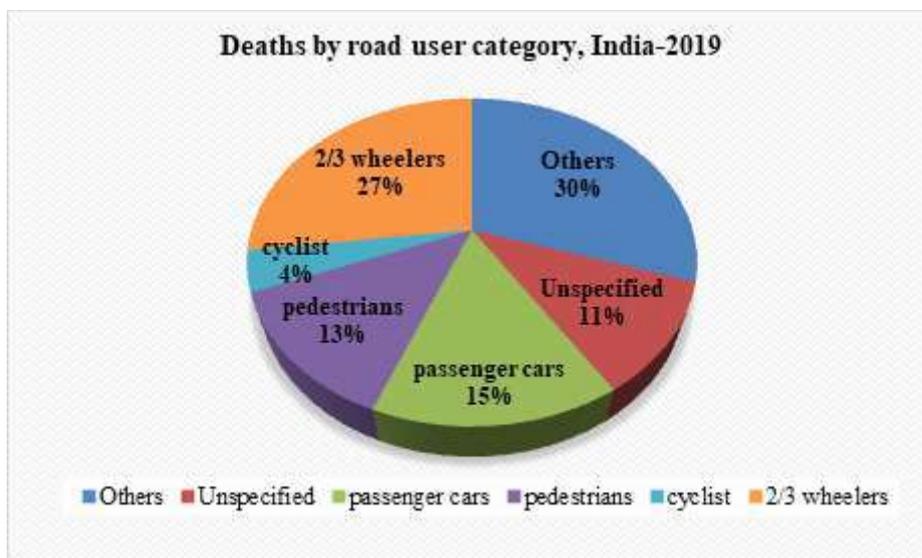


**Fig 3 Road Accidents – 2019, Ministry of Road Transport, India**

Today, metropolitan cities are facing one common problem of bumper to bumper traffic on the roads and this results in congestion. This is the main reason for accidents and as well as vehicles emitting pollution. Road safety is a must for saving precious human life and this can also cause a threat to the clean environment. Some features such as airbags, hazard warning systems, and seat belts are available but they cannot resolve the problems that occurred because of driver's incapability to predict the situations before it happens.

At present, the speed of other vehicles is not predictable and cannot respond accordingly. However, with new technologies like wireless sensor communications and other types of equipment, speed can be predicted to broadcast a warning message. These messages can be sent at an interval of a few seconds to reduce the risk of possible accidents [17].

The vehicles are increasing at a very fast rate in the last few years. It has been reported by road transport authorities that in the year 2001 there were only 55 million of vehicles get registered but the registration of vehicles increased to 142 million in the year 2011. This is really, an alarming statistics for traffic management and road safety concerns. Even in the last decade, there was a rise of 219% registered vehicles for one million of the population. The Government of India (GoI) is in the process to expand the national highway network for more than 200,000 km. The GoI has already launched the Bharatmala Pariyojana, that target to build 66,100 km of coastal roads, expressways, economic corridors, and borders to boost the highway network as National highways account for 2% of the total road network and carry over 40% of total traffic [18]. Some of the other major issues that has to be taken care in near future are discussed below.

**a. Congestion**

The cities mostly metropolitan are facing severe traffic congestion problems because of the rapid growth in private-vehicle registration. The average speed of a vehicle is around 17-19 km/h, with the slowest times

witnessed during the evening hours in metro cities. The average speed of traffic in key Indian cities is just 17-23km/h while the average cycling speed is 15-16 km/h [19].

### b.    Road accidents

A total of 501,423 road accidents and 146,133 death in road accidents were in 2019; this means 1,374 accidents and 400 deaths on India's roads every day. Sadly, 54.1% of people killed in road accidents are in the age group of  15-34 years only  It is estimated that around 3% of GDP economy lost due to road mishaps. [20].

### c.    Air pollution

The Global Burden of Disease 2018 (GBD) study, reported that the 'outdoor air' pollution is listed in the top 10 risks around the world and in the developing countries of Asia it is among the top six risks for humans. Air pollution has greater impact on developing countries such as India, as 1.4 million people lost their life due to air pollution; US$ 505 billion towards welfare losses; and US$ 55.4 billion towards lost labour [21].

## 3.    CONCLUSION

Hence, research is very much required for Intelligent Transportation System focusing on V2V, V2I, and V2Hybrid communication to deploy intelligent traffic systems. VANET is a fundamental area of research to overcome the factors mentioned above. Routing plays a vital role here because if the information is not disseminated timely and accurately then accident disaster may occur in real-time traffic scenarios.  VANET is made through random vehicular movements on highways or city drives. These vehicles or nodes are free to move as per their need and speed or as per driver's mood and driving habits. This uncertain movement of nodes generates newly evolved challenges and problems for the researchers. These problems motivated the researcher to develop and devise a new set of protocols and algorithms that can be more specifically focused on VANETS routings. The VANET can be tested using simulation software to analyze the performance before the implementation in real-world applications. The research work presented in this paper aims to analyze and focus on the status of the road conditions and accidents that took place in India. It also discussed that the Intelligent Transportation and VANET shall be implemented in near future that may help for smoother transportation facility and lowering the rate of accidents.

## REFERENCES

[1]  R. J. Hall, "An improved geocast for mobile ad hoc networks," *IEEE Transactions on Mobile Computing*, Vol. 10, No. 2, pp. 254–266, 2011.

[2]  J. Luo and J. P. Hubaux, "A survey of research in inter-vehicle communications," in *Embedded Security in Cars: Securing Current and Future Automotive IT Applications*, Springer Berlin Heidelberg, 2006, pp. 111–122.

[3]  P. Kaleeswari, N. M. J. a, and P. G. Student, "SURVEY ARTICLE A Survey on Routing Protocols in VANET," Vol. 2, No. 3, pp. 383–388, 2013.

[4]  P. Muhlethaler, A. Laouiti, and Y. Toor, "Comparison of Flooding Techniques for Safety Applications in VANETs," in *2007 7th International Conference on ITS Telecommunications*, 2007, pp. 1–6.

[5]  K. C. Lee and M. Gerla, "Opportunistic vehicular routing," *2010 European Wireless Conference, EW 2010*, pp. 873–880, 2010.

[6]  R. Tomar, H. Sastry, and M. Prateek, "Establishing Parameters for Comparative Analysis of V2V Communication in VANET," *Journal of Scientific and Industrial Research (JSIR)*, Vol. 79, No. 01, pp. 26–29, 2020.

[7]  R. Tomar, M. Prateek, and G. H. Sastry, "Vehicular Adhoc Network (VANET)- An introduction," *International Journal of Control Theory and Applications*, Vol. 9, No. 18, pp. 8883–8888, 2016.

[8]  G. G. Suresha, "Internet Access in Vehicular Ad-Hoc Networks Based on Infrastructure and LTE Communications Masters Thesis in Communication and Signal Processing," No. January, 2017.

[9]  R. Tomar, M. Prateek, and G. H. Sastry, "Vehicular adhoc network (vanet)-an introduction," 2016.

[10] S. Panichpapiboon and W. Pattara-Atikom, "Connectivity requirements for self-organizing traffic information systems," *IEEE Transactions on Vehicular Technology*, Vol. 57, No. 6, pp. 3333–3340, 2008.

[11] G. D. Singh, M. Prateek, and H. S. G, "Swarm Intelligence Based Algorithm for Efficient Routing in VANET," *International Journal of Innovative Technology and Exploring Engineering*, Vol. 9, No. 5, pp. 1124–1136, 2020.

[12] "WRS Data – World Road Statistics." [Online]. Available: https://worldroadstatistics.org/wrs-data/. [Accessed: 21-Dec-2020].

[13] "Overview of Road Accidents in India | PRSIndia." [Online]. Available: https://www.prsindia.org/policy/vital-stats/overview-road-accidents-india. [Accessed: 27-Oct-2020].

[14] "MOTOR VEHICLES - Statistical Year Book India 2018 | Ministry of Statistics and Program Implementation | Government Of India." [Online]. Available: http://mospi.nic.in/statistical-year-book-india/2018/189. [Accessed: 27-Oct-2020].

[15] "MOTOR VEHICLES - Statistical Year Book India 2017 | Ministry of Statistics and Program Implementation | Government Of India." [Online]. Available: http://mospi.nic.in/statistical-year-book-india/2017/189. [Accessed: 27-Oct-2020].

[16] "WHO | Global status report on road safety 2009," *WHO*, 2015.

[17] "Intelligent Transportation Systems - Benefits of Intelligent Transportation Systems Fact Sheet." [Online]. Available: https://www.its.dot.gov/factsheets/benefits_factsheet.htm. [Accessed: 27-Oct-2020].

[18] "Roadways in India - Road Industry, Network, Projects & FDI." [Online]. Available: https://www.investindia.gov.in/sector/roads-highways. [Accessed: 07-Dec-2020].

[19] "(No Title)." [Online]. Available: https://olawebcdn.com/ola-institute/ease-of-moving.pdf. [Accessed: 27-Oct-2020].

[20] "Road Accidents in India | Ministry of Road Transport & Highways, Government of India." [Online]. Available: https://morth.nic.in/road-accident-in-india. [Accessed: 27-Oct-2020].

[21] "Over 7 billion people face unsafe air: State of Global Air 2018 | Institute for Health Metrics and Evaluation." [Online]. Available: http://www.healthdata.org/news-release/over-7-billion-people-face-unsafe-air-state-global-air-2018. [Accessed: 27-Oct-2020].

## MOLECULAR DOCKING STUDIES ON THE PHYTOCHEMICALS OF EPIPHYLLUM OXYPETALLUM FLOWER AGAINST URINARY TRACT INFECTIONS

**S. S. Meenambiga\*, P. Jayashree, M. Shalini and Soumi Acharya**

Department of Bio-Engineering, School of Engineering, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai-600117, Tamilnadu, India

**ABSTRACT**

*The present study focuses on the molecular docking studies with the selected phytochemicals from the flower extract of Epiphyllum oxypetalum against the protein FdeC to treat urinary tract infections. Molecular docking and drug-likeness were performed for the natural compounds of Epiphyllum oxypetalum flower. Five compounds satisfying Lipinski's rule of five were subjected to study the molecular interactions using the software Auto Dock 4.2.6. The molecular docking results showed that the phytochemicals of Epiphyllum oxypetalum has good inhibition towards the E. coli FdeC receptor.The compounds 7-hydroxy-3-[1,1-dimethylprop-2-enyl] coumarin and spiro[androst-5-ene 17,1'-cyclobutan]-2'-one were found to have good inhibition with activation energy of -6.17 kcal/mol and -4.12 kcal/mol docking score. Thus, it proved to be a good inhibitor of E. coli and this serves as a lead to develop a drug based on the molecular interactions analyzed to specifically treat urinary tract infections.*

*KEYWORDS: Epiphyllum oxypetalum, FdeC, Molecular docking, Urinary tract infections*

**INTRODUCTION:**

*Epiphyllum oxypetalum* is a species of cactus and it is the most commonly cultivated species. It is one of the under-utilized resources available in the tropical regions of the globe. It is a unique plant and it is a night - blooming flower in the month of June to September. In India, it is known as Bramhakamal and it is considered as a sacred plant. The phylloclades contain some active ingredients and exhibit antibacterial activity[1]. The juice of the stem is used to induce blistering and expel parasitic worms from the body. The chemical content of *Epiphyllum oxypetalum* has a potent power to stifle the pain which can neutralize blood clotting [2]. This flower has many medicinal values and used to treat prostate diseases, bladder irritation, gynecological inflammation, congested kidney, and nervous headaches. It also helps in reducing heat by detoxification and loosening stools [3].

Urinary tract infections [UTIs] are considered a severe public health problem and most commonly caused by *Escherichia coli, Klebsiella pneumonia, Proteus mirabilis, Enterococcus faecalis,* and *Staphylococcus saprophyticus*. Lower tract [cystitis] affects the urethra and bladder and upper tract UTIs [pyelonephritis] affect the kidneys. If the bacteria move from the infected kidney into the blood then this condition is called urosepsis. These infections are less common in men than in women. UTIs are caused by both gram-negative and gram-positive bacteria and as well as by fungi. The most causative agent for both uncomplicated and complicated UTIs are uropathogenic *E.coli*[UPEC][4]. Some *E.coli* strains live as harmless commensals in animal intestines whereas other distinct genotypes cause significant morbidity and mortality as human intestinal pathogens. Conventional vaccinology approaches have been unsuccessful in providing highly immunogenic, safe, and cross-protective vaccines against extraintestinal pathogenic *E.coli* [Ex-PEC] strains. Some *E.coli* strains live as harmless commensals in animal intestines whereas other distinct genotypes cause significant morbidity and mortality as human intestinal pathogens.

FdeC is a broadly conserved, *E.coli* adhesion protein whose expression is upregulated on the surface of UPEC when it contacts host cells[5]. FdeC is a major target during humoral immune responses which significantly reduced kidney colonization. The ECOK1_0290 is a protective antigen which is renamed as FdeC [factor adherence E.coli and also contains 1416 amino acid protein. FdeC shares 95% identity with EaeH, a putative adhesion that is identified by subtractive hybridization from the genome sequence of the enterotoxigenic *E.coli* [ETEC] strain H10407 [6]. In ExPEC strain and other *E.coli* pathotypes, the FdeC gene resides in a locus containing three putative regulatory genes and five putative reductases and hydrolases. FdeC gene is highly conserved with > 91% identity at the amino acid sequence level. It shows structural similarity with intimin, containing an N-terminal β–barrel and C-terminal extracellular domain which belongs to the type V group of autotransporter proteins [7]. In both intimin and invasin, the domain D5 is C-type lectin-like moiety which is closely related to domain D4 plays an important role in bacterial binding to their respective receptors.

The crystal structure of region B [residues 597 to 1008] is responsible for the antigenic properties of the protein. Recombinant FdeC$_{AB}$ has the intrinsic capacity to bind to the human bladder [UM-UC-3] and urethral epithelial

[tUEC] cells and also bound to the ovary [CHO], cervix [HeLa] and the kidney [Vero] epithelial cells. Recombinant FdeC also showed a dose-dependent binding to collagen types I, III, V & VI [8].

Lipinski's rule of five was developed to set "drug ability" guidelines for New Molecular Entities [NMEs]. It describes the molecular properties important for a drug's pharmacokinetics. This rule helps for proper selection of the drug and knowing whether the drug is suitable for oral formulations. It can predict drug-likeness and due to rule simplicity, it became an efficient tool in the drug designing process. It is applicable only for those drugs which are absorbed through passive transport mechanisms. Phytochemicals that satisfy Lipinski's rule are used for docking studies [9].

## MATERIALS AND METHODS

### Ligand selection

The phytochemical [ligand] were selected from the ethanol extract of *Epiphyllum oxypetalum* flower through GC-MS analysis which includes hexadecanoic acid, ethyl ester, nonadecanoic acid, oleic acid, 11-tridecen-1-ol, 1-octadecyne,hexadecanal, spiro[androst-5-ene17,1'-cyclobutan]-2'-one, 3hydroxy-,[3.beta.,17.beta.]-, 1,6;3,4-dianhydro-2-deoxy-beta-D-lyxo-hexopyranose, di-N-decyl sulfone, 7-hydroxy-3-[1,1-dimethylprop-2-enyl]coumarin and pterin-6-carboxylic acid. The above-mentioned compounds are included in Table 1 with its IUPAC name, molecular structure,and chemical formula, and the information is retrieved from the PubChem database. Lipinski's rule of 5 parameters such as molecular weight, log P, number of hydrogen bond donors, number of hydrogen bond acceptors, and molecular refractivity was taken from the PubChem database for the above mentioned compounds. The information about the Lipinski rule for the above-mentioned phytochemicals was shown in Table 2.

### FdeCProtein structure

The three-dimensional protein structure of FdeC was retrieved from the protein data bank [PDB]. The PDB ID of the FdeC protein is 4E9L. The Protein Data Bank was established in 1971 as a computer-based archival file for macromolecular structures and it is one of several data base activities in the field of crystallography. It covers atomic co-ordinates, structure factors, and phases from diffraction studies of macromolecules [10].The water molecules were removed from the protein macromolecule for effective ligand binding. FdeC contains several bacterial Ig-like domains that are revealed by sequence analysis. The A chain of this protein consists of 420 amino acid residues. In the N-terminal region, it contains a domain of unknown function [DUF3442] and forms a β–barrel multidomain structure. This protein represents a potential vaccine antigen against uropathogenic *E.coli* [UPEC] mediated UTI.

### Docking studies

Docking studies were performed using an automated bioinformatic docking tool-Auto dock 4. This software is used to predict how small molecules, such as substrates or drug candidates, bind to a receptor of known 3-D structure. It allows fully flexible modeling of specific portions, in a similar manner as the ligand [11]. The structures were converted in the .pdbqt format using Auto dock tools, adding Gasteiger charges. It constitutes two methodologies namely rapid grid-based energy evaluation and effective search of torsional freedom to accomplish the drug development process [12].

### Discover Studio Visualizer

Discovery studio visualizer was developed and distributed by Accelrys, which is a free software which is designed to offer an interactive environment for viewing and editing molecular structures, sequences, X-ray reflection data, etc. [13]. It is used to study the stimulation of small molecules and large macromolecules. It is used for three-dimensional visualization and generation of two-dimensional plots of the protein-ligand interactions [14].
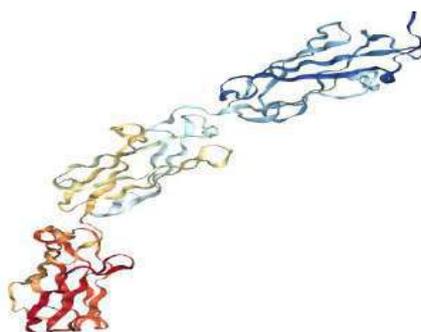


**FIGURE 1:Structure of protein FdeC [PDB ID: 4E9L]**
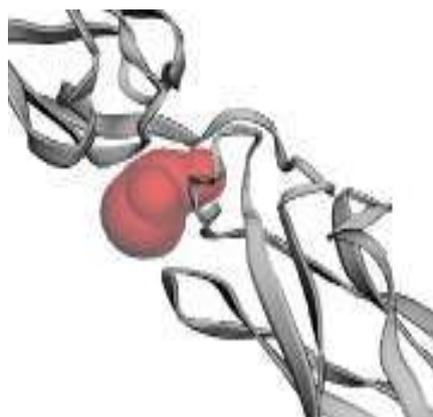
**FIGURE 2:Active site of protein FdeC[PDB ID: 4E9L]**



**FIGURE 3: Active binding pocket no. 1 of FdeC receptor**

**Table 1**: Details of phytochemicals

| S. No. | Compound | IUPAC name | Structure | Chemical Formula |
|---|---|---|---|---|
| 1 | Hexadecanoic acid, ethyl ester | Ethyl hexadecanoate |  | $C_{18}H_{36}O_2$ |
| 2 | Oleic acid | [Z]-octadec-9-enoic acid |  | $C_{18}H_{34}O_2$ |
| 3 | 1-Octadecyne | octadec-1-yne |  | $C_{18}H_{34}$ |
| 4 | 11-Tridecen-1-ol, [Z]- | tridec-11-en-1-ol |  | $C_{13}H_{26}O$ |
| 5 | Hexadecanal | Hexadecanal |  | $C_{16}H_{32}O$ |

| 6 | 1,6:2,3-Dianhydro-4-deoxy-beta-d-lyxo-hexopyranose | |  | $C_6H_8O_3$ |
|---|---|---|---|---|
| 7 | Pterin-6-carboxylic acid | 2-amino-4-oxo-1H-pteridine-6-carboxylic acid |  | $C_7H_5N_5O_3$ |
| 8 | Spiro[androst-5-ene-17,1'-cyclobutan]-2'-one | 3-hydroxy-10,13-dimethylspiro[1,2,3,4,7,8,9,11,12,14,15,16-dodecahydrocyclopenta[a]phenanthrene-17,2'-cyclobutane]-1'-one |  | $C_{22}H_{32}O_2$ |
| 9 | Di-n-decylsulphone | 1-decylsulfonyldecane |  | $C_{20}H_{42}O_2S$ |
| 10 | 7-Hydroxy-3-[2-methylbut-3-en-2-yl]chromen-2-one | 7-hydroxy-3-[2-methylbut-3-en-2-yl]chromen-2-one |  | $C_{14}H_{14}O_3$ |
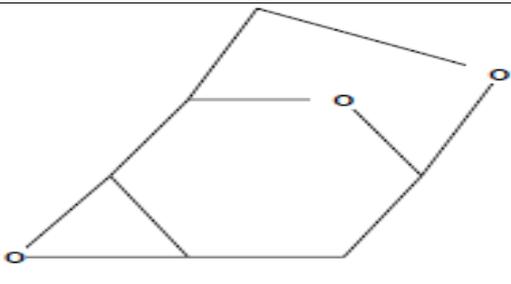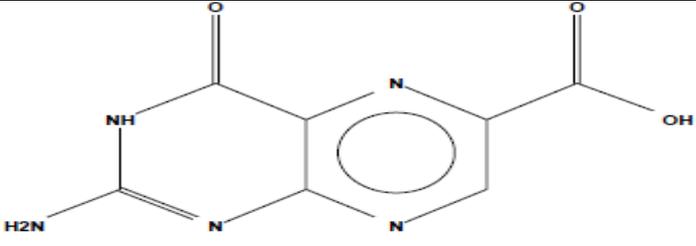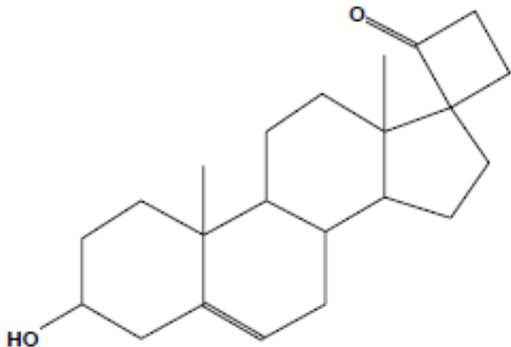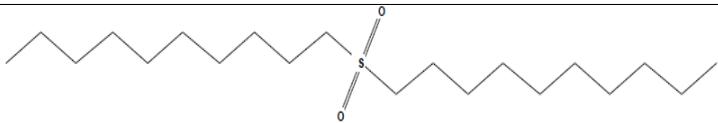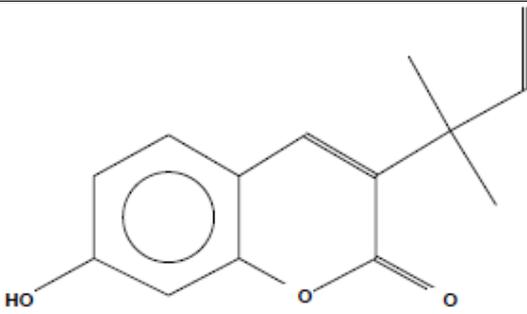
**TABLE 2:**

| S.No | Phytochemical compound | Molecular weight [<500] | Log P [<5] | H-bond Donor [<5] | H-bond acceptor [<100] | Molar refractivity [<130] |
|---|---|---|---|---|---|---|
| 1 | 11-tridecen-1-ol | 198 | 4.06 | 1 | 1 | 63.45 |
| 2 | Spiro[androst-5-ene-17,1'-cyclobutan]-2'-one, 3-hydroxy-, [3.beta.,17.beta.]- | 328 | 4.65 | 1 | 2 | 94.38 |
| 3 | 7-hydroxy-3-[1,1-dimethylprop-2-enyl]coumarin | 230 | 2.90 | 1 | 3 | 65.69 |
| 4 | Pterin-6-carboxylic acid | 207 | -0.94 | 4 | 8 | 48.56 |
| 5 | Hexadecanal | 240 | 5.66 | 0 | 1 | 76.37 |

**RESULT AND DISCUSSION:**

The ethanol extract of *E .oxypetalum* flower acts as a traditional medicine for the urinary tract infection against pathogenic bacteria *E. coli.* The FdeC receptor towards a bacterial pathogen shows and helps in inhibiting disease that caused by the *E. coli.* Molecular docking analysis was differentiated using the binding energy of each compound and its drug challenge against microbial disease [15].

The active compounds were analyzed using a Lipinski rule of five. The rules of five for the drug-likeness of each compound that should be depends upon were the molecular mass should be less than 500 Dalton. Hydrogen bond donor less than 5, hydrogen bond acceptors less than 10, high lipophilicity less than 5 [LOGp], sand molar refractivity between 40-13 [16,17]. Referral with this criteria the compound such as 11-tridecen-1-ol, Spiro[androst-5-ene-17, 1'-cyclobutan]-2'-one, 3- hydroxy-, [3.beta.,17.beta.]-, 7-hydroxy-3-[1, 1-dimethylprop-2-enyl] coumarin and Pterin-6- carboxylic acid were satisfied with the Lipinski rule of five were shown in table 2.

FdeC receptor catalytic site predictions were analyzed using the Cast p program. The best ligand binding site was observed to be at pocket no. 1 of FdeC receptor of volume 78.296 Å and Area of 89.305 Å which consists of 37 residues[18,19].

The analyzed 37 active residues were used as catalytic sites for 5 compounds used for docking studies. The results of the interaction between the active site residues of the target were shown in table 3. By analyzing the docking interactions 7-hydroxy-3-[1,1-dimethylprop-2-enyl]coumarin and spiro[androst-5-ene17,1'-cyclobutan]-2'-one were found to have the highest activation energy of -6.17kcal/mol and -4.12 kcal/mol [figure 5 and 7] the other compound that has less active energy and further it could be useful for identification and development of a new preventive and therapeutic drug against urinary tract infection.

**Table 3: Molecular docking analysis of phytochemicals of *Epiphyllum oxypetalum* flower against UTI**

| Compound | Binding energy | Vander waals Interaction | No. of Hydrogen Bonds | Hydrogen interactions | Total no of residues |
|---|---|---|---|---|---|
| Hexadecanal | -1.90 | VAL851,THR807,VAL795,SER794,VAL73,ALA796 | 1 | THR809 | VAL851,THR807,VAL795,SER794,VAL73,ALA796, THR809 |
| spiro[androst-5-ene17,1'-cyclobutan]-2'-one | -4.12 | LYS845,THR807,THR809,VAL795 | 1 | SER794 | LYS845,THR807,THR809,VAL795, SER794 |
| Pterin-6-carboxylic Acid | -3.59 | VAL808,THR807,VAL795,SER794,LYS792 | - | - | VAL808,THR807,VAL795,SER794,LYS792 |
| 11-tridecen-1-ol | -2.09 | VAL795,VAL808,THR807,SER794,VAL793,VAL811,LEU810 | 2 | THR809, LYS792 | VAL795,VAL808,THR807,SER794,VL811,LEU810, THR809,LYS792, AL793,VA |
| 7-hydroxy-3-[1,1-dimethylprop-2-enyl]coumarin | -6.17 | VAL808,VAL795,THR809 | 2 | SER794, THR807 | VAL808,VAL795,THR809,SER794, THR807 |
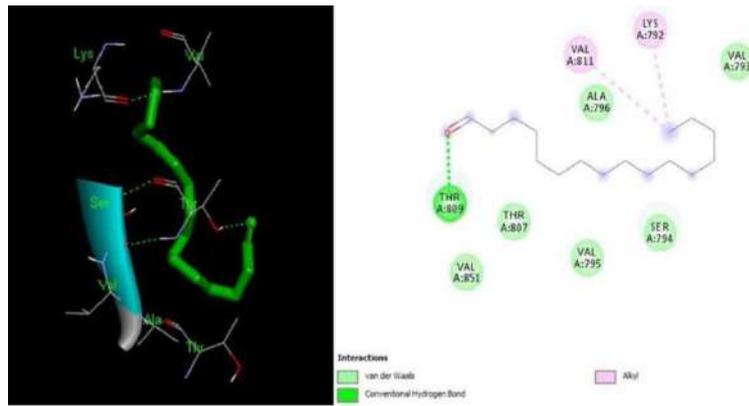
**FIGURE 4: 3D and 2D interaction of compound hexadecanal with FdeC [PDB ID: 4E9L]**
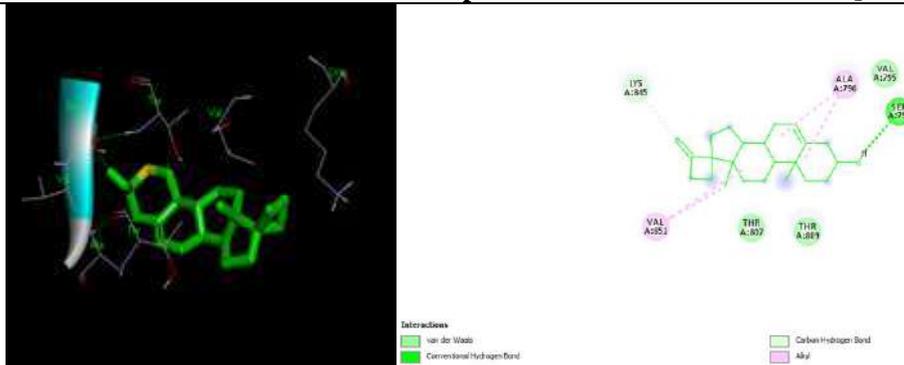


**FIGURE 5: 3D and 2D interaction of compound spiro[androst-5-ene17,1'-cyclobutan]- 2'-one with FdeC [PDB ID: 4E9L]**
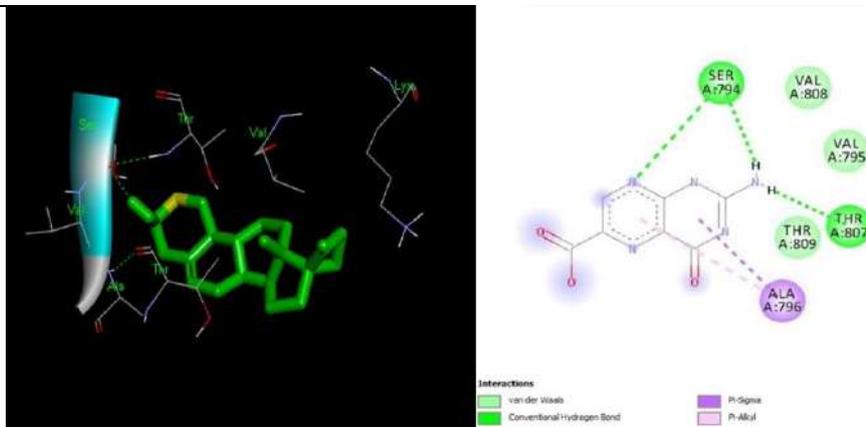


**FIGURE 6: 3D and 2D interaction of compoundPterin-6-carboxylic acid with FdeC [PDB ID: 4E9L]**
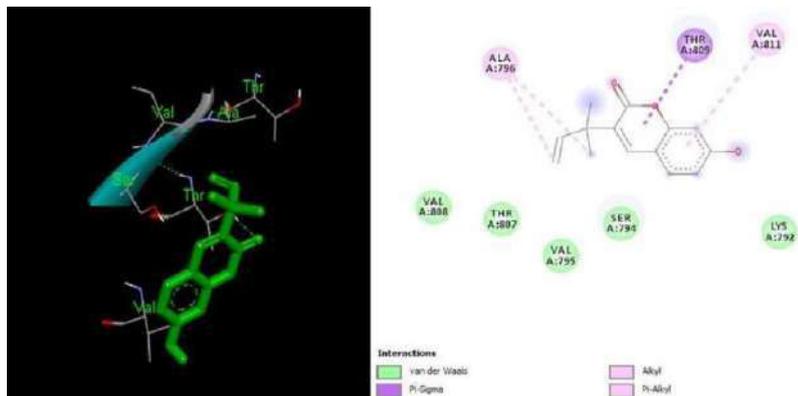


**FIGURE 7: 3D and 2D interaction of compound 7-hydroxy-3-[1,1- dimethylprop-2enyl] coumarin with FdeC [PDB ID: 4E9L]**
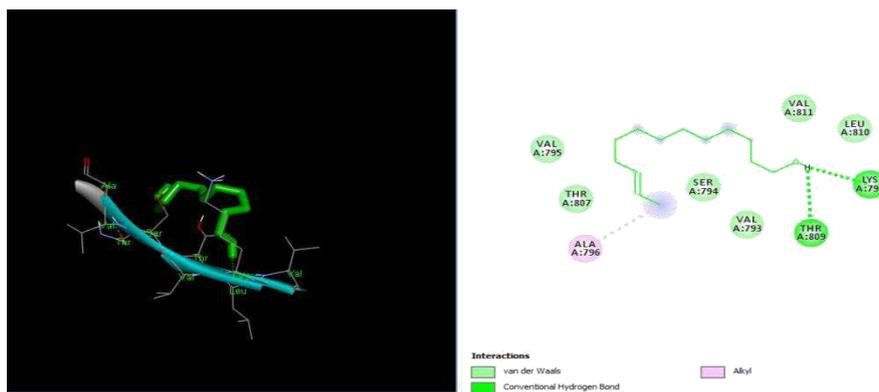
**FIGURE 8: 3D and 2D interaction of compound 11-tridecen-1-ol with FdeC [PDB ID: 4E9L]**

## CONCLUSION:

Secondary metabolites from the flower *Epiphyllum oxypetalum* possess antibacterial properties against urinary tract infections but the study about their mechanism of action is still lacking. In our study, the Phyto compounds 7-hydroxy-3-[1,1-dimethylprop-2-enyl] coumarin with -6.17 kcal/mol and spiro [androst-5-ene17,1'-cyclobutan]-2'-one with -4.12 kcal/mol docking score was suggested as a good drug compound against bacterial infections caused by *E. coli*. Thus, it proved to be a good inhibitor of *E. coli* and this serves as a lead to develop a drug based on the molecular interactions analyzed to specifically treat urinary tract infections.

## REFERENCE:

1) Upendra RS, Khandelwal P. Assessment of nutritive values, phytochemical constituents and biotherapeutic potentials of *Epiphyllum oxypetalum*. Int. J. Pharm. Pharmaceut. Sci. 2012;4:421-5

2) Matsuura N. The analysis of the aroma ingredients of the flower of Queen of the Night [*Epiphyllum oxypetalum* Haw.]. Korio.2002;214:12

3) Dandekar R, Fegade B, Bhaskar VH. GC-MS analysis of phytoconstituents in alcohol extract of *Epiphyllumoxypetalum* leaves. Journal of Pharmacognosy and Phytochemistry. 2015 May 1;4[1].

4) Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nature reviews microbiology. 2015 May;13[5]:269.

5) Bogema D, McKinnon J, Liu MY, Hitchick N, Miller N, Venturini C, Iredell J, Darling AE, Chowdury PR, Djordjevic S. Whole genome analysis of ExPEC ST73 from a single hospital over a 2-year period identified different circulating clonal groups. bioRxiv. 2018 Jan 1:428599.

6) Chen Q, Savarino SJ, Venkatesan MM. Subtractive hybridization and optical mapping of the enterotoxigenic Escherichia coli H10407 chromosome: isolation of unique sequences and demonstration of significant similarity to the chromosome of E. coli K-12. Microbiology. 2006 Apr 1;152[4]:1041-54.

7) Easton DM, Allsopp LP, Phan MD, Moriel DG, Goh GK, Beatson SA, Mahony TJ, Cobbold RN, Schembri MA. The intimin-like protein FdeC is regulated by H-NS and temperature in Enterohaemorrhagic Escherichia coli. Applied and environmental microbiology. 2014 Sep 19:AEM-02114.

8) Nesta B, Spraggon G, Alteri C, Moriel DG, Rosini R, Veggi D, Smith S, Bertoldi I, Pastorello I, Ferlenghi I, Fontana MR. FdeC, a novel broadly conserved Escherichia coli adhesin eliciting protection against urinary tract infections. MBio. 2012 May 2;3[2]:e00010-12.

9) Benet LZ, Hosey CM, Ursu O, Oprea TI. BDDCS, the rule of 5 and drugability. Advanced drug delivery reviews. 2016 Jun 1;101:89-98.

10) Bernstein FC, Koetzle TF, Williams GJ, Meyer Jr EF, Brice MD, Rodgers JR, Kennard O, Shimanouchi T, Tasumi M. The Protein Data Bank: A computer-based archival file for macromolecular structures. European Journal of Biochemistry. 1977 Nov;80[2]:319-24.

11) Morris GM, Huey R, Lindstrom W, Sanner MF, Belew RK, Goodsell DS, Olson AJ. AutoDock4 and AutoDockTools4: Automated docking with selective receptor flexibility. Journal of computational chemistry. 2009 Dec;30[16]:2785-91.

12) Meenambiga SS, Rajagopal K, Durga R. *In silico*docking studies on the components of Inonotus sp., a medicinal mushroom against cyclooxygenase-2 enzyme. Asian J Pharm Clin Res, 2015; 8:142–5.

13) Platform AE. Introduction to the Discovery Studio Visualizer. San Diego, California, USA: Accelrys Software Inc. 2005.

14) Nitulescu G, Nicorescu IM, Olaru OT, Ungurianu A, Mihai DP, Zanfirescu A, Nitulescu GM, Margina D. Molecular Docking and Screening Studies of New Natural Sortase A Inhibitors. International journal of molecular sciences. 2017 Oct 23;18[10]:2217.

15) Suganya J, Radha M, Naorem DL, Nishandhini M. In silico docking studies of selected flavonoids-natural healing agents against breast cancer. Asian Pac J Cancer Prev. 2014 Jan 1;15[19]:8155-9.

16) Alves MJ, Ferreira IC, Froufe HJ, Abreu RM, Martins A, Pintado M. Antimicrobial activity of phenolic compounds identified in wild mushrooms, SAR analysis and docking studies. Journal of applied microbiology. 2013 Aug;115[2]:346-57.

17) Chauhan R. *In silico approach towards finding inhibitory effect of phytochemicals on Trypanothionereductase in Leishmaniadonovani* [Doctoral dissertation].

18) Qaddir I, Rasool N, Hussain W, Mahmood S. Computer-aided analysis of phytochemicals as potential dengue virus inhibitors based on molecular docking, ADMET and DFT studies. Journal of vector borne diseases. 2017 Jul 1;54[3]:255.

19) Atere TG, Akinloye OA, Ugbaja RN, Ojo DA, Metibemu DS. Molecular Interactions and Docking Studies of the Phytochemical Constituents of Costusafer against Therapeutic Targets of Type 2 Diabetes. J ApplBioinformaComputBiol 6. 2017;2:2.

## BEST PRACTICES IN TEACHER EDUCATION INSTITUTIONS OUTCOME BASED EDUCATION - ONE OF THE BEST PRACTICES AT VISTAS

**Dr. V. Girija**
Associate Professor, Vels Institute of Science Technology and Advanced Studies

**ABSTRACT**

*The overall purpose and intent of the bench marking Best practice is summarized as the development of an understanding of the fundamentals that lead to success, focus on continuous improvement efforts and management of the overall change process to close the gap between an existing practice of the institution and that of the best in class institutions . The two major bodies that are responsible in India for Higher educational accreditation are National Board of Accreditation (NBA) and National Assessment and Accreditation Council (NAAC). It is mandatory for the institutions to publish the status of accreditation on the official website, so that the stakeholders, students, parents may know about the infrastructure and other important details about the institution before enrolling. This will also help the institutions to go for a National Institutional Ranking Framework (NIRF) that will help them compete with other premier institutions globally. Outcome based education is a theory that bases education around pre-defined goals(outcomes). By the end of the educational experience, each student is expected to have achieved the goal. It is a holistic approach to convert a student into a great person, based on desired outcomes and defined goals. The Vision and Mission of School of Education, VISTAS syncs with Outcome Based Education. Therefore as one of the Best Practices,Outcome-Based Education is followed in the School of Education, VISTAS. In this paper,the measurement of attainment of COs and POs. for a sample course- Pedagogy of Commerce for the year 2018 is shown.*

## OUTCOME-BASED EDUCATION (OBE)

Ever increasing global competition and demand for quality of education and employable work-force from industries and new business requirements have led to raising the employability and career professionally. While constructing curriculum, care is taken to improve not only the technical skills but also the soft skills the employability for such graduates increases. While formulating and revising the curriculum the course outcomes which led to programme outcomes plays a major role. Outcome Based Education is one of the Best Practices followed by the School of Education. In outcome based education, the course outcomes are identified to realize the programme outcomes. Courses within a curriculum, student learning outcomes are more specific and describe achievement expected in a particular course student learning outcomes for an academic program are defined as the knowledge, skills, or behaviours that a program's students should be able to demonstrate upon program completion. Course outcomes are compiled using Bloom's taxonomy, the learning outcomes are measurable and stated with action verbs that clearly describes the knowledge, skill and application of the students. The learning outcomes are achieved by the efficient faculties, digital library, labs, e-learning resources, etc. The COs and POs are identified and formulated to meet the global standards as per the norms of NBA, NAAC, etc. The Course outcomes are designed to cover the entire syllabus.

### Mechanism of Communication

Syllabus for the programme are well planned in advance before the commencement of the classes. The syllabus and the list of prescribed text books and reference book, learning objectives and learning outcomes are made while formatting and also the respective faculties are made to prepare lesson plans. Course handouts are prepared and communicated to students. Also, the details of COs and POs are communicated to students in departmental meeting. The students are given clear instructions about learning outcomes through mentors and faculty members in the class rooms. Booklets containing syllabus, Course and Programme objectives and outcomes with reference books are printed and circulated to all the students. A few hard copies of syllabus booklet are made available in the library and also in the department. Orientation programmes for students and teachers about COs, POs and the method of attainment of learning outcomes are conducted by the department. Workshops are conducted to develop the course and programme learning objectives and outcomes. Attainment of program outcomes, program specific outcomes and course outcomes are evaluated by the department. Course coordinator should specify which COs were not achieved satisfactorily and action plan to achieve them next year.

### Course Outcomes

The course outcomes state the major skills. Knowledge, attitude or ability that students will acquire. It is expressed in terms of measurable and observable behaviours. Course outcomes should be agreed upon by the

faculty in a program and should drive program outcomes and always begin with an action verb like write, install, solve and apply etc.

## Programme Outcomes

Programme Outcome describe what students should know and be able to do at the end of the programme which has to be in attributes of IEA (International Association for the Evaluation of **Educational** Achievement). It has to be measurable and achievable. The dimensions of Programme outcomes are knowledge outcomes, skill outcomes, attitude and value outcomes and behavioural outcomes.

## CO-PO Mapping

School of Education at VISTAS collects and evaluates data on program and course outcomes and uses them to assess the Outcome-Based Education. The assessment takes place at course level and program level. The method of attainment of COs, POs and PSOs start from writing appropriate COs for each course of the program from 1st year to final year . The COs are written by respective faculty members using action words. Then a correlation is established between COs and POs in the scale of 1 to 3, 1 being low, 2 being medium and 3 being high. A mapping matrix is prepared in this regard for every course including elective courses. The COs written and their mapping with POs are reviewed by the Program Outcome Assessment Committee (POAC). The process of attainment of Cos, POs and PSOs starts from writing appropriate Course Outcomes for each course of the program from first year to second year in a two-year B.Ed. degree program. The course outcomes are written by the respective faculty member using action verbs of learning levels suggested by Bloom and Anderson. A mapping matrix is prepared in this regard for every course in the program including the elective subjects. The course outcomes written and their respective mapping with POs are reviewed frequently by senior faculty members before they are finalized.

This practice will gain international recognition and global employment opportunities, as they become innovative graduates with professional and soft skills, social responsibility and ethics. This will also enable the teaching a far more creative and innovative career.  The course outcome of pedagogy of Commerce, is shown here as sample. The  tables  below show the COs and the CO-PO mapping matrix for a sample course.

## Assessment tools

Direct methods display the student's knowledge and skills from their  performance in the continuous assessment tests, end-semester examinations, presentations, and classroom assignments. These methods serve as a sample of what students know and can do and provide strong evidence of student learning. Target level set to score is 2.

**Program Name**            **: B.Ed.**

**Course Name**               **: Pedagogy of Teaching Commerce**

### Table:1 Course outcome

| Co.No | Program level | Course outcomes |
|---|---|---|
| | | Students will be able to |
| **CO1O4.1** | K2 | Discuss the role of teaching |
| **CO1O4.2** | K3 | Use different teaching aids to suit the needs of learners |
| **CO1O4.3** | K4 | Distinguish the methods of teaching |
| **CO1O4.4** | K5 | Select the individualized instruction |

### Table:2 Mapping of Course outcomes and programme outcomes

| PO→ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 0 | 0 | 2 | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - |
| **CO3** | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - |
| **CO4** | 1 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| Avg. | 2 | 2 | 1.5 | 1.5 | 2.75 | - | - | - | - | - | - | - |

PO – Program Outcomes

CO - Course Outcomes

**Overall Average – 1.95**

**Semester**                    **: II**

**Table:3 Course outcome**

| Co.No | Program level | Course outcomes |
|---|---|---|
| | | Students will be able to |
| **CO2O3.1** | K5 | Support Co-Scholastic activities in School |
| **CO2O3.2** | K5 | Select practical areas in Evaluation and administration of Test |
| **CO2O3.3** | K4 | Examine teacher professionalization and teacher commitment |
| **CO2O3.4** | K5 | Appraise ways and means of enhancing teacher commitment |

**Table:4 Mapping of Course outcomes and programme outcomes**

| PO→ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - |
| **CO2** | 1 | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - |
| **CO3** | 2 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - |
| **CO4** | 1 | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - |
| Avg. | 1.25 | 2.5 | 2.75 | 2.75 | 2.75 | 1.25 | - | - | - | - | - | - |

PO – Program Outcomes

CO - Course Outcomes

**Overall Average – 2.20**

Semester                  : III

**Table:5 Course outcome**

| Co.No | Program level | Course outcomes |
|---|---|---|
| | | Students will be able to |
| **CO301.1** | K4 | Examine the types of learning resources in teaching |
| **CO301.2** | K5 | Appraise the results of classroom research |
| **CO301.3** | K4 | Organize Action researches in schools whenever necessary |
| **CO301.4** | K3 | Implement ICT and Cybernetics in Education |

**Table:6 Mapping of Course outcomes and programme outcomes**

| PO→ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - |
| **CO2** | 1 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| **CO3** | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - |
| **CO4** | 3 | 2 | 1 | 2 | 3 | - | - | - | - | - | - | - |
| Avg. | 2 | 2.5 | 2 | 2.25 | 3 | - | - | - | - | - | - | - |

PO – Program Outcomes

CO - Course Outcomes

**Overall Average – 2.35**

Semester                  : IV

**Table:7    Course outcome**

| Co.No | K –level | Course outcomes |
|---|---|---|
| | | Students will be able to |
| **CO4O4.1** | K3 | Understands the curricular development |
| **CO4O4.2** | K3 | Demonstrate community activities |
| **CO4O4.3** | K5 | Select the appropriate instructional materials |
| **CO4O4.4** | K4 | Indentify the suitable techniques |

**Table:8 Mapping of Course outcomes and programme outcomes**

| PO→ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4O4.1 | 3 | 3 | 1 | 1 | 3 | - | - | - | - | - | - | - |
| CO4O4.2 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - |
| CO4O4.3 | 1 | 2 | 3 | 3 | 1 | - | - | - | - | - | - | - |
| CO4O4.4 | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - |
| Avg. | 2.25 | 2.25 | 1.75 | 1.75 | 2.25 | - | - | - | - | - | - | - |

**PO – ProgramOutcomes**
**CO - Course Outcomes**
**Overall Average – 2.05**

¤

Using tables and the overall course attainment levels of pedagogy of teaching Commerce and Accountancy the level is found to be 2.14. This indicates how a course is performing in terms of attainment values of course outcome and program outcomes. The attainment value thus computed is above the target level and hence course outcome and program outcomes framed works out well. If the attainment value happened to be below the target set then action plans may be tried and programme levels may be changed. If result is found to be non-attained then reasons for non-attainment are analyzed. Based on the analysis, action plan with remedial measures are implemented to address the gaps in learning outcomes.

As per NBA Student exit surveys, employer survey, co-curricular and extra-curricular activities can be used for determining in-direct attainment of POs and PSOs. Here in the School of Education exit survey is taken for consideration. 80% of direct attainment and 20% in-direct attainment are taken into consideration. Detailed summary reports of attainment of each CO and POs presented to the POAC. The computed values are compared with the set values of Pos. The target values are set in discussion with the management and senior faculty members. The course outcomes and program outcomes for B.Ed. program will be found and compared with the set target attainment values. The course outcomes and program outcomes for B.Ed. program have been found and compared with the set target attainment values. It is observed that the overall program attainment value is greater than the target attainment value. Hence, it was concluded that B.Ed. program of our institution VISTAS has reached the set target attainment level.

## CONCLUSION
Assessment and evaluation process provide critical information to faculty and administrators on the effectiveness of the design, delivery and direction of an educational program. Improvements based on the feedback from evaluations will close the system loop and the process will continue year after year.

**REFERENCES:**
1. Accreditation Manual for UG Engineering Programmes (Teir-II), available at http://www.nbaind.org/Files/NBA%20-%20Tier%20II%20Manual.pdf

2. Anderson, L. W., and Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.

3. Bloom, B. S. (1956). Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain. New York: David McKay Co Inc.

4. Evaluation guidelines by NBA, available at http://www.nbaind.org/files/evaluation-guidelines-tier-ii-v0.pdf

5. Exit Survey: Student's Questionnaire for Indirect PO Attainment

6. National Board of Accreditation Self-Assessment Report (SAR) For Engineering Programs of Tier – II Institutions – First Time Accreditation, June 2015, available at http://www.nbaind.org/En/1079-self-assessment-report-tier-ii.aspx

7. Girija.V "Pedagogical transitions using Blooms Taxonomy" in International Journal of Research in Engineering,IT,and Social Sciences(IJREISS)Volume 9, FEB-2019 ISSN:2250-0588

8. Girija.V Felvia Shanthi,Poonguzhali(2019)An Overview of graduating from an National Board of Accrediation Certified College and Vision and Mission of Organizations (JETIR)Volume 6, Issue 5 ISSN:368-374

9.  Dr.R.Jayaprabha, Mrs.R.Jeyanthi, Dr.T.Komalavalli, Mrs.A.Punitha, Dr.V.Girija(2019) An Empirical Study On Measuring Attainment Of Course Outcomes And Program Outcomes Of B.Ed. Program As Per Self-Assessment Report-June 2015(IJSSHR) ISSN:2348-3164 pp.522-528

10. Zamri Mohamed, Mohd Yusof Taib, M.S. Reza " Assessment Method for Course Outcome and Program Outcome In Outcome Based Education (OBE)", http://jntuhcej.org/web/tutorials/faculty/4_SVRAJU%20

## THE LAW OF SOWING AND REAPING IN MANGGARAI LANGUAGE (A CULTURAL LINGUISTIC ANALYISIS)

**Fransiskus Bustan and Tans Felix**
Lecturer of Nusa Cendana University Kupang

## ABSTRACT
*This study examines the law of sowing and reaping in Manggarai language in view of cultural linguistic perspective by referring specifically to the form and meaning of linguistic units used in the traditional expression of Manggarai language along with the conceptualization of Manggarai society. The research is descriptive. The results of study show that the law of sowing and reaping in Manggarai language is reflected in the form and meaning of linguistic units used in the traditional expressions of Weri latung goklatung, weri woja ako woja 'Planting corn, harvesting corn, planting rice, harvesting rice'. In terms of the form of linguistic units used, the traditional expression is a compound sentence and, along with the discursive context of its use, the sentence is a sentencial metaphor. The word classes functioning as the subjects are nominal metaphors especially plant metaphors, as reflected in the words latung 'corn' and woja 'rice'. As conceptualizaed in the cognitive map of Manggarai society, the traditional expression implies didactic meaning that what we sow is also what we will reap, that is if we sow the good, we will also reap the good, or vice versa, if we sow the bad, we will also reap the bad. Regardless the difference in the choice of words, the meaning is universal as it applies to all societies on this earth.*

*Keywords: law, sowing, reaping, Manggarai language*

## INTRODUCTION
Culture serves as a sense of identity indicating the existence of a society as members of an ethnic group and, at the same time, as a symbol of identity indicating their difference when compared to members of other ethnic groups. The function of culture both as a sense of identity and as a symbol of identity of a society as members of an ethnic group can be seen through language they employ. This is because language they employ serves as the mirror of their culture, and as culture is the world view of a society, the language they employ is also defined as the window of their world (Sapir, 1949; Cassirer, 1987; Foley, 1997; Kramsch, 2001; Bustan, 2005; Bustan and Liunokas, 2019).

The use of language at the micro-interactional level can be seen in such types of cultural texts such as ritual speech, folklore, folk songs, traditional expressions, rhymes, and proverbs. The characteristics of linguistic units used in the cultural texts are unique and specific to culture according the underlying context of their use, as reflected in the two poles of linguistic signs, that is pairing of form and meaning. The relationship between the two poles of linguistic signs is very close as form is a container of meaning and meaning is an echo of intent and will signal conveyed according to the task being carried out and acted upon by linguistic unit in question. Given that context is always present before the text, the analysis of meaning must always refer to the context, including the socio-cultural context as nonverbal environment accommodating and facilitating the form of linguistic units used in the cultural text. Meaning as an echo of intent and a sign of willis perceived in one unit with conceptualization embedded in the cognitive map of its speakers which serves as a container revealing their cultural knowledge in viewing the world (Bustan, 2005).

Bearing the matters stated above in minds, in this study, we examine the relationship between Manggarai language and Manggarai culture belonging to Manggarai society as members of Manggarai ethnic group inhabiting most of Manggarai area located in the western part of the island of Flores in the province of East Nusa Tenggara, Indonesia, with the distribution area boundaries being the Flores Sea to the north, the Sawu Sea to the south, Wae Mokel to the east, and the Sape Strait to the west (Verheijen. 1991; Bagul,1997; Lawang, 1999; Bustan, 2005; Bustan, 2006; Bustan, 2007; Bustan and Bire, 2018; Bustan and Liunokas, 2019; Bustan et al, 2021b; Bustan et al, 2021c), manifested in their conceptualization in viewing the world. However, as the relationship is so complex that the study focuses on the law of sowing and reaping in Manggarai language, as reflected in the form and meaning of linguistic units that the members of Manggarai society employ in the traditional expression of Manggarai language.

We are interested in doing the research for the reason that the conceptualization of Manggarai socety regarding the law of sowing and reaping, as reflected in the form and meaning of linguistic units used in the traditional expression of Manggarai language, is unique and specific to the socio-cultural context of Manggarai society as the nonverbal environment that underlies the presence of the linguistic units concerned. Added to this, another

reason is that there are no research results that examine specifically and in depth the conceptualization of Manggarai society regarding the law of sowing and reaping in view of cultural linguistic perspective with special reference to the form and meaning of linguistic units used in the traditional expression of Manggarai language along with its function and significance as the mirror of Manggarai culture as well as the window of the world of Manggarai society as members of Manggarai ethnic group (Bustan, 2005; Bustan and Liunokas, 2019).

## OBJECTVES

In general, this study aims to examine the relationship between Manggarai language and Manggarai culture belonging to Manggarai society, as reflected in the conceptualization embedded in their cognitive map regarding the law of sowing and reaping by referring specifically to the form and meaning of traditional expression in Manggarai language. In accordance with the scope of discussion, in particular, this study aims to (1) describe and explain the form of traditional expression regarding the law of sowing and reaping in Manggarai language and (2) describe and explain the meaning of traditional expression about the law of sowing and reaping in Manggarai language.

## LITERATURE REVIEW

As previously mentioned, the study is viewed from the perspective of cultural linguistics, one of the new theoretical perspectives in cognitive linguistics that examines the relationship between language, culture, and conceptualization. Cultural linguistics is regarded as a new paradigm or model in the cognitive linguistics as it examines the language used in the context of the lives of a society as members of a social group through the prism of their culture with the aim of revealing the conceptualizations imprinted in their cognitive map in viewing the world (Palmer and Sharifian, 2007). The basis of the underlying argument is that there is a very close relationship between language and cognition or the human mind (Casson, 1981; Stross, 1981; Cassirer, 1987; Palmer, 1996;

Foley, 1997; Bustan, 2005).

The basic concepts that should be taken into account as the main concerns or interests of study in cultural linguistics are language, culture, and conceptualization. As language can be defined differently, in the perspective of cultural linguistics, language is defined as a cultural activity and, at the same time, as an instrument to organize other cultural domains. This implies that language in a cultural product and practice. Similar to language, as different people define culture differently, in the perspective of cultural linguistics, culture is defined as a source of conceptualization of human experience in the context of life as members of a social group, as reflected in such cognitive structures as schemas, categories, metaphors, and scripts. The relationship of both language and culture is reflected in conceptualization, that is the fundamental thought process that underlies the formation of schemas, categories, metaphors, and scripts as the subordinate elements of cognitive structures (Palmer and Sharifian, 2007; Bustan et al, 2021b; Bustan et al, 2021c). Apart from schemes, categories, and scripts, metaphor is one of the most prominent aspects of study in cultural linguistics because the conception of human thinking is always facilitated through the use of metaphors or metaphorical expressions (Bustan et al, 2017; Bustan et al, 2021a).

The approach used in cultural linguistics is ethnographic approach in combination with several related approaches including the Boasian linguistic approach, ethnosemantics, and ethnography of speaking. The main purpose of using these approaches is not only to identify language differences due to cultural differences, but also to know the cultural elements of cultural knowledge such as cognitive and cultural schemas. Along with the use of the approaches, language is also defined as a system of symbol used by a society as members of a social group to conceptualize various types of their experiences in the world (Palmer, 1996; Foley, 1997; Bustan, 2005; Palmer and Sharifian, 2007).

## RESEARCH METHOD

This study is descriptive based on the phenomenological paradigm as its philosophical foundation (Muhadjir, 1995; Nusa Putera, 2011; Afrizal, 2014). This is because the study describes data regarding the law of sowing and reaping in Manggarai, as reflected in the form and meaning of the linguistic units used in the traditional expression of Manggarai language. Added to this, the data is presented as and as it is according to the facts found in the context of the life of Manggarai society at the time the research was conducted. The facts were concerned with how their behavior, perceptions, motivations, and actions were related to the law of sowing and reaping, as reflected in the form and meaning of linguistic unit used in the traditional expression of Manggarai language.

The research procedures were field and library research (Moleong, 1993; Bungin, 2007; Nusa Putera, 2011; Afrizal, 2014). The field research was aimed at collecting primary data regarding the conceptualization of

Manggarai society about the law of sowing and reaping, as reflected in the form and meaning of linguistic units used in traditional expressions of Manggarai language. The main location of research was Pagal village because we have built rapports with community members in that village in several previous research activities. The sources of data were the members of Manggarai society, especially those residing in Pagal village, represented by three key informants who were selected according to the ideal criteria of Faisal (1990), Spradley (1997), and Sukidan (2005). The methods of data collection were observation and interview. The techniques of data collection were recording, elicitation, and note-taking (Bungin, 2007). The library research was aimed at obtaining secondary data. The method of data collection was documentary study through searching various data available in various documents, both printed and electronic documents. The techniques of data collection were reading and note-taking. The types of documents used as the sources of data acquisition were of two kinds involving general references (books) and special references (research results, monographs, scientific articles, papers).

The data were analyzed qualitatively using the inductive method as the analysis moved from the data to abstraction and local-ideographical theory describing the law of sowing and reaping in Manggarai language in view of cultural linguistic perspective. The results of data analysis were negotiated and discussed on an ongoing basis with the key informants to obtain conformity with the conceptualization ascribed and imprinted in their cognitive maps regarding the law of sowing and reaping in Manggarai language with special reference to the form and meaning of linguistic units used in the traditional expression of Manggarai language.

## RESULTS AND DISCUSSION
### Results
The results of study show that both Manggarai language and Manggarai culture belonging to Manggarai society as members of Manggarai ethnic group are closely related. The relationship is manifested, among others, in the conceptualization of Manggarai society regarding the law of sowing and reaping. The law is reflected in the form and meaning of linguistic units used in the traditional expression of Manggarai language, *Weri latung, gok latung, weri woja, ako woja* 'Planting corn, harvesting corn, planting rice and harvesting rice'. The the form and meaning of linguistic units used are unique and specific to Manggarai culture revealing the conceptualization of Manggarai society about the law of sowing and reaping. The law implies that the members of Manggarai society should organize the patterns of good behaviors when interacting with one another. This is because, as conceptualized in the cognitive map of Manggarai society, if they sow the good in their patterns of behaviors, they will reap the good in the future, or vice versa, if they sow the bad in their patterns of behaviors, they will reap the bad in the future.

### Discussion
As can be seen in the physical features of linguistic units used, the traditional expression of *Weri latung gok latung, weri woja ako woja* 'Plant corn, harvest corn, plant rice, harvest rice' in Manggarai language is a compound sentence made up of two independent clauses as its subordinate elements. The two independent clauses as its subordinate elements are

(1) *Weri latung gok latung* 'Planting corn and harvesting corn' and (2) *Weri woja ako woja* 'Planting rice and harvesting rice'. The combination of the two independent clauses forms a compound sentence construction with an asyndenton pattern as the relationship between the two independent clauses is not coupled with the use of the word *agu* 'and' or *ko* 'or' as the coordinating conjunction. The relationship of the form of linguistic units used in the two independent clauses is meaningfully related to each other. Nevertheless, iconically-topographically, the ordering pattern of the two independent clauses cannot be changed by prioritizing the independent clause (2) or leaving the independent clause (1). This is because the traditional expression is regarded as a fixed form of traditional expression in Manggarai language accepted as a part of social conventions inherited from the ancestors of Manggarai society.

In view of the content stored in the form of linguistic units used, the traditional expression is a conditional sentence with the omission of the word *eme* 'if', the word *ite* 'we' as a plural second person pronoun, and the word *ngong* 'meaning'. If the three words were used, the construction would be as follows: (1) *Eme ite weri latung, ngong ite gok latung* 'If we plant corn, meaning that we harvest corn' and (2) *Eme ite weri woja, ngong ite akowoja* 'If we plant rice, meaning that we harvest rice'. These three words were deleted because, as mentioned earlier, the traditional expression is a fixed form of traditional expression in Manggarai language accepted as part of social conventions inherited from the ancestors of Manggarai society.

On the ground of the discursive context accommodating its use, the traditional expression of *Weri latung gok latung, weri woja ako woja* 'Plant corn, harvest corn, plant rice, harvest rice' in Manggarai language appears in a

form of sentencial metaphor. The types of wordclass serving as the subjects of the two independent clauses are nominal metaphors or, more specifically, plant metaphors characterized by the use of the word (noun) *latung* 'corn' and the word (nomina) *woja* 'paddy' which refer to the types of plants. It is worth noting that corn and rice are taken as examples because, apart from being the main types of crops grown on agricultural lands, both were the staple food of Manggarai society in the past (Bustan, 2005; Bustan et al, 2021b).

In accordance with the conceptualization embedded in the cognitive map of Manggarai society, the form of linguistic units used in the traditional expression of *Weri latung goklatung, weri woja ako woja* 'Planting corn and harvesting corn, planting rice and harvesting rice' in Manggarai language implies didactic meaning which is concerned withhow Manggarai society as members of Manggarai ethnic group should organize their patterns of behaviors, both verbal behavior patterns (words) and nonverbal behavior patterns (actions), when interacting with one another in the context of their daily lives. The expected behavior patterns are the patterns of good behaviors or behavior patterns implying the values of goodness in the framework of maintaining the harmony of social relations with others in and the harmony of transcendental relationships with God as the Creator of the Universe, known as *Morin agu Ngaran* in Maggarai language (Bustan and Liunokas, 2017). Along with the conceptualization ascribed and imprinted in the cognitive map of Manggarai society, if we sow the good, then surely we will reap the good in the future, or vice versa, if we sow the bad, then surely we will reap the evil in the future, or in other words, we cannot reap the good if we sow the bad.

The use of corn (*latung*) and rice (*woja*) as examples is closely related to the existence ofManggarai society as the bearers of dry land farming culture because the main types of crops they grew in their agricular lands in the past were corn and rice. Another reason is that corn and rice were regarded by the members of Manggarai society as the bearers of dry land farming culture as the symbols of living welfare and the indicators of householdeconomic welfare. The conceptualization, according to Bustan et al (2021), can also be seen in the sentence of Manggarai language, *Latung peno mbaru, woja peno ca'o* 'Corn full of house, rice full of storage', one of the fragments of cultural discourse spoken in thecontext of *penti ritual*, the new year ritual of agricultural custom for Manggarai society as a sign of the transition of the season from the old season to the new season (Bustan, 2005; Bustan, 2006).

As its function as a moral guide and ethical guide in managing the patterns of behaviors for Manggarai society, the traditional expression is regarded as one of the local wisdomsinherited from their ancestors that should be preserved in order to stay alive and develop. Apart from the differences in the choice of words, the meaning implied in the form of linguistic units used is regarded universal because it applies to all societies on this earth.

## CONCLUSION

The relationship between Manggarai language and Manggarai culture belonging to Manggarai society as members of Manggarai ethnic group, as reflected in the law of sowing and reaping in Manggarai language paying special attention to the form and meaning of linguistic units used in the traditional expression of *Weri latung gok latung, weri woja ako woja* 'Planting corn, harvesting corn, planting rice, harvesting rice'. The form of linguistic units used show that the traditional expression is a compound sentence. While in terms of the discursive context of its use, the traditional expression is a sentencialmetaphor in the kinds of word classes used as subjects are nominal metaphors especiallyplant metaphor, as reflected in the use of the words latung 'corn' and woja 'rice'. The content stored in the form of linguistic units used implies didactic meaning for the members of Manggarai society that if they sow the good in their life, then they will surelyreap the good, or vice versa, if they sow the bad in life, they will surely reap the bad as well. Regardless the differences in the choice of words, the traditional expression of Manggarai language regarding the law of sowing and reaping is one of the local wisdomsbelonging to Manggarai society that should be preserved as its meaning is universal to allsocieties on this earth.

## REFERENCES

- Afrizal. (2014). *Metode Penelitian Kualitatif: Sebuah Upaya Mendukung Penggunaan Penelitian Kualitatif dalam Berbagai Disiplin Ilmu*. Jakarta: Raja Grafindo Persada.

- Alwasilah, C. A. (1985). *Sosiologi Bahasa*. Bandung: Angkasa.

- Bagul, D. A. (1997). *Kebudayaan Manggarai*: *Sebuah Khasanah Kebudayaan Nasional*.

- Surabaya: Ubhaya Press.

- Bungin, B. (2007). *Penelitian Kualitatif: Komunikasi, Ekonomi, Kebijakan Publik, dan Ilmu Sosial Lainnya*. Jakarta: Prenada Media.

- Bustan, F. (2005). "Wacana budaya *tudak* dalam ritual *penti* pada kelompok etnik Manggarai di Flores Barat: sebuah kajian linguistik budaya." *Disertasi*. Program Doktor (S3) Linguistik Universitas Udayana Denpasar.

- Bustan, F. (2006). *Etnografi Budaya Manggarai Selayang Pandang*. Kupang: Publikasi Khusus LSM Agricola.

- Bustan, F., Bire, J., Semiun, A. (2017). *The Features of Anthropomophic Metaphor in the Manggarai language*. Germany: Lambert LAP Publishing.

- Bustan, F., Liunokas, Y. (2019). "The forms and meanings of verbal expressions on the existence of God as a supernatural power in Manggarai language". *International of Innovation* 5 (3), 16, 2019.

- Bustan, F., Bire, J., Jehane, H. (2021a). "The function of plant metaphor as a symbol of unity in for Manggarai speech community". *Academic Journal of Educational Sciences* 5 (01), 1-6, 2021.

- Bustan, F., Kabelen, A., Sarong, Y. S., Gana, F. (2021b). "Indicators of family life welfare in traditional economic system of Manggarai society (a cultural linguistic analysis)". *International Journal of Advance and Innovative Research. Volume 8, Issue 4 (1): October – December 2021 Part 2, pp. 2015-221.*

- Bustan, F., Gana, F., Sarong Y. S. (2021c). "The cultural conceptualization of Manggarai society on social conflict in family realm". *International Journal of Advance and Innovative Research. Volume 8, Issue 4 (1): October – December 2021. Part 2, pp.3013-3020.*

- Cassirer, E. (1987). *Manusia dan Kebudayaan*: *Sebuah Esai tentang Manusia.*

- Diterjemahkan oleh Alois A. Nugroho. Jakarta: Gramedia.

- Casson, R. W. (1981). "General introduction." Dalam *Language, Culture, and Cognition: Anthropological Perspectives*. Ronald W. Casson (Ed.). New York: Macmilan.

- Faisal, S. (1990). *Penelitian Kualitatif*: *Dasar-dasar dan Aplikasi*. Malang: Yayasan Asih Asah Asuh (YA3).

- Foley, W. A. (1997). *Anthropological Linguistics*: *An Introduction*. Oxford: Blackwell. Kramsch, C. (2001). *Language and Culture*. Oxford: Oxford University Press.

- Lawang, M. Z. R. (1999). *Konflik Tanah di Manggarai*: *Pendekatan Sosiologik*. Jakarta: Penerbit Universitas Indonesia.

- Moleong, L. J. (1993). *Metodologi Penelitian Lapangan Kualitatif.* Bandung: Remaja.

- Rasda Karya.

- Muhadjir, N. (1995). *Metodologi Penelitian Kualitatif*: *Telaah Positivistik, Rasionalistik, Phenomenologik, Realisme Metaphisik*. Yogyakarta: Rake Sarasin.

- Nusa Putra. (2011). *Penelitian Kualitatif: Proses dan Aplikasi*. Jakarta: Indeks.

- Palmer, G. B. (1996). *Toward a Theory of Cultural Linguistics*. Austin: The University of Texas Press.

- Palmer, G. B., Sharifian, F. (2007). "Applied cultural linguistics: an emerging paradigm." In *Applied Cultural Linguistics*. Edited by Farzard Sharifian and Gary B. Palmer. Amsterdam: John Benjamin.

- Sapir, E. (1949). *Culture, Language and Personality*. David G. Mandelbaum (Ed.).

- Berkeley: University of California Press.

- Stross, B. (1981). "Language, culture, and cognition." Dalam *Language, Culture, and Cognition*: *Anthropological Perspectives*. Ronald W. Casson (Ed.). New York: Macmilan..

- Spradley, J. P. (1997). *Metode Etnografi.* Diterjemahkan oleh M. Z. Elizabeth.

- Yogyakarta: Tiara Wacana Yogya.

- Sudikan, S. Y. (2005). *Metode Penelitian Kebudayaan*. Surabaya: Unesa Unipress bekerjasama dengan Citra Wacana.

- Verheijen, J.A. (1991). *Manggarai dan Wujud Tertinggi*. Jakarta: LIPI-RUL.

## THE FEATURES OF HUMAN METAPHORS IN THE RAI DIALECT

### Ulinsa[1], Fransiskus Bustan[2] and Josua Bire[3]
[1]The Lecturer of Department of Language and Arts Education, Tadulako University Palu
[2]The Lecturer of Study Program of English Education, Nusa Cendana University Kupang
[3]The Lecturer of Study Program of English Education, Nusa Cendana University Kupang

**ABSTRACT**

*This study investigates the features of human metaphors in the Rai dialect as one the dialects of the Kaili language in vew of cultural linguistics as a new theoretical perspective in cognitive linguistics exploring the relationship of language, culture, and conceptualization. This is a descriptive study. The methods of data collection were observation, interview, and documentary study, while the techniques of data collection were recording, elicitation, and note-taking. The sources of data were the members of Rai ethnics represented by three key informants. Data were analyszed qualitatively by using inductive method. The result of study shows that the features of human metaphor in the Rai dialect are unique and specific, as reflected in the forms and meanings of the linguisti units used in such verbal expressions of mata nuue, vivi ntalinti, puse ntasi, and pa'a nubulu. It is expected that the results of study might be beneficial to support the study of language belonging to a society as members of a social group along with the function of language they employ as the mirror of their culture as well as the window of their world.*

*Key words: feature, human metaphor, the Rai dialect*

**INTRODUCTION**

Both language and culture belonging to a society as members of a social group are closely related (Cassirer, 1987; Kramsch, 2001; Bustan, 2005; Wardaugh, 2011). The manisfestation of such a relationship is reflected in the conceptualization ascribed in their cognitive map in viewing the world (Casson, 1981; Bustan, 2005; Bustan et al, 2017). The conception is in line with the theory of linguistic relativity proposed by Sapir and Whorf that the varying cultural concepts and categories inherent in different languages affect the cognitive classification of the experienced world in such a way that the speakers of different languages think and behave differently (Miller, 1968; Keesing, 1981; Bustan et al, 2017).

The differences between languages due to cultural differences can be seen in metaphors that the speakers of those languages employ when communicating with one another in their contexts of living together. It is worth noting, however, that even though the use of metaphors is universal to all languages and cultures all over the world, many linguistic evidences show that the features of metaphors employed by a society as members of a social group are unique and specific to culture they share (Kovecses, 2009). Th unique and specific features can be seen, for instance, in human metaphor as a kind of nominal metaphor indicated by using the organ of human body attached to nonhuman entity existing in physical environment. The attachment creates not only a new form but also a new meaning due to the extension of meaning from denotative to conotative meaning (Foley, 1997; Bustan et al, 2017).

Bearing the matters stated above in minds, this study investigates the features of human metaphors in the Rai dialect, a local language spoken by the members of the Rai ethnics living in the region of Tavaili and Sirenja in the island of Sulawesi, Indonesia (Gazali, 2009) with special reference to the forms and meanings of the linguistic units used in the verbal expressions of the Rai dialect appearing as human metaphors. We are interested in conducting the study for the reason that the features of human metaphors in the Rai dialect are unique and specific to the Rai culture designating the conceptualization ascribed in the cognitive map of the Rai ethnics in viewing the world. The unique and specific features of human metaphors in the Rai dialect can be seen in the forms and meanings of linguistic units used designating the conceptualization ascribed in the cognitive map of the Rai society as members of the Rai ethnics in viewing the world on the basis of phenomenologic realities they experience in the contexts of living together. Added to this, another reason is that the results of previous studies show that there has no any study exploring in more depth the features of human metaphors in the Rai dialect in terms of their forms and meanings in view of cultural linguistics.

**FRAMEWORK**

As previously mentioned, this study is viewed from cultural linguistic perspective, one of the new theoritical perspectives in cognitive linguistics exploring the relationship of language, culture, and conceptualization belonging to a society as members of a social group in viewing the world (Palmer, 1996; Palmer and Farzad, 2007:1). Cultural linguistics is defined as one of the new theoritical perspectives in cognitive linguistics because

language used by a society as members of a social group is explored through the prism or lens of culture they share. The main aim of the study is to uncover the conceptualizations ascribed in their cognitive map in viewing the world that involve both the factual world and the symbolic world. Language in this light serves as the mirror of culture shared by a society as members of a social group and culture serves as the source of conceptualization of experiences faced by them in the contexts of living together. The relationship of both language and culture belonging to them is manifested in their conceptualization as reflected in such aspects of cognitive structures as scheme, category, metaphor, and script (Palmer and Farzad, 2007).

Metaphor can be defined differently and, as a result, there are many different definitions and conceptions of metaphor. Apart from such differences, according to Badudu (1983:70), metaphor refers to the use of word which does not share true meaning as it is an analogy on the basis of certain similarities. This implies meaning that metaphor is concerned with the use of reference towards a group of things that has certain relation to facilitate the difference of analogic relation with another group. This conception implies that metaphor is concerned with the use of reference towards a group of things that has certain relation to facilitate the difference of analogic relation with another group. More specifically, Verhaar (1999:393) pointed out that metaphor is concerned with the use of word or verbal expression whose literal meaning refers implicitly to another meaning through comparison based on similarity in feature, quality, and behavior.

Along with the function of language as the mirror of culture adhered by a society as members of a social group as well as the window of their world, Duranti (2001:64-65) propounded that metaphor is the implementation of their system of knowledge used as a guide for them to understand the world (Casson, 1981). Metaphor in this light is defined as a theory of society containing their experiences on the world that functions not only as a conceptual frame to understand the world but also as a linguistic device enabling them to relate various domains of experiences and coherences between interrelated events. Aa such, metaphor can be identified and known from semantic aspect as the transference of name as well as from the perspective of anthropology and philosophy. In the perspective of anthropology and philosophy, metaphor serves as the basic character of relationship between both the human linguisticality and the world. This emphasizes that, as human linguisticality is always metaphoric, all words and names are the results of human creation and not given by nature. Metaphor in this light is defined as a part of cultural conceptualization emerging in coginition level. This view supports the conception that both language and cognition are closely related (Palmer and Farzad, 2007; Bustan et al, 2017).

Many facts show that metaphor as one of the aspects of cognitive structures shared by a society as members of a social group are of various kinds. However, as metaphoric symbol can't be understood its meaning without reference to its context of use in discourse, metaphor can be identified into several kinds including nominal, predicative, and sentencial metaphor. Nominal metaphor and predicative metaphor can be understood their meanings by observing the contexts of sentences in which they are used. Sentencial metaphor can be understood its meaning in view of its relation with sentences preceding or following it. Nominal metaphor appears in the form of noun or noun phrase, predicative metaphor appears in the predicate of a sentence, and sentencial metaphor appears in the form of complete sentence. Along with the kinds of nous used as its component parts, nominal metaphor can also be identified into several kinds. One of those kinds is known as human metaphor which refers to a kind of nominal metaphor indicated by using the organ of human body attached to nonhuman entity existing in physical environment (Wahab, 1990; Foley, 1997; Palmer and Farzad, 2007; Bustan et al, 2017). Other than creating a new form, one of the the prominent features of human metaphor is the extension of meaning from denotative to conotative meaning. Similar to other kinds of nominal metaphors, according to Bustan et al (2017), the study of human metaphor can be seen from two poles of linguistic sign, that is pairing of form (signifier or expression) and meaning (signified or content) (Bustan, 2005; Foley, 1997:25-26).

**METHOD**

This study is descriptive as it describes the features of human metaphors the features of human metaphors in Rai dialect paying special attention to the forms and meanings of the linguistic units used. The methods of data collection were observation, interview, and documentary study, while the techniques of data collection were recording, elicitation, and note-taking. The sources of data (primary data) were the members of the Rai ethnics represented by three key informants and they were selected on the basis of criteria proposed by Spradley (1997) and Sudikan (2001). The data were then analyzed qualitatively by using inductive method as the process of analysis was started from data to the local theory describing the features of human metaphors in the Rai dialect.

**FINDINGS AND DISCUSSION**

**Findings**

The results of study show that, in terms of the linguistic units used, the features of human metaphors in the Rai dialect are unique and specific to the Rai culture designated by using the organs of human body such as eye (s), mouth, navel, and foot attached to nonhuman entities existing in the physical environment. The attachments create not only new forms but also new meanings due to the extension of meanings from denotative to conotative meanings through implied comparison and association because of having certain similirities in feature, quality, and behavior. Based on data selection, some examples of verbal expressions in the Rai dialect in which the forms and meanings of the linguistic units used reveal the unique and specific features of human metaphors in the Rai dialect are as follows: (01) *mata nuue*, (02) *vivi ntalinti*, (03) *puse ntasi*, and (04) *pa'a nubulu*

**Discussion**

Referring to the findings provided above, this part discusses in more depth the forms and meanings of the linguistic units used in the verbal expressions of the Rai dialect revealing the unique and specific features of human metaphors in the Rai dialect.

As seen in data (01), the verbal expression of *mata nuue* is a form of human metaphor in the Rai dialect appearing as a nominal phrase made up of two words (nouns) as its component parts. The two words (nouns) as its component parts are the word (noun) *mata* 'eye (s)' as HEAD (H) and the word (noun) *nuue* 'water' as its MODIFIER (M). The word (noun) *mata* 'eye (s)' is modified by the word (noun) *nuue* 'water', or vice versa, the word (noun) *nuue* 'water' modifies the word (noun) *mata* 'eye (s)'. The word (noun) *mata* 'eye (s)' as HEAD (H) distributes preceding the word (noun) *nuue* 'water', or vice versa, the word (noun) *nuue* 'water' as its MODIFIER (M) distributes following the word (noun) *mata* 'eye (s)' as HEAD (H). The distribution of the two words (nouns) can't be changed as the verbal expression of *mata nuue* is regarded as a fixed form in the Rai dialect. Based on the lexical meanings of its words, the denotative meaning of the verbal expression of *mata nuue* in the Rai dialect is 'water eyes' or 'the eyes of water'. Because of implied comparison and association reflecting the form of human metaphor, the verbal expression of *mata nuue* in the Rai dialect refers to a nonhuman entity existing in physical environment that has certain similirities in feature, quality, and behavior with *mata* as the organ (s) of human body on the head as the source (s) of tears when one cries. The attachment of the word (noun) *mata* 'eye (s)' to the word (noun) *nuue* 'water' extends its meaning from denotative to conotative meaning which is referred to as the source of water or spring, that is a place where ground water flows out of the ground analogous to the human eye (s) as the sources of tears when one cries.

As seen in data (02), the verbal expression of *vivi ntalinti* is a form of human metaphor in the Rai dialect appearing as a nominal phrase made up of two words (nouns) as its component parts. The two words as its component parts are the word (noun) *vivi* 'lips' as HEAD (H) and the word (noun) *ntalinti* 'beach' as its MODIFIER (M). The word (noun) ) *vivi* 'lips' is modified by the word (noun) *ntalinti* 'beach', or vice versa, the word (noun)) *ntalinti* 'beach' modifies the word (noun) *vivi* 'lips'. The word (noun) *vivi* 'lips' as HEAD (H) distributes preceding the word (noun) *ntalinti* 'beach' as its MODIFIER (M), or vice versa, the word (noun) *ntalinti* 'beach' as MODIFIER (M) distributes following the word (noun) *vivi* 'lips' as HEAD (H). The distribution of the two words (nouns) can't be changed as the verbal expression of *vivi ntalinti* is regarded as a fixed form in the Rai dialect. Along with the lexical meanings of its words, the denotative meaning of the verbal expression of *vivi ntalinti* in the Rai dialect is 'beach lips' or 'the lips of beach'. Due to implied comparison and association designating the form of human metaphor, the verbal expression of *vivi ntalinti* in the Rai dialect refers to a nonhuman entity existing in physical environment that has certain similirities in feature, quality, and behavior with 'lips' as the organs of human body located in the front part of mouth. Because of the attachment of the word (noun) *vivi* 'lips' as HEAD (H) to the word (noun) *ntalinti* 'beach' as its MODIFIER (M), the verbal expression of *vivi ntalinti* in the Rai dialect extends its meaning from denotative to conotative meaning which is referred to as the front part of a beach analogous to the human lips located on the front part of human's mouth.

As seen in data (03), the verbal expression of *puse ntasi* is a form of human metaphor in the Rai dialect appearing as a nominal phrase made up of two words (nouns) as its component parts. The two words (nouns) as its component parts are the word (noun) *puse* 'navel' as HEAD (H) and the word (noun) *ntasi* 'sea' as its MODIFIER (M). The word (noun) *puse* 'navel' is modified by the word (noun) *ntasi* 'sea', or vice versa, the word (noun) *ntasi* 'sea' modifies the word (noun) *puse* 'navel'. The word (noun) *puse* 'navel' as HEAD (H) distributes preceding the word (noun) *ntasi* 'sea' as its MODIFIER (M), or vice versa, the word (noun) *ntasi* 'sea' as MODIFIER (M) distributes following the word (noun) the word (noun) *puse* 'navel' as HEAD (H). The distribution of the two words (nouns) can't be changed as the verbal expression of *puse ntasi* is regarded as a fixed form in the Rai dialect. Along with the lexical meanings of its words, the denotative meaning of the verbal

expressions of *puse ntasi* in the Rai dialect is 'sea navel' or 'the navel of sea'. On the ground of implied comparison and association, the verbal expression of *puse ntasi* in the Rai dialect refers to a nonhuman entity existing in physical environment that has certain similarities in feature, quality, and behavior with navel as the organ of human body located on the center part of stomach. Due to the attachment of the word (noun) *puse* 'navel' as HEAD (H) to the word (noun) *ntasi* 'sea' as its MODIFIER (M), the verbal expression of *puse ntasi* in the Rai dialect extends its meaning from denotative to conotative meaning which is referred to as the sea whirlpool analogous to human navel located on the central part of stomach.

As seen in data (04), the verbal expression of *pa'a nubulu* is a form of human metaphor in the Rai dialect appearing as a nominal phrase made up of two words (nouns) as its component parts. The two words (nouns) as its component parts are the word (noun) *pa'a* 'foot' fas HEAD (H) and the word (noun) *nubulu* 'mountain' as its MODIFIER (M). The word (noun) *pa'a* 'foot' is modified by the word (noun) *nubulu* 'mountain', or vice versa, the word (noun) *nubulu* 'mountain' modifies the word (noun) *pa'a* 'foot'. The word (noun) *pa'a* 'foot' as HEAD (H) distributes preceding the word (noun) *nubulu* 'mountain' as its MODIFIER (M), or vice versa, the word (noun) *nubulu* 'mountain' as MODIFIER (M) distributes following the word (noun) *pa'a* 'foot' as HEAD (H). The distribution of the two words (nouns) can't be changed as the verbal expression of *pa'a nubulu* is a fixed form of verbal in the Rai dialect. Based on the lexical meanings of its words, the denotative meaning of the verbal expression of *pa'a nubulu* in the Rai dialect is 'mountain foot' or 'the foot of a mountain'. On the basis of implied comparison and association designating the form of human metaphor, the verbal expression of *pa'a nubulu* in the Rai dialect refers to a nonhuman entity existing in physical environment that has certain similarities in feature, quality, and behavior with 'foot' as the organ of human body located on the lower part. The attachment of the word (noun) *pa'a* 'foot' as HEAD (H) to the word (noun) *nubulu* 'mountain' as its MODIFIER (M) causes the verbal expression of *pa'a nubulu* in the Rai dialect extend its meaning from denotative to conotative meaning which is referred to as the bottom of a mountain analogous to human foot located on the lower part of human body as the foundation of human's strength when standing.

## CONCLUSION

Both the Rai dialect and the Rai culture belonging the Rai society as the members of the Rai ethnics are closely related. The relationship is manifested in the conceptualization of Rai society as members of Rai ethnics in viewing the world, as reflected in the features of human metaphors they employ. In terms of the forms and meaning of the linguistic units used, the features of human metaphors in the Rai dialect are unique and specific designated by using the organs of human body attached to nonhuman entities existing in physical environment. The attachments cause the extensions of meanings from denotative to conotative meanings through implied comparison and association on the basis of having certain similiraties in feature, quality, and behavior. The unique and specific features of human metaphors in the Rai dialect can be seen in such verbal expressions as *mata nuue* which is referred to as the source of water or spring as a place where groundwater flows out of the ground, *vivi ntalinti* which is referred to as the front part of a beach, *puse ntasi* which is referred to as the sea whirlpool analogous to human navel located on the central part of stomach, and *pa'a nubulu* which is referred to as the bottom of a mountain analogous to foot located on the lower part of human body serving as the foundation of a human's strength when standing. The results of the study might be beneficial to support the study of language or dialect belonging to a society as members of a social group, especially the Rai society as the members of the Rai ethnics regarding the function of the Rai dialect as the mirror of their culture and the window of their world as well.

## SOURCES OF REFERENCES

1. Badudu, J. S. (1983). *Sari Kesusastraan Indonesia*. Bandung: Pustaka Prima.

2. Bustan, F. (2005). "Wacana budaya *tudak* dalam ritual *penti* pada kelompok etnik Manggarai di Flores Barat: sebuah kajian linguistik budaya". *Disertasi*. Denpasar: Program Doktor (S3) Linguistik Universitas Udayana.

3. Bustan, F., Bire, J., and Semiun, A. (2017). *The Features of Anthropomorphic Metaphor in the Manggarai Language.* Germany: LAP LAMBERT ACADEMIC PUBLISHING.

4. Cassirer, E. (1987). *Manusia dan Kebudayaan*: *Sebuah Esai tentang Manusia*. Diterjemahkan oleh Alois A. Nugroho. Jakarta: Gramedia.

5. Casson, R. W. (1981). *Language, Culture, and Cognition: Anthropological Perspectives*. New York: Macmillan.

6. Duranti, A. (1997). *Linguistic Anthropology*. Cambridge: Cambridge University Press.

7. Foley, W. A. (1997). *Anthropological Linguistics*: *An Introduction*. Oxford: Blackwell.

8. Gazali, L. (2009). "Nyanyian rakyat Kaili: struktur, fungsi, dan nilai". *Disertasi*. Malang: Program Pascasarjana IKIP Malang.

9. Goodenough, W. H. (1964). "Cultural anthropology and linguistics. In *Language in Culture and Society*: *A Reader in Linguistics and Anthropology*. New York: Harper & Row.

10. Keesing, R. M. (1981). "Theories of culture." In *Language, Culture and Cognition*: *Anthropological Perspectives*. Edited by Ronald W. Casson. New York: Macmilan.

11. Kovecses, Z. (2009). "Metaphorical meaning making: discourse, language and culture". *Quardens de Filologia. Estudis Linguistics*. Vol. XIV (2009) 135-151.

12. Kramsch, K. (2001). *Language and Culture*. Oxford: Oxford University Press.

13. Miller, R. L. (1968). *The Linguistic Relativity Principle and Humboldtian Ethnolinguistics*: *A History and Appraisal*. Paris: The Hague

14. Muhadjir, N. (1995). *Metodologi Penelitian Kualitatif*: *Telaah Positivistik, Rasionalistik, Phenomenologik, Realisme Metaphisik*. Yogyakarta: Rake Sarasin.

15. Palmer, G. B. (1996). *Towards a Theory of Cultural Linguistics*. Austin: The University of Texas Press.

16. Palmer, G. B. and Farzad, F. (2007). "Applied cultural linguistics: an emerging paradigm". In *Applied Cultural Linguistics*. Edited by Farzad Sharifian and Gary B. Palmer. Amsterdam: John Benjamin.

17. Spradley, J. P. (1997). *Metode Etnografi*. Diterjemahkan oleh Misbah Zulfa Elizabeth. Yogyakarta: Tiara Wacana Yogya.

18. Sudikan, S. Y. (2001). *Metode Penelitian Kebudayaan*. Surabaya: Unesa Unipress bekerjasama dengan Citra Wacana.

19. Verhaar, J. W. M. (1999). *Pengantar Linguistik*. Yogyakarta: Gadjah Mada University Press.

20. Wahab, A. (1990). *Butir-butir Linguistik*. Surabaya: Airlangga University Press.

21. Wardaugh, R. (2011). *An Introduction to Sociolinguistics*. New Jersey: Wiley-Blackwell.

## THZ FREQUENCY ANALYSIS OF ROD PHOTONIC CRYSTAL FOR OPTICAL SENSOR

**Teguh P. Negara[1] and Sudradjat S[2]**

[1]Departement of Computer Science, Universitas Pakuan, Bogor, Indonesia

[2]Departement of Mathematic, Universitas Padjajaran, Bandung, Indonesia

**ABSTRACT**

*The THz frequency analysis has been carried out on the rod photonic crystal structure using the inite Difference Time Domain (FDTD) method. The method gives the result, there is a transmittance band when the wave propagates in the structure. The transmittance of PBP shows the characteristics of the structure by looking at several parameters that affect it. For changes in optical parameters, namely the refractive index of rods, it causes PBP to shift linearly towards lower frequencies. This linear change is quite sensitive and can be controlled by selecting the rod radius value. From the simulation results, the optimal radius value is $0.0375 \mu m$ with a sensitivity value of $0.35$*

*Keywords: rod photonic crystal, FDTD method, transmittance characterictic*

## INTRODUCTION

Optical technology has a considerable development compared to technology in electronics, there are many optical phenomena that have not been exploited for optical technology. One of the causes is modeling (solution with mathematical solutions) which is an early stage before fabrication applies a fairly strong mathematical tool and provision of optimal computing in order to uncover optical phenomena that can be intended for optical devices (1). The interaction of light on the structure can be analyzed numerical uses "strong form" and "weak form" to describe phenomena that are occurs and its application in the field of optics (2). "Weak form" in numerical simulation known as the Finite Difference method (finite difference) whose solution uses the form differential . The Finite-Difference Method was developed for the time domain known as Finite Difference Time Domain (FDTD) which was first used by Yee in 1966 for electric-magnetic problem (3). This method is now widely applied as the main analytical method. One of the reasons for choosing this method is that it is easy to analyze problems based on integral equations which are very difficult to solve with the Moment Method and others. In addition to using this method does not require the basics of deep knowledge. The FDTD method can be used to analyze wave propagation in various structures and see structural characteristics based on their transmittance or reflectance patterns.

In this study, the FDTD method was used to analyze the transmittance pattern of the rod photonic crystal structure. Photonic crystal structures, with various variations, namely the form of layers, rods, and gratings have been widely developed from the simulation stage to fabrication. The simulation of electromagnetic wave propagation in the rod photonic crystal structure shows the presence of a transmittance band in the interval from the Photonic Band Gap (PBG), which is called Photonic Band Pass (PBP). PBP characteristics can be influenced by the optical and physical parameters of the structure. Determination of physical and optical parameters is quite important for research development, namely the fabrication stage.

**Purpose of the Present Study**

The simulation results are expected to be further developed towards optimization and to the fabrication stage for sensor and filter applications

**Method**

The method used in this study is a Finite Difference Time Domain method which is derived from Maxwell's equation. For 2-dimensional EM waves, there are two modes of electric and magnetic field components, namely TE polarization and TM polarization. For the magnetic field has a component in the z-axis direction, while the electric field has a component in the x-axis and y-axis directions, it is called Transverse Electric (TE) mode. For the electric field has a component in the z-axis direction, while the magnetic field has a component in the y-axis direction, it is called Magnetic Transverse (TM) mode.

**Mathematic Formulation**

Based on the Yee algorithm, and the perfectly matched layer (PML) as the chosen boundary condition, the corresponding Maxwell equations to be discretized can be written in the following form:

$$i\omega\left(1+\frac{\sigma(x,y)}{i\omega\varepsilon_0}\right)^{-1} D_z = \frac{1}{\varepsilon_0}\left(\frac{\partial H_x}{\partial y}-\frac{\partial H_y}{\partial y}\right) \tag{1}$$

$$i\omega\left(1+\frac{\sigma(x,y)}{i\omega\varepsilon_0}\right)H_x = \frac{\partial D_z}{\partial y} \tag{2}$$

$$i\omega\left(1+\frac{\sigma(x,y)}{i\omega\varepsilon_0}\right)H_y = \frac{\partial D_z}{\partial x} \tag{3}$$

with $D_z = g\varepsilon_0 E_z$ and $g = \left(\varepsilon_r(x,y)+\frac{\sigma(x,y)dt}{\varepsilon_0}\right)^{-1}$, while $\sigma_p$, $\sigma$, and $\varepsilon_r$ denote the PML parameter, material conductivity and the relative permittivity of the material, respectively, while $\omega$ is the operational frequency.

To investigate the change in the electric field due to material changes in the defect rod, we consider the amount of energy at the end of the device as a function of time, defined by:

$$Q(t) = \int_0^h \varepsilon\left|\overline{E}(t)\right|^2 dy \tag{4}$$

with $E$ denoting the TM case of the electric field at the left end of the structure and $h$ is the structure thickness. Further, we define the following parameter for a given refractive index of defect rod

$$W = \frac{1}{t}\int_0^t Q(t)dt \tag{5}$$

which describes the time average energy density, where $t$ is the corresponding measurement time. The steady state, continuous wave field $E(\omega)$ is calculated from $E(t)$ by Fourier transform during the simulation [4]

$$E(\omega) = \int_0^t e^{i\omega t} E(t)dt \tag{6}$$

Then the stored data is Fourier transformed and integrated. Finally, the ratio is taken between obtained integrated results to incident spectra which results in transmission spectra versus frequency. The transmittance of structure is

$$T = \left|\frac{E_t(\omega)}{E_i(\omega)}\right|^2 \tag{7}$$

To see the interaction between the rod and electromagnetic waves with the appropriate resonance conditions, it is modeled with the simplest approach, namely the quasi-static model.. This approach applies when the size of the particle is much smaller than the wavelength of light in the surrounding medium $(d \ll \lambda)$. FDTD simulation is carried out with simulation parameters, each of which is different for each measure. This is done to maintain the stability of numerical calculations. One of them looks at at finite-difference for time, $\Delta t$ and finite difference for space, $\Delta x = \Delta y = \delta$, expressed in Courant numbers are:

$$S = \frac{c\Delta T}{\delta} \leq \frac{1}{\sqrt{3}} \tag{8}$$

**Instrument**

In this study, simulation uses finite difference time domain (FDTD) and finite difference frequency domain two dimension (2D) method computing by Matlab software. All of the simulations presented in this research are done with a system whose specifications are given in Table 1 below.

**Table 1** *The computing system specifications*

| Component | Spesifications |
|---|---|
| Processor | Intel(R) Core(TM) i7 CPU 920 @ 2.67 GHz |
| Memory | 6.00 GB |
| System Type | 64-bit Operating System |
| Operating System | Windows 7 Professional |
| Programming Language/Compiler | Matlab v.7.8.0.347 (R2009a) 32-bit (win32) |

**Design Structure**

The sketch of the model is shown in Fig. 1 which is homogeneous in the $x$-direction. It is important to note that because the periodicity of the system is only in one dimension, the model is called 1D PC. For the

numerical simulation we use periodic rods for the dielectric material namely with refractive index $n_L = 1.3$ and substrat Silicon (Si) with refractive index $n_H = 2.21$. The structure is in the air medium with refractive index $n_0 = 1$. The length of device is $L = 1.276$ and thickness is $h = 1.245$. Rod has a radius $r = 4.5\mu m$ with lattice constant is $a = 13\mu m$. In our simulation we use a mesh number of $1.3 \times 4$. Each mesh has a size of $\Delta x = \Delta y = 0.01\mu m$, while the time step is taken to be $0.1925 \times 110^6 s$ at frequency $0.69 THz$. For the wavelength range in the settings $380nm - 480\mu m$. The value of the radius and refractive index of the rod can be varied to see the characteristics of the transmission

**Figure 1**

*Simulation design for photonic crystal structures using FDTD*
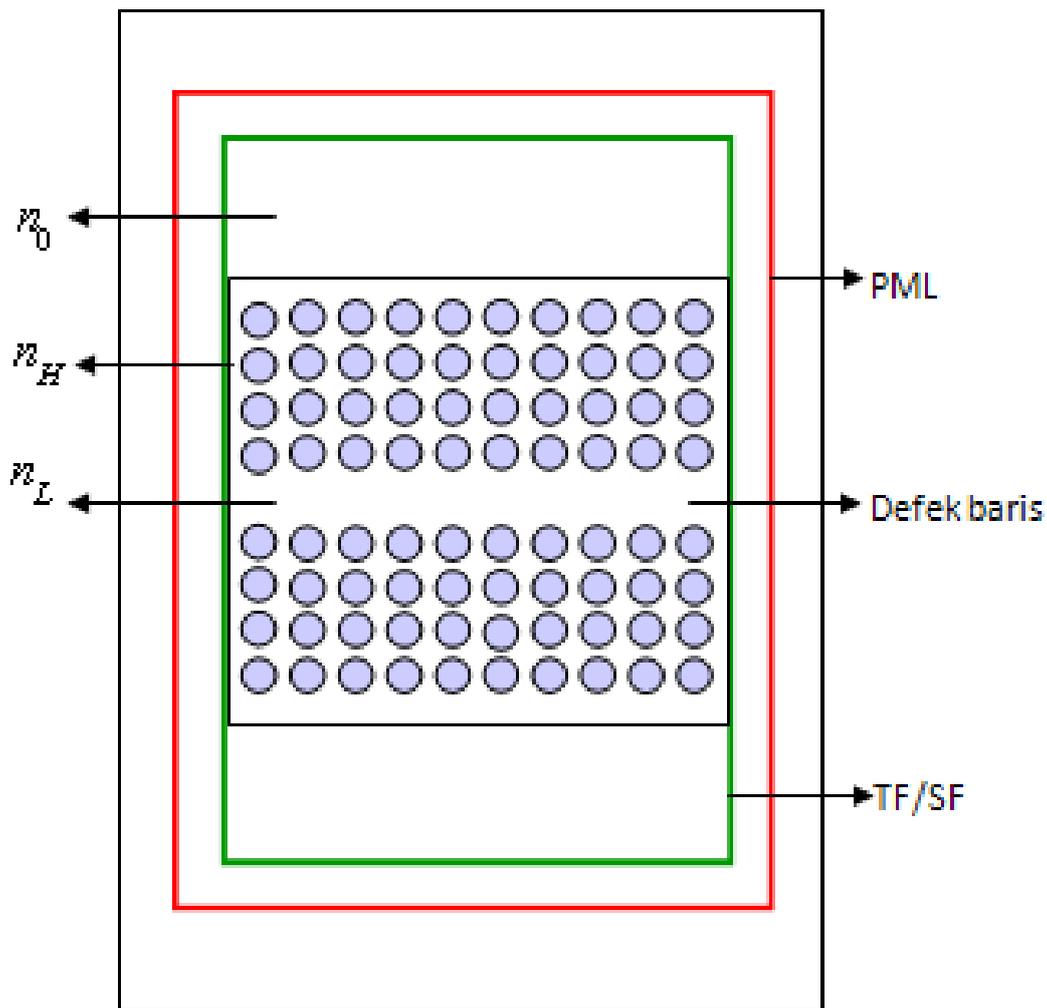


The incoming electric field can be used to analyze the computational area, but the scatter field calculation needs to be carried out by deriving the equation with the boundary conditions. Although the reflection on the absorption boundary wall occurs in the analysis region, this reflection must be smaller than the incoming wave, therefore in the computational domain apart from being limited by the reflection absorption limit (PML) it is also limited by the scatter absorption limit (TF/SF).

## Results
## Wave propagation
The EM wave propagation in the photonic rod crystal structure can be seen in Figure 2. The waves begin to enter the structure at time $2.791 \times 10^9 s$ (Figure 2a) and experience a decrease in field value when entering the structure (figure 2b). Waves propagate over time $7.7 \times 10^9 s$ and experience steady state conditions after passing that time

**Figure 2**

*Simulation of EM wave propagation in rod photonic crystal structure:  (a). when it starts to enter the structure and  (b) when conditions are steady state*



(a)



(b)
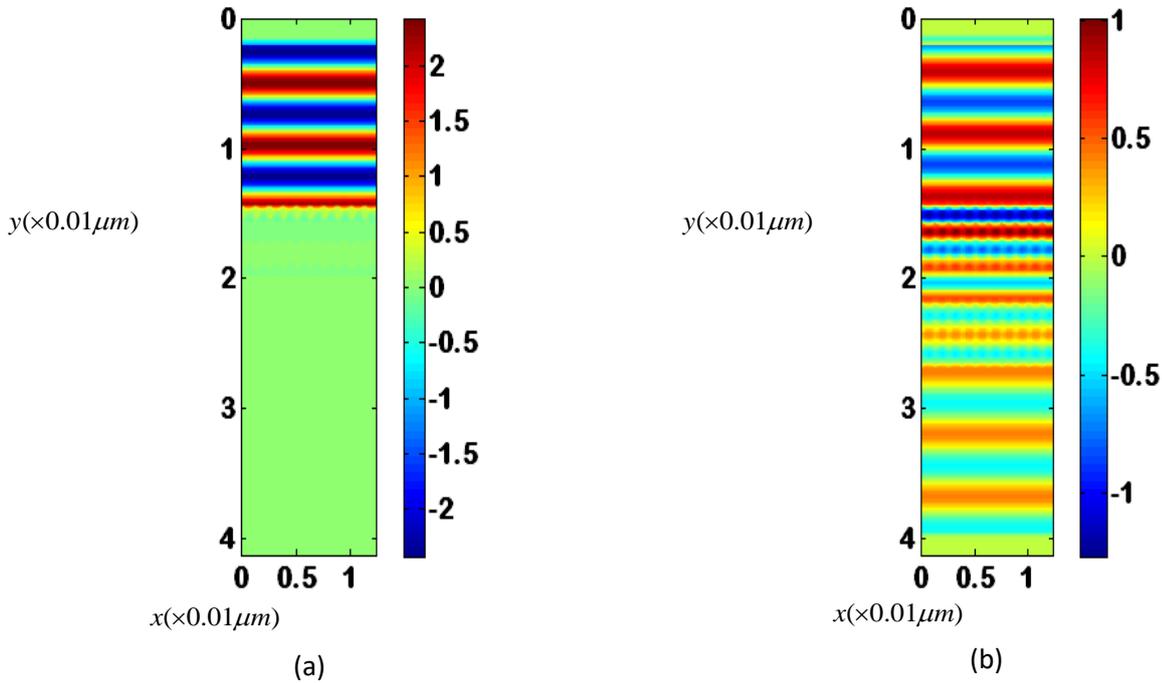
**Variation of optical parameters**

For the change in the refractive index of the rod, it is found that the PBP shift and the transmittance peak decrease, as shown in Figure 3a. For the value of the refractive index rod $2.00$, $2.01$, $2.02$, $2.03$, $2.04$, $2.05$, PBP shifts to the left at frequency $0.7576$, $0.7557$, $0.7519$, $0.7481$, $0.7444$, $0.7426$ in $THz$. For the relationship between changes in the refractive index of the rod to the frequency shift, it is found that the results are linear with a sensitivity value of $0.32$ (Figure 3b). The sensitivity value is obtained from the equation::

$$s = \frac{df}{dn}$$ 

(9)

**Figure 3**

(a) *PBP response to changes in the refractive index of rod.* $2.00$ *(red),* $2.01$ *(green),* $2.02$ *(blue),* $2.03$ *(orange),* $2.04$ *(purple),* $2.05$ *(black). (b) Changes in PBP frequency with changes in the refractive index of rod. (c) The change in the PBP peak with the change in the refractive index of rod*

(b)



(c)
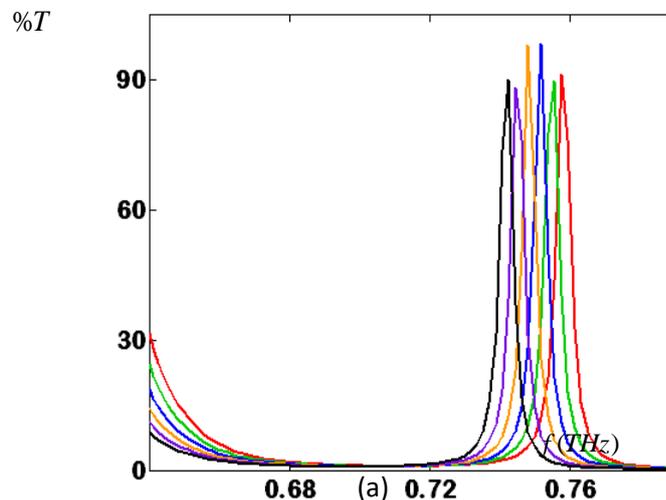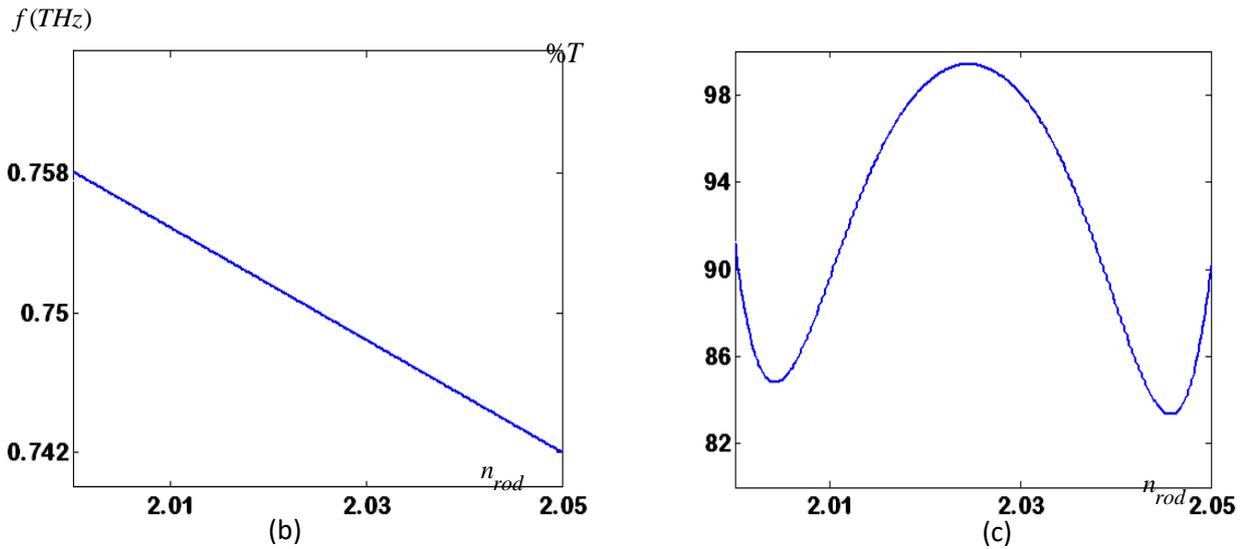
In addition, PBP also experienced a change in peak transmittance along with changes in the value of the rod's refractive index, namely $91.23$, $89.74$, $98.4$, $98.03$, $88.39$, $90.13$. For the relationship between changes in the refractive index of rods to changes in transmittance peaks, it was found that the results were non-linear (Figure 3c).

## Variation of physical parameters

For a change in the radius of the rod, it is found that there is a PBP shift and a decrease in the peak transmittance as shown in Figure 4.

### Figure 4

*(a) PBP response to changes in rod radius. $0.01875(red)$, $0.025(green)$ , $0.03125(blue)$, $0.0375(orange)$, $0.04375(purple)$ , $0.05(black)$. (b) Changes in PBP frequency with changes in the radius of the ro. (c) The change in the PBP peak with the change in the radius of the rod*



(a)



(b)



(c)
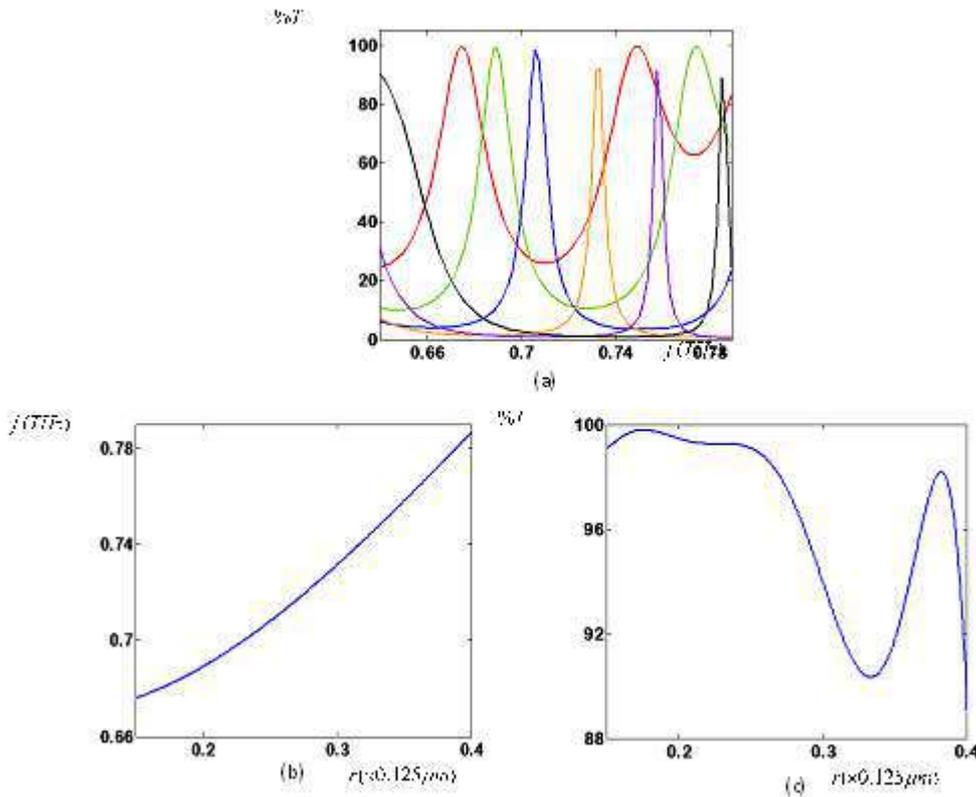
For the value of the rod radius $0.01875$, $0.025$, $0.03125$, $0.0375$, $0.04375$, $0.05$ in $\mu m$, PBP shifts to the right at frequency $0.6742$, $0.6897$, $0.7059$, $0.7481$, $0.7576$, $0.7853$ in $THz$ (Figure 4a). For the relationship

between changes in rod radius and frequency shift, the results are close to linear (figure 4b). In addition, PBP also experienced changes in the peak of PBP according to changes in the value of the rod radius, namely 99.12, 99.41, 98.40, 92.39, 91.23, 89.01. For the relationship between changes in rod radius to changes in transmittance peaks, it is found that the results are non-linear (Figure 4c)

## DISCUSSION

As the results in Figure 3b, that the change in the value of the refractive index of the rod causes a shift in the PBP towards a smaller frequency. The response of changes in the value of the rod's refractive index to changes in frequency is linear with a sensitivity value of $0.32$. This result applies to the rod radius value of $0.04375 \mu m$.

For variations in the value of the rod radius, it causes changes in the position and peak of the PBP. The frequency shift and PBP peak changes do not change linearly with changes in the radius of the rod. The selection of the rod radius value can be used as a control to select the PBP which is more sensitive to changes in the rod's refractive index

Simulations were carried out on variations in rod radius to see the sensitivity value, namely the change in PBP frequency to changes in the rod's refractive index. Based on table 2, it is found that the greatest sensitivity is obtained at the radius of the rod with a value of $0.0375 \mu m$ with a sensitivity of $0.35$.

**Table 2** *Sensitivity values for various rod radius values*

| $r(\mu m)$ | $S$ |
|---|---|
| 0.01875 | 0.33 |
| 0.0250 | 0.31 |
| 0.03125 | 0.32 |
| 0.0375 | 0.35 |
| 0.04375 | 0.32 |
| 0.050 | 0.33 |

## CONCLUSION

The FDTD method has succeeded in analyzing the characteristics of PBP based on changes in optical parameters, namely the refractive index of the rod and physical parameters, namely the radius of the rod. The PBP shift towards changes in the refractive index of the rod is found to be linear, so it can be considered to build a sensor device by placing the material to be sensed on the rod. While the selection of the radius of the defect produces a non-linear PBP position and peak value, it can also be considered to choose a set frequency value in order to produce an optimal PBP at a sensitive peak value.

## REFERENCES

[1]. Alatas, H., Mayditia, H., Hardhienata, H., Iskandar, A.A., Tjia, M.O. 2006. Single-frequency refractive index sensor based on a finite one-dimensional photonic crystals with two defects. Japanese Journal of Applied Physics, Part 1: Regular Papers and Short Notes and Review Papers, 45 (8 B), pp. 6754-6758. DOI: 10.1143/JJAP.45.6754

[2]. Reddy, JN. 2006. Pengantar Metode Elemen Hingga (edisi ketiga). McGraw-Hill: New-York. ISBN 9780071267618

[3]. K. S. Yee.1966. Numerical solution of initial boundary value problems involving maxwell's equation in isotropic media. IEEE Trans. Antennas Propag., 14(3),pp. 302–30.

[4]. Y.H. Liu, Q. H. Liu and Z. P. Nie, "A New Efficient FDTD to Frequency DomainConversion ALghorithm," PIER progress in Electromagnetic Research, vol. 92, pp. 33-46, 2009.

## INDIAN AGRICULTURE AND GROWTH

**R D Vaidkar*, V K Khobarkar* and N V Shende***
*Assistant Professor and **Professor, Dr. PDKV Akola, Maharashtra, India

**ABSTRACT**

*The need to prioritise the use of new technologies, including drones and AI-based decision support systems, and pitched for increasing agriculture research and organic farming*

*Focus should be on use of new technology including drones and AI-based decision support systems, reduction in use of chemical fertilizers and use of low-cost organic inputs and supporting startups for innovations*

*An increased focus on harnessing the potential of the allied activities, pointing out that animal husbandry, dairying, fisheries and wages have helped increase incomes as farm holdings have fragmented. The average size of household ownership holdings fell to 0.512 hectares in 2019 from 0.592 hectares in 2013 and 0.725 hectares in 2003.*

*In view of this fragmentation, it called for increased focus on the development of small farm technology and boosting non-farm businesses.*

*Pointing to a direct correlation between capital investments in agriculture and its growth rate, it called for a focused and targeted approach to ensure higher public and private investment in the sector.*

It requires a diversified approach that takes into account peculiarities and constraints of states, investment in infrastructure and linking farmer producer groups with markets.

The centrality of agriculture in India goes much beyond its immediate employment contribution, where it engages close to 42 per cent of the country's workforce. The sector not only feeds the large and growing Indian population but with its close interlinkage with poverty, it is best positioned to alleviate problems of malnutrition and hunger. In addition, agriculture supplies inputs for other industries and is critical for triggering a multiplier effect in the economy, where a financially empowered farming community triggers a demand-led growth, particularly for manufactured products and services. There is no doubt that the sector needs to grow not just for those employed in it but also for the economy as a whole.

But "how" to grow is the question? More specifically, one seeks a growth process that is not just more efficient, and inclusive of India's small and marginal but is also sustainable — both financially and environmentally — and augments farmer incomes. But then comes the question of the diversity in Indian states, where they differ as much on endowments of factors of production like land and water as they do on access to market opportunities. They even differ in their vulnerabilities to climate and weather changes. Can a generic all-India agricultural strategy guide each state? Should the roadmap not be customised to the needs, vulnerabilities, and resource-base of each state?

In a recent publication from Springer Nature, Revitalising Indian Agriculture and Boosting Farmer Incomes, which we have co-edited with Ranjana Roy, strategies for six Indian states — Punjab, Madhya Pradesh, Gujarat, Uttar Pradesh, Bihar and Odisha —have been proposed. We studied each of these states to identify factors that contributed to their growth and issues which constrained it. In addition to suggesting customised solutions, we also identify best-practices for replication in other Indian states.The study found that in the six states, three factors explained most of the agrarian growth. One, access to infrastructure — mainly irrigation and roads — two, diversification to high value agricultural products like fruits, vegetables, and allied activities like dairy and poultry, and three, price incentives or favourable terms of trade.

FIGURE 1 SOURCES OF GROWTH 2000-01 TO 2015-16
(Share in growth contributed by each sector)

FIGURE 2 COMPARING STATE AGDP GROWTH RATES WITH AMFFRI RANK

Source: Gulati, Roy and Saini (2021)

Source: Gulati, Roy and Saini (2021) Based on data from MOSPI and NITI Aayog. Data for AGDP is for 2000-01 to 2015-16 and NITI ranking is as on October 2016. Note: Because both Kerala and Bihar did not have APMC acts, they do not have AMFFRI ranks.

Bringing markets closer to farmers and increasing the efficiency of the value-chains emerged as an important factor that explained agricultural growth in Gujarat (mainly cotton, groundnut, livestock), Madhya Pradesh (wheat, soybean, pulses), Odisha (livestock and fruits and vegetables), and Bihar (maize and livestock). Access to irrigation emerged as a critical factor of growth. By ensuring timely access to sufficient irrigation, states like Gujarat and Punjab could explain their high performances. Role of uninterrupted quality power too emerged important in this. Diversification of the agricultural basket of a state was found to strengthen a state's agri-performance (Figure 1).

For the period between 2000-01 to 2015-16, we found that among the six states, GVO in agriculture grew the fastest in Gujarat at 9.1 per cent. About a quarter of this growth came from growth in livestock, followed by cotton and F&V sectors that each made about an equal contribution of 17 per cent. Madhya Pradesh with an average GVO growth of 8 per cent grew second fastest. Again, it was fruits and vegetables and livestock that together explained about 39 per cent of this growth. The lowest growth was observed in Punjab, about 35 per cent of this came from livestock sector and about 30 percent from cereals. Oilseeds contributed largest to growth in Gujarat (16.9 per cent) and Madhya Pradesh (12.5 per cent). Pulses made a substantial contribution only in case of MP (11.6 per cent) and sugar emerged an important growth driver in UP (11.6 per cent).

The requirement to undertake policy reforms, mainly related to marketing, emerged as a key driver and predictor of growth. We mapped (Figure 2) historical agricultural growth rate averages of Indian states against the state-wise ranks on the NITI Aayog's Agricultural Markets and Farmer Friendly Reforms Index — AMFFRI, an index that evaluates Indian states on the extent to which each of them undertook required agri-reforms; a low AMFFRI rank implies the state is undertaking desired reforms. It was found that states that undertook reforms, and were thus ranked low on AMFFRI, witnessed a relatively faster agri-GDP growth rate (blue box) and states which did not undertake required reforms, and thus were ranked high on the AMFFRI (red box), witnessed relatively lower agri-GDP growth rates.

There were some exceptions: Karnataka, Haryana and Maharashtra. These states undertook reforms, and thus had low AMFFRI ranks, but they witnessed a low agri-GDP growth rate. This is likely to be attributed to the delayed effect of reforms on the agri-performance.

As a part of the roadmap, the book makes a case for states to move beyond production-centric approach to a value-chain approach with FPOs at its centre. It highlights importance and requirement of growing public investments in basic infrastructure, like roads, markets, power supplies, and agri-R&D. And finally, in the longer run, rationalising subsidies (both input and output) via direct income transfer is suggested, as that will not only empower farmer but will also give them right signals for efficient use of these resources (fertilisers, power, water). This will help put agriculture on a higher growth trajectory, augment farmers' incomes, and promote sustainable development of agriculture.

## INTUITIONISTIC L-FUZZY SOFT NORMAL SUBHEMIRINGS OF A HEMIRING

### Dr. N. Anitha[1] and K. Geetha[2]

[1]Assistant Professor, Department of Mathematics, Periyar University PG ExtensionCentre, Dharmapuri-636701

[2]Research Scholar, Department of Mathematics, Periyar University, Salem –11

**ABSTRACT**

*In this paper we investigate Intuitionistic L-Fuzzy soft normal subhemirings of a Hemiring .The purpose of the study is to introduce the concept of Intuitionistic Fuzzy set with L-Fuzzy soft normal subhemirings in a Hemiring . Here we implement the concept of strongest Intuitionistic L-Fuzzy soft relations ,homomorphic preimage,composition operation and some of its related properties are analyzed .*

*2000 AMS SUBJECT CLASSIFICATION:05C38,15A15,05A15,15A18.*

*KEYWORDS : Soft set, Fuzzy soft set, L-fuzzy set,L-fuzzy soft subhemiring, Intuitionistic L-fuzzy soft subhemiring, Iintuitionistic L-fuzzy soft normal subhemiring, pseudo L-fuzzy soft coset.*

## 1  INTRODUCTION:

The theory of of Intuitionistic Fuzzy Set plays an important role inmodern mathematics.The idea of Intuitionistic L-Fuzzy soft set was introduced by Atanassov [ 1,2] as an extension of L.A .Zadeh 's [16] fuzzy set.Molodsov introduced the concept of soft set theory.Maji et al.[8] analyzedthe reduction of the weight soft set .Maji et al.[9] contributedtowards the fuzzification of notion of soft set.

Atanassov [1,2] generalizedthese idea to Intuitionistic Fuzzy set using a degree of membership and degree of non- membership under the consideration that the sum of the two degrees is smaller than one which means that there is a certain imprecision is the decision of membership or non- membership.

In this paper, we introduce the concept of intuitionistic fuzzy set in L-fuzzy soft subhemirings of a hemiring and analyzed the basic properties and some related theorems.

## 2  PERLIMINARIES

In this section we list some basic definitions which we need for our further studies. Throughout this paper Let X be a non-empty set and L= (L,$\leq$ ) be a complete lattice with least element 0 and greatest element 1.

**2.1 DEFINITION :**A pair (F, E) is called a soft set (over U) iff F is a mapping E into the set of all subsets of the set U.

**2.2DEFINITION:** Let (U, E) be a soft universe and $A \subseteq E$. Let $f(U)$be the set of all fuzzy subsets in U. A pair $(\widetilde{F},A)$ is a called a fuzzy soft set over U,where $\widetilde{F}$ is a mapping given by$\widetilde{F}$:A$\to f(U)$.

**2.3DEFINITION:** Let X be a non-empty set A L-fuzzy subset A of X is function A: X $\to$ L.

**2.4 DEFINITION:**Let R be a hemiring. An intuitionistic L-fuzzy soft subset (F,A) of R is said to be an intuitionistic L-fuzzy soft subhemiring (ILFSSHR) of R if it satisfies the following conditions:

(i)    $\mu_{(F,A)} (x_{(F,A)} + y_{(F,A)}) \geq \{\mu_{(F,A)} (x_{(F,A)}) \wedge \mu_{(F,A)} (y_{(F,A)})\}$,

(ii)   $\mu_{(F,A)} (x_{(F,A)} y_{(F,A)}) \geq \{ \mu_{(F,A)} (x_{(F,A)}) \wedge \mu_{(F,A)} (y_{(F,A)}) \}$,

(iii)  $\nu_{(F,A)}(x_{(F,A)} + y_{(F,A)}) \leq \{ \nu_{(F,A)} (x_{(F,A)}) \vee \nu_{(F,A)} (y_{(F,A)}) \}$,

(iv)   $\nu_{(F,A)} (x_{(F,A)} y_{(F,A)}) \leq \{ \nu_{(F,A)} (x_{(F,A)}) \vee \nu_{(F,A)} (y_{(F,A)}) \}$,

for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.

**2.5DEFINITION:** Let R be a hemiring. An intuitionistic L-fuzzy soft subhemiring A of R is said to be an intuitionistic L-fuzzy soft normal subhemiring (ILFNSHR) of R if it satisfies the following conditions:

(i)    $\mu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})$,

(ii)   $\nu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.

**2.6 DEFINITION:**Let (F,A) and (G,B) be intuitionistic L-fuzzy soft subsets of sets H and J, respectively. The product of (F,A) and (G,B), denoted by (F,A) x(G,B), is defined as (F,A) x(G,B) = { $\langle$ ( $x_{(F,A)}$, $y_{(G,B)}$ ), $\mu_{(F,A) x(G,B)}$

$(x_{(F,A)}, y_{(G,B)})$, $\nu_{(F,A) \, x(G,B)}$ $(x_{(F,A)}, y_{(G,B)})$ ⟩ / for all $x_{(F,A)}$ in H and $y_{(G,B)}$ in J }, where $\mu_{(F,A) \, x(G,B)}$ $(x_{(F,A)}, y_{(G,B)})$ = { $\mu_{(F,A)}$ $(x_{(F,A)}) \wedge \mu_{(G,B)}$ $(y_{(G,B)})$ } and $\nu_{(F,A) \, x(G,B)}$ $(x_{(F,A)}, y_{(G,B)})$ = { $\nu_{(F,A)}$ $(x_{(F,A)}) \vee \nu_{(G,B)}$ $(y_{(G,B)})$ }.

**2.7 DEFINITION:** Let (F,A) be an intuitionistic L-fuzzy soft subset in a set S, the strongest intuitionistic L-fuzzy Soft relation on S, that is a intuitionistic L-fuzzy soft relation on ((F,A) is (G,V) given by $\mu_{(G,V)}(x_{(G,V)}, y_{(G,V)})$ = { $\mu_{(F,A)}(x_{(F,A)}) \wedge \mu_{(F,A)}(y_{(F,A)})$ } and $\nu_{(G,V)}$ $(x_{(G,V)}, y_{(G,V)})$ = { $\nu_{(F,A)}$ $(x_{(F,A)}) \vee \nu_{(F,A)}$ $(y_{(F,A)})$ }, for all $x_{(F,A)}$ and $y_{(F,A)}$ in S.

**2.8 DEFINITION:** An intuitionistic L-fuzzy soft subhemiring A of a hemiring R is called a intuitionistic L-fuzzy soft characteristic subhemiring of R if $\mu_{(F,A)}$ $(x_{(F,A)})$ = $\mu_{(F,A)}$ ( $f(x_{(F,A)})$ ) and $\nu_{(F,A)}$ $(x_{(F,A)})$ = $\nu_{(F,A)}$ ( $f(x_{(F,A)})$ ), for all $x_{(F,A)}$ in R and f in Aut (R).

**2.9 DEFINITION:** Let ( R, +, · ) and ( $R^!$, +, · ) be any two hemirings. Let f : R → $R^!$ be any function and (F,A) be an intuitionistic L-fuzzy soft subhemiring in R, (G,V) be an intuitionistic L-fuzzy soft subhemiring in f(R) = $R^!$, defined by $\mu_{(G,V)}$ $(y_{(G,V)})$ = $\sup\limits_{x \in f^{-1}(y)}$ $\mu_{(F,A)}$ $(x_{(F,A)})$ and $\nu_{(G,V)}(y_{(G,V)})$ = $\inf\limits_{x \in f^{-1}(y)}$ $\nu_{(F,A)}$ $(x_{(F,A)})$, for all $x_{(F,A)}$ in R and $y_{(G,V)}$ in $R^!$. Then (F,A) is called a preimage of (G,V) under f and is denoted by $f^{-1}((G,V))$.

**Note:** This definition is used throughout this chapter for image and preimage in functions.

**2.10 DEFINITION:** An intuitionistic L-fuzzy soft subset A of a set X is said to be normalized if there exist x in X such that $\mu_{(F,A)}$ $(x_{(F,A)})$ =1 and $\nu_{(F,A)}$ $(x_{(F,A)})$ = 0.

**2.11 DEFINITION:** Let (F, A) be an intuitionistic L-fuzzy soft subhemiring of a hemiring ( R, +, · ) and a in R. Then the pseudo intuitionistic L-fuzzy soft coset $(a(F,A))^p$ is defined by $((a\mu_{(F,A)})^p)(x_{(F,A)})$ = p(a) $\mu_{(F,A)}$ $(x_{(F,A)})$ and $((a\nu_{(F,A)})^p)(x_{(F,A)})$ = p(a) $\nu_{(F,A)}$ $(x_{(F,A)})$, for every $x_{(F,A)}$ in R and for some p in P.

## 3. PROPERTIES OF INTUITIONISIC - L-FUZZY SOFT NORMAL SUBHEMIRINGS OF A HEMIRING R

In this section, we investigate some basic properties of IntuitionisticL-fuzzy soft normal subhemiring of a hemiring .Throughout this section (R,+, .) be a Hemiring.

**3.1 Theorem:** Let ( R, +, . ) be a hemiring. If (F,A) and (G,B) are two intuitionistic L-fuzzy soft normal subhemirings of R, then their intersection (F,A)∩(G,B) is an intuitionistic L-fuzzy soft normal subhemiring of R.

**Proof:** Let $x_{(F,A)}$ and $y_{(F,A)} \in R$.Define (F,A) and (G,B) are two intuitionistic L-fuzzy soft subhemirings of a hemiring R.Let (F,A) ={ ⟨ $x_{(F,A)}$, $\mu_{(F,A)}$ $(x_{(F,A)})$, $\nu_{(F,A)}$ $(x_{(F,A)})$ ⟩ / $x_{(F,A)} \in R$ } and (G,B) = { ⟨ $x_{(F,A)}$, $\mu_{(G,B)}(x_{(F,A)})$, $\nu_{(G,B)}(x_{(F,A)})$ ⟩ / $x_{(F,A)} \in R$ } be an intuitionistic L-fuzzy soft normal subhemirings of a hemiring R.Let (H,C) = (F,A) ∩(G,B) and (H,C) = {⟨ $x_{(F,A)}$, $\mu_{(H,C)}(x_{(F,A)})$, $\nu_{(H,C)}(x_{(F,A)})$ ⟩ / $x_{(F,A)} \in R$ }, where $\mu_{(H,C)}$ $(x_{(F,A)})$ = { $\mu_{(F,A)}$ $(x_{(F,A)}) \wedge \mu_{(G,B)}(x_{(F,A)})$ } and $\nu_{(H,C)}$ $(x_{(F,A)})$ = { $\nu_{(F,A)}(x_{(F,A)}) \vee \nu_{(G,B)}(x_{(F,A)})$ }.Then (H,C) is an intuitionistic L-fuzzy soft subhemiring of a hemiring R,(i) $\mu_{(H,C)}$ $(x_{(F,A)}y_{(F,A)})$ = { $\mu_{(F,A)}$ $(x_{(F,A)}y_{(F,A)}) \wedge \mu_{(G,B)}$ $(x_{(G,B)}y_{(G,B)})$ },

= { $\mu_{(F,A)}$ $(y_{(F,A)}x_{(F,A)}) \wedge \mu_{(G,B)}$ $(y_{(G,B)}x_{(G,B)})$ } = $\mu_{(H,C)}$ $(y_{(H,C)}x_{(H,C)})$ , for all $x_{(H,C)}$ and $y_{(H,C)}$ in R.

Therefore, $\mu_{(H,C)}(x_{(H,C)}y_{(H,C)})$ = $\mu_{(H,C)}(y_{(H,C)}x_{(H,C)})$ , for all $x_{(H,C)}$ and $y_{(H,C)}$ in R.

(ii) $\nu_{(H,C)}(x_{(H,C)}y_{(H,C)})$ = { $\nu_{(F,A)}$ $(x_{(F,A)}y_{(F,A)}) \vee \nu_{(G,B)}$ $(x_{(G,B)}y_{(G,B)})$ }, = { $\nu_{(F,A)}$ $(y_{(F,A)}x_{(F,A)}) \vee \nu_{(G,B)}$ $(y_{(G,B)}x_{(G,B)})$ } = $\nu_{(H,C)}(y_{(H,C)}x_{(H,C)})$ , for all $x_{(H,C)}$ and $y_{(H,C)}$ in R.Therefore, $\nu_{(H,C)}(x_{(H,C)}y_{(H,C)})$ = $\nu_{(H,C)}(y_{(H,C)}x_{(H,C)})$ , for all $x_{(H,C)}$ and $y_{(H,C)}$ in R.Hence (F,A)∩(G,B) is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R.

**3.2 Theorem:** Let ( R, +, . ) be a hemiring. The intersection of a family of intuitionistic L-fuzzy soft normal subhemirings of R is an intuitionistic L-fuzzy soft normal subhemiring of R.

**Proof:** Let { $(F,A)_i$ }$_{i \in I}$ be a family of intuitionistic L-fuzzy soft normal subhemirings of a hemiring R and let (F,A) = $\bigcap\limits_{i \in I}$ $(F,A)_i$ .Here for every $x_{(F,A)}$ and $y_{(F,A)}$ in R.Clearly the intersection of a family of intuitionistic L-fuzzy soft subhemirings of a hemiring R is an intuitionistic L-fuzzy soft subhemiring of a hemiring R.

(i) $\mu_{(F,A)}( x_{(F,A} y_{(F,A}) = \inf\limits_{i \in I} \mu_{(F,A)_i} (x_{(F,A)}y_{(F,A)}) = \inf\limits_{i \in I} \mu_{(F,A)_i} (y_{(F,A)}x_{(F,A)})$

$= \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Therefore, $\mu_{(F,A)} (x_{(F,A)}y_{(F,A)}) = \mu_{(F,A)} (y_{(F,A)}x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.

(ii) $\quad \nu_{(F,A)} (x_{(F,A)}y_{(F,A)}) = \sup_{i \in I} \nu_{(F,A)_i}(x_{(F,A)}y_{(F,A)}) = \sup_{i \in I} \nu_{(F,A)_i}(y_{(F,A)}x_{(F,A)}) = \nu_{(F,A)}$

$(y_{(F,A)}x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Therefore, $\nu_{(F,A)} (x_{(F,A)}y_{(F,A)}) = \nu_{(F,A)} (y_{(F,A)}x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Hence the intersection of a family of intuitionistic L-fuzzy soft normal subhemirings of a hemiring R is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R.

**3.3 Theorem:** Let (E,A) and (F,B) be intuitionistic L-fuzzy soft subhemiring of the hemirings G and H, respectively. If (E,A) and (F,B) are intuitionistic L-fuzzy soft normal subhemirings, then (E,A)x(F,B) is an intuitionistic L-fuzzy soft normal subhemiring of GxH.

**Proof:**Let (E, A) and (F,B) be intuitionistic L-fuzzy soft normal subhemirings of the hemirings G and H respectively.Clearly (E,A)x(F,B) is an intuitionistic L-fuzzy soft subhemiring of GxH.

Let $x_{(E,A)1}$ and $x_{(E,A)2}$ be in G, $y_{(F,B)1}$ and $y_{(F,B)2}$ be in H.Then ( $x_{(E,A)1}$, $y_{(F,B)1}$ ) and ( $x_{(E,A)2}$, $y_{(F,B)2}$ ) are in GxH.Now, $\mu_{(E,A)x(F,B)}[ (x_{(E,A)1}, y_{(F,B)1})(x_{(E,A)2}, y_{(F,B)2})] = \mu_{(E,A)x(F,B)}( x_{(E,A)1}x_{(E,A)2}, y_{(F,B)1}y_{(F,B)2} ) = \{ \mu_{(E,A)} ( x_{(E,A)1}x_{(E,A)2} ) \wedge \mu_{(F,B)} ( y_{(F,B)1}y_{(F,B)2} ) \} = \{ \mu_{(E,A)} ( x_{(E,A)2}x_{(E,A)1} ) \wedge \mu_{(F,B)} ( y_{(F,B)2}y_{(F,B)1} ) \}, = \mu_{(E,A)x(F,B)}( x_{(E,A)2}x_{(E,A)1}, y_{(F,B)2}y_{(F,B)1} ) = \mu_{(E,A)x(F,B)}[ (x_{(E,A)2}, y_{(F,B)2})(x_{(E,A)1}, y_{(F,B)1}) ]$. Therefore, $\mu_{(E,A)x(F,B)}[ (x_{(E,A)1}, y_{(F,B)1})(x_{(E,A)2}, y_{(F,B)2}) ] = \mu_{(E,A)x(F,B)}[ (x_{(E,A)2}, y_{(F,B)2})(x_{(E,A)1}, y_{(F,B)1}) ]$.And $\nu_{(E,A)x(F,B)}[ (x_{(E,A)1}, y_{(F,B)1})(x_{(E,A)2}, y_{(F,B)2}) ] = \nu_{(E,A)x(F,B)}( x_{(E,A)1}x_{(E,A)2}, y_{(F,B)1}y_{(F,B)2} ) = \{ \nu_{(E,A)} ( x_{(E,A)1}x_{(E,A)2} ) \vee \nu_{(F,B)} ( y_{(F,B)1}y_{(F,B)2} ) \} = \{ \nu_{(E,A)} ( x_{(E,A)2}x_{(E,A)1} ) \vee \nu_{(F,B)} ( y_{(F,B)2}y_{(F,B)1} ) \}, = \nu_{(E,A)x(F,B)}( x_{(E,A)2}x_{(E,A)1}, y_{(F,B)2}y_{(F,B)1} ) = \nu_{(E,A)x(F,B)} [ (x_{(E,A)2}, y_{(F,B)2})(x_{(E,A)1}, y_{(F,B)1}) ]$. Therefore, $\nu_{(E,A)x(F,B)}[ (x_{(E,A)1}, y_{(F,B)1})(x_{(E,A)2}, y_{(F,B)2}) ] = \nu_{(E,A)x(F,B)}[ (x_{(E,A)2}, y_{(F,B)2})(x_{(E,A)1}, y_{(F,B)1}) ]$.Hence (E,A)x(F,B) is an intuitionistic L-fuzzy soft normal subhemiring of GxH.

**3.4 Theorem:** Let (F,A) be an intuitionistic L-fuzzy soft subset in a hemiring R and (G,V) be the strongest intuitionistic L-fuzzy soft relation on R. Then (F,A) is an intuitionistic L-fuzzy soft normal subhemiring of R if and only if (G,V) is an intuitionistic L-fuzzy soft normal subhemiring of RxR.

**Proof:**Suppose that (F,A) is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R.

Then for any $x = ( x_{(F,A)1}, x_{(F,A)2} )$ and $y = ( y_{(F,A)1}, y_{(F,A)2} )$ are in RxR.Clearly (G,V) is an intuitionistic L-fuzzy soft subhemiring of a hemiring R.We have, $\mu_{(G,V)}(x_{(G,V)}y_{(G,V)}) = \mu_{(G,V)} [(x_{(G,V)1}, x_{(G,V)2})(y_{(G,V)1}, y_{(G,V)2})] = \mu_{(G,V)} ( x_{(G,V)1}y_{(G,V)1} , x_{(G,V)2}y_{(G,V)2} ) = \{ \mu_{(F,A)} (x_{(F,A)1} y_{(F,A)1}) \wedge \mu_{(F,A)} ( x_{(F,A)2}y_{(F,A)2}) \} = \{ \mu_{(F,A)} (y_{(F,A)1} x_{(F,A)1}) \wedge \mu_{(F,A)} ( y_{(F,A)2}x_{(F,A)2}) \} = \mu_{(G,V)} ( y_{(G,V)1}x_{(G,V)1} , y_{(G,V)2} x_{(G,V)2} ) = \mu_{(G,V)} [(y_{(G,V)1}, y_{(G,V)2}) (x_{(G,V)1}, x_{(G,V)2})] = \mu_{(G,V)} (y_{(G,V)}x_{(G,V)})$Therefore, $\mu_{(G,V)}( x_{(G,V)}y_{(G,V)}) = \mu_{(G,V)}(y_{(G,V)}x_{(G,V)})$, for all $x_{(G,V)}$ and $y_{(G,V)}$ in RxR.And, $\nu_{(G,V)} (x_{(G,V)}y_{(G,V)}) = \nu_{(G,V)} [(x_{(G,V)1}, x_{(G,V)2})(y_{(G,V)1}, y_{(G,V)2})] = \nu_{(G,V)} ( x_{(G,V)1}y_{(G,V)1} , x_{(G,V)2}y_{(G,V)2} ) = \{ \nu_{(F,A)} (x_{(F,A)1} y_{(F,A)1}) \vee \nu_{(F,A)} ( x_{(F,A)2}y_{(F,A)2}) \} = \{ \nu_{(F,A)} (y_{(F,A)1} x_{(F,A)1}) \vee \nu_{(F,A)} ( y_{(F,A)2}x_{(F,A)2}) \} = \nu_{(G,V)} ( y_{(G,V)1}x_{(G,V)1} , y_{(G,V)2} x_{(G,V)2} ) = \nu_{(G,V)} [(y_{(G,V)1}, y_{(G,V)2}) (x_{(G,V)1}, x_{(G,V)2})] = \nu_{(G,V)} (y_{(G,V)}x_{(G,V)})$. This proves that (G,V) is an intuitionistic L-fuzzy soft normal subhemiring of RxR.Conversely,assume that (G,V) is an intuitionistic L-fuzzy soft normal subhemiring of RxR, then for any $x = (x_1, x_2)$ and $y = (y_1, y_2)$ are in RxR, we know that (F,A) is an intuitionistic L-fuzzy soft subhemiring of R,

if $\mu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) \leq \mu_{(F,A)} (x_{(F,A)2}y_{(F,A)2})$, then$\mu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) = \{ \mu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) \wedge \mu_{(F,A)} (x_{(F,A)2}y_{(F,A)2}) \} = \mu_{(G,V)} ( x_{(G,V)1}y_{(G,V)1} , x_{(G,V)2}y_{(G,V)2} ) = \mu_{(G,V)} [(x_{(G,V)1}, x_{(G,V)2}) (y_{(G,V)1}, y_{(G,V)2})]= \mu_{(G,V)} (x_{(G,V)}y_{(G,V)}) = \mu_{(G,V)} (y_{(G,V)}x_{(G,V)}) = \mu_{(G,V)} [(y_{(G,V)1}, y_{(G,V)2})(x_{(G,V)1}, x_{(G,V)2})] = \mu_{(G,V)} ( y_{(G,V)1}x_{(G,V)1} , y_{(G,V)2}x_{(G,V)2} ) = \{ \mu_{(F,A)} (y_{(F,A)1}x_{(F,A)1}) \wedge \mu_{(F,A)} (y_{(F,A)2}x_{(F,A)2}) \} = \mu_{(F,A)} (y_{(F,A)1}x_{(F,A)1})$. We get, $\mu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) = \mu_{(F,A)} (y_{(F,A)1}x_{(F,A)1})$, for all $x_{(F,A)1}$ and $y_{(F,A)1}$ in R.

If $\nu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) \geq \nu_{(F,A)} (x_{(F,A)2}y_{(F,A)2})$, then$\nu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) = \{ \nu_{(F,A)} (x_{(F,A)1}y_{(F,A)1}) \vee \nu_{(F,A)} (x_{(F,A)2}y_{(F,A)}) \} = \nu_{(G,V)} ( x_{(G,V)1}y_{(G,V)1} , x_{(G,V)2}y_{(G,V)2} ) = \nu_{(G,V)} [(x_{(G,V)1}, x_{(G,V)2}) (y_{(G,V)1}, y_{(G,V)2})]= \nu_{(G,V)} (x_{(G,V)}y_{(G,V)}) = \nu_{(G,V)} (y_{(G,V)}x_{(G,V)}= \nu_{(G,V)} [(y_{(G,V)1}, y_{(G,V)2})(x_{(G,V)1}, x_{(G,V)2})] = \nu_{(G,V)} ( y_{(G,V)1}x_{(G,V)1} , y_{(G,V)2}x_{(G,V)2} ) = \{ \nu_{(F,A)} (y_{(F,A)1}x_{(F,A)1}) \vee \nu_{(F,A)} (y_{(F,A)2}x_{(F,A)2}) \} = \nu_{(F,A)} (y_{(F,A)1}x_{(F,A)1})$.

We get, $\nu_{(F,A)}(x_{(F,A)1}y_{(F,A)1}) = \nu_{(F,A)} (y_{(F,A)1}x_{(F,A)1})$, for all $x_{(F,A)1}$ and $y_{(F,A)1}$ in R.It conclude (F,A) is an intuitionistic L-fuzzy soft normal subhemiring of R.

**3.5 Theorem:** Let (R, +, .) and (R$^1$, +, .) be any two hemirings. The homomorphic image of an intuitionistic L-fuzzy soft normal subhemiring of R is an intuitionistic L-fuzzy soft normal subhemiring of R$^1$.

**Proof:**Let $( R, +, . )$ and $( R^!, +, . )$ be any two hemirings and $f : R \rightarrow R^!$ be a homomorphism. Then,(i) $f(x+y) = f(x) + f(y)$ and(ii) $f(xy) = f(x) f(y)$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Let $(G,V) = f((F,A))$, where $(F,A)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R. We have to prove that $(G,V)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring $R^!$.

Now, for $f(x_{(G,V)})$, $f(y_{(G,V)})$ in $R^!$,clearly $(G,V)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring $R^!$, since $(F,A)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring R. Now,$\mu_{(G,V)}(f(x_{(G,V)})f(y_{(G,V)}))= \mu_{(G,V)}(f(x_{(G,V)}y_{(G,V)})$ ), as f is a homomorphism$\geq \mu_{(F,A)} (x_{(F,A)} y_{(F,A)})= \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})\leq \mu_{(G,V)} ( f(y_{(G,V)}x_{(G,V)})$ )= $\mu_{(G,V)} ( f(y_{(G,V)}) f(x_{(G,V)})$ ), as f is a homomorphismClearly $\mu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)}))= \mu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)}))$, for all $f(x_{(G,V)})$ and $f(y_{(G,V)})$ in $R^!$.And $\nu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)}))= \nu_{(G,V)}(f(x_{(G,V)}y_{(G,V)})$ ), as f is a homomorphism$\leq \nu_{(F,A)} (x_{(F,A)} y_{(F,A)})= \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})\geq \nu_{(G,V)} (f(y_{(G,V)}x_{(G,V)})$ )= $\nu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)})$ ), as f is a homomorphism

It proves that$\nu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)})$ )= $\nu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)})$ ), for all $f(x_{(G,V)})$ and $f(y_{(G,V)})$ in $R^!$.

**3.6 Theorem:** Let $(R, +, .)$ and $(R^!, +, .)$ be any two hemirings. The homomorphic preimage of an intuitionistic L-fuzzy soft normal subhemiring of $R^!$ is an intuitionistic L-fuzzy soft normal Ssubhemiring of R.

**Proof:**Let $( R, +, .)$ and $( R^!, +, .)$ be any two hemirings and $f : R \rightarrow R^!$ be a homomorphism. Then,(i) $f(x+y) = f(x) + f(y)$ and(ii) $f(xy) = f(x) f(y)$, for all x and y in R.Let $(G,V) = f((F,A))$, where $(G,V)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring $R^!$. We have to prove that $(F,A)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R.Let $x_{(F,A)}$ and $y_{(F,A)}$ in R. Then,clearly $(F,A)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring R, since $(G,V)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring $R^!$.Now, $\mu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \mu_{(G,V)} (f(x_{(G,V)}y_{(G,V)})$ ), since $\mu_{(F,A)} (x_{(F,A)}) = \mu_{(G,V)} ( f(x_{(G,V)}) ) = \mu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)})$ ), as f is a homomorphism $= \mu_{(G,V)} (f(y_{(G,V)})f(x_{(G,V)}) ) = \mu_{(G,V)} (f(y_{(G,V)}x_{(G,V)})$ ), as f is a homomorphism$= \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, since $\mu_{(F,A)} (x_{(F,A)}) = \mu_{(G,V)} (f(x)$ )which implies that$\mu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Now $\nu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \nu_{(G,V)} (f(x_{(G,V)}y_{(G,V)})$ ), since $\nu_{(F,A)} (x_{(F,A)} ) = \nu_{(G,V)} (f(x_{(G,V)}) ) = \nu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)})$ ), as f is a homomorphism $= \nu_{(G,V)} (f(y_{(G,V)})f(x_{(G,V)}) )= \nu_{(G,V)} (f(y_{(G,V)}x_{(G,V)})$ ), as f is a homomorphism

$= \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, since $\nu_{(F,A)} (x_{(F,A)}) = \nu_{(G,V)}(f(x)$ )which implies that$\nu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.

**3.7 Theorem:** Let $(R, +, .)$ and $(R^!, +, .)$ be any two hemirings. The anti-homomorphic image of an intuitionistic L-fuzzy soft normal subhemiring of R is an intuitionistic L-fuzzy soft normal subhemiring of $R^!$.

**Proof:**Let $( R, +, .)$ and $( R^!, +, .)$ be any two hemirings and $f : R \rightarrow R^!$ be an anti-homomorphism. Then (i) $f ( x + y ) = f(y) + f(x)$ and (ii) $f(xy) = f(y) f(x)$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Let $(G,V) = f((F,A))$, where $(F,A)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R. We have to prove that $(G,V)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring $R^!$.Now, for $f(x_{(G,V)})$ and $f(y_{(G,V)})$ in $R^!$,clearly $(G,V)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring $R^!$, since $(F,A)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring R.Now, $\mu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)}))= \mu_{(G,V)} ( f(y_{(G,V)}x_{(G,V)})$ ), as f is an anti-homomorphism$\geq \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})= \mu_{(F,A)} (x_{(F,A)} y_{(F,A)})\leq \mu_{(G,V)}(f(x_{(G,V)}y_{(G,V)})$ )

$= \mu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)})$ ), as f is an anti-homomorphismwhich implies that$\mu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)})$ )= $\mu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)})$ ), for all $f(x_{(G,V)})$ and $f(y_{(G,V)})$ in $R^!$.And$\nu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)})$ )= $\nu_{(G,V)}(f(y_{(G,V)}x_{(G,V)})$ ), as f is an anti-homomorphism$\leq \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})$

$= \nu_{(F,A)} (x_{(F,A)} y_{(F,A)})\geq \nu_{(G,V)}(f(x_{(G,V)}y_{(G,V)})$ )= $\nu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)})$ ), as f is an anti-homomorphismwhich implies that$\nu_{(G,V)}(f(x_{(G,V)})f(y_{(G,V)})$ )= $\nu_{(G,V)}(f(y_{(G,V)}) f(x_{(G,V)})$ ), for all $f(x_{(G,V)})$ and $f(y_{(G,V)})$ in $R^!$.

**3.8 Theorem:** Let $(R, +, .)$ and $(R^!, +, .)$ be any two hemirings. The anti-homomorphic preimage of an intuitionistic L-fuzzy soft normal subhemiring of $R^!$ is an intuitionistic L-fuzzy soft normal subhemiring of R.

**Proof:**Let $( R, +, .)$ and $( R^!, +, .)$ be any two hemirings and $f : R \rightarrow R^!$ be an anti-homomorphism. Then (i) $f(x+y) = f(y) + f(x)$ and (ii) $f(xy) = f(y) f(x)$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Let $(G,V) = f((F,A))$, where $(G,V)$ is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring $R^!$. We have to prove that $(F,A)$is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R.Let $x_{(F,A)}$ and $y_{(F,A)}$ in R, then,clearly $(F,A)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring R, since $(G,V)$ is an intuitionistic L-fuzzy soft subhemiring of a hemiring $R^!$.Now$\mu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \mu_{(G,V)} (f(x_{(G,V)}y_{(G,V)})$ ), since $\mu_{(F,A)} (x_{(F,A)}) = \mu_{(G,V)} ( f(x_{(G,V)}) ) = \mu_{(G,V)} (f(y_{(G,V)})f(x_{(G,V)})$ ), as f is an anti-homomorphism $= \mu_{(G,V)} (f(x_{(G,V)})f(y_{(G,V)})$ )

$= \mu_{(G,V)} (f(y_{(G,V)}x_{(G,V)}))$, as f is an anti-homomorphism $= \mu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, since $\mu_{(F,A)} (x_{(F,A)}) = \mu_{(G,V)} (f(x))$ )which implies that$\mu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \mu_{(F,A)}(y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.Now$\nu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \nu_{(G,V)}(f(x_{(G,V)}y_{(G,V)}))$, since $\nu_{(F,A)} (x_{(F,A)}) = \nu_{(G,V)}(f(x_{(G,V)}))$

$= \nu_{(G,V)}(f(y_{(G,V)})f(x_{(G,V)}))$, as f is an anti-homomorphism$= \nu_{(G,V)}(f(x_{(G,V)})f(y_{(G,V)}))$

$= \nu_{(G,V)}(f(y_{(G,V)}x_{(G,V)}))$, as f is an anti-homomorphism$= \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, since $\nu_{(F,A)} (x_{(F,A)}) = \nu_{(G,V)}(f(x_{(G,V)}))$ )which implies that$\nu_{(F,A)} (x_{(F,A)} y_{(F,A)}) = \nu_{(F,A)} (y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.

**In the following Theorem ∘ is the composition operation of functions:**

**3.9 Theorem:** Let (F,A) be an intuitionistic L-fuzzy soft subhemiring of a hemiring H and f is an isomorphism from a hemiring R onto H. If (F,A) is an intuitionistic L-fuzzy soft normal subhemiring of the hemiring H, then (F,A)∘f is an intuitionistic L-fuzzy soft normal subhemiring of the hemiring R.

**Proof:** Let $x_{(F,A)}$ and $y_{(F,A)}$ in R and (F,A) be an intuitionistic L-fuzzy soft normal subhemiring of a hemiring H.Then we have, clearly (F,A)∘f is an intuitionistic L-fuzzy soft subhemiring of a hemiring R. Now, $(\mu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = \mu_{(F,A)} (f(x_{(F,A)} y_{(F,A)}))= \mu_{(F,A)} (f(x_{(F,A)})f(y_{(F,A)}))$, as f is an isomorphism$= \mu_{(F,A)} (f(y_{(F,A)})f(x_{(F,A)}))= \mu_{(F,A)} (f(y_{(F,A)} x_{(F,A)}))$, as f is an isomorphism

$= (\mu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$,which implies that $(\mu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = (\mu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.And, $(\nu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = \nu_{(F,A)} (f(x_{(F,A)} y_{(F,A)}))= \nu_{(F,A)} (f(x_{(F,A)})f(y_{(F,A)}))$, as f is an isomorphism$= \nu_{(F,A)} (f(y_{(F,A)})f(x_{(F,A)}))= \nu_{(F,A)} (f(y_{(F,A)} x_{(F,A)}))$, as f is an isomorphism$= (\nu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$,which implies that $(\nu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = (\nu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.

**3.10 Theorem:** Let (F,A) be an intuitionistic L-fuzzy soft subhemiring of a hemiring H and f is an anti-isomorphism from a hemiring R onto H. If (F,A)is an intuitionistic L-fuzzy soft normal subhemiring of the hemiring H, then (F,A)∘f is an intuitionistic L-fuzzy soft normal subhemiring of the hemiring R.

**Proof:** Let $x_{(F,A)}$ and $y_{(F,A)}$ in R and (F,A) be an intuitionistic L-fuzzy soft normal subhemiring of a hemiring H.Then we have, clearly (F,A)∘f is an intuitionistic L-fuzzy soft subhemiring of a hemiring R. Now, $(\mu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = \mu_{(F,A)} (f(x_{(F,A)} y_{(F,A)}))= \mu_{(F,A)} (f(y_{(F,A)})f(x_{(F,A)}))$, as f is an anti-isomorphism$= \mu_{(F,A)} (f(x_{(F,A)})f(y_{(F,A)}))= \mu_{(F,A)} (f(y_{(F,A)} x_{(F,A)}))$, as f is an anti-isomorphism$= (\mu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$,which implies that $(\mu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = (\mu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.And, $(\nu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = \nu_{(F,A)} (f(x_{(F,A)} y_{(F,A)}))$

$= \nu_{(F,A)} (f(y_{(F,A)})f(x_{(F,A)}))$, as f is an anti-isomorphism$= \nu_{(F,A)} (f(x_{(F,A)})f(y_{(F,A)}))= \nu_{(F,A)} (f(y_{(F,A)} x_{(F,A)}))$, as f is an anti-isomorphism$= (\nu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$,which implies that $(\nu_{(F,A)}∘f)(x_{(F,A)} y_{(F,A)}) = (\nu_{(F,A)}∘f)(y_{(F,A)} x_{(F,A)})$, for all $x_{(F,A)}$ and $y_{(F,A)}$ in R.So it conclude (F,A)∘f is an intuitionistic L-fuzzy soft normal subhemiring of a hemiring R.

**CONCLUSION :**
In this paper we have characterize the Intuitionistic L-fuzzy soft normal subhemirings of hemiring and extended the notion of Intuitionistic fuzzy normal tointuitionistic fuzzy soft normalsubhemirings of hemiring .Further we have estrablished the related properties . These properties will be helpful to the researches to formulate the areaof mathematics such as automata theory , formal language.

**REFERENCES:**
[1] Atanassov K.T, Intuitionistic Fuzzy Sets-Theory and Applications, Springer Verlag , New York, (1999).

[2] Biswas.R, Fuzzy subgroups and Anti-fuzzy subgroups, Fuzzy sets and systems,35,121-124 ( 1990 ).

[3] Biswas, R, Roy, A.R, On intuitionistic fuzzy sets, Notes on Intuitionistic Fuzzy Sets, 3(4), (1997).

[4] Chakrabarty, K., Biswas, R., Nanda, A note on union and intersection of Intuitionistic fuzzy sets , Notes on Intuitionistic Fuzzy Sets , 3(4), (1997).

[5] Goguen, J., L-fuzzy sets, Journal Math. Anal. Appl., 18, 145- 174 (1967) .

[6] Hur.K, Kang.H.W and H.K.Song, Intuitionistic fuzzy subgroups and subrings, Honam Math. J. 25 no.1, 19-41 (2001)

[7] Kumud Borgohain and Chittaranjan Gohain, Some New operations on Fuzzy Soft Sets, International Journal of Modern Engineering Research (IJMER), Vol.4,Issue 4(2014),65-68.

[8]  Maji, P.K., R. Biswas and A.R. Roy,. Fuzzy soft sets. The J. Fuzzy Math., 9: 589-602.( 2001).

[9]  Maji P.K, Roy A.R and  Biswas.R, An application of soft sets in a decision making problem, An International Journal of Computers and Mathematics with Applications, 44 (2002), 1077–1083.

[10] Maji P.K, Biswas.R and Roy A.R, Soft set theory, An International Journal of Computers and Mathematics with Applications, 45 (2003), 555-562.

[11] Palaniappan. N & Arjunan. K, Some properties of intuitionistic fuzzy subgroups , Acta Ciencia Indica, Vol.XXXIII M. No.2, 321-328 (2007).

[12] Sidky.F.I and Atif Mishref.M, Fuzzy cosets and cyclic and Abelian fuzzy subgroups, fuzzy sets and systems, 43243-250 (1991).

[13] Sivaramakrishna das.P, Fuzzy groups and level subgroups, Journal of Mathematical Analysis and Applications, 84, 264-269 (1981).

[14] Tanushree Mitra Basu, Nirmal Kumar Mahapatra and Shyamal Kumar Mondal On Some New Operations in Fuzzy Soft SetAnd Intuitionistic Fuzzy Soft Set TheoryIRACST – International Journal of Computer Science and Information Technology & Security(IJCSITS), ISSN: 2249-9555 Vol. 2, No.2, A(2012).

[15] Tariq Shah, Nasreen Kausar and Inayatur-Rehman.Intuitionistic Fuzzy Normal subrings over anon-associative ring An. S̡t. Univ. Ovidius Constant̡a Vol. 20(1), (2012), 369–386

[16] Zadeh L.A, Fuzzy Sets, Information and Control, 8(1965), 33.

## INCORPORATION OF COVID-19 VACCINATION AND ITS BENEFITS

**P. Bhavyashree[1], S. Ivo Romauld[2*], P. Vivek[3] and D. Jenila Rani[4]**

[1,2,3]Department of Bioengineering, School of Engineering, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai, Tamil Nadu, India

[4]Department of Biotechnology, Saveetha Institute of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai, India

**ABSTRACT**

*The Novel Corona Virus (Covid - 19) is the most infectious and lethal disease that affects the body's respiratory system. This virus emerged unexpectedly in late December 2019 in Wuhan, China. This disease is transmitted through inhalation or contact with an infected person. The world has been pushed to the brink of a pandemic. Globally, there have been many economic losses, which have had a significant impact on many individual lives and resulted in the deaths of millions of people. Vaccination is the only way to defeat this disease. In this chapter, we will look at the different types of vaccines and how they are designed, as well as their actions, immunogenicity and safety.*

*Key words: Corona virus, pandemic, vaccination, types of vaccination, clinical Trails, benefits of vaccination.*

**INTRODUCTION:**

The novel coronavirus (covid-19). The severe acute respiratory syndrome coronavirus 2 (SARS covid-2). It is a lethal virus that appeared unexpectedly in late December 2019. This is a deadly virus that is spreading throughout the world rapidly. It originated in the city of Wuhan in China. A Coronavirus is a positive-stranded RNA type single-stranded virus. The virus will only multiply with the help of a cell. This disease is passed on by inhalation or contact with infected droplets. The symptoms are fever, dry cough, sore throat, breathlessness, and fatigue. People have taken more crucial measures to manage this disease, from increasing personal protection equipment and highlighting the importance of social distancing and wearing masks to now wearing double masks. The immediate breakout of the coronavirus has created unexpected challenges. The pandemic situation has affected the individual lives of a billion people and also affected economic conditions globally. Vaccination is the most essential medical treatment for preventing and controlling this deadly and infectious disease.

## 2. Types of vaccination

### 2.1 Live-Attenuated vaccine: -

Live-attenuated vaccines are alive and weaken the virus by reducing its virulence, but they can replicate. They remove the genes which are responsible for the virulence. So, the replication will occur slowly due to the less abundant t-RNA. Also, reverse genetic techniques have been applied to remove the envelope protein which causes the disease in the virus and also inactivate the exonuclease of protein. An attenuated virus replicates like a natural infection. It triggers and causes a strong T-cell and B-cell immune response to the whole organism.

The live attenuated vaccine has the inherited ability to induce toll receptors such as TLR3, TLR7/8, TLR9 of the innate immune system and that involves B-cells like CD4 and CD8 T-cells. They are the most potent immunogenic vaccines. The Bacille Calmette-Guerin (BCG) vaccine is a live vaccine that has been widely used to prevent tuberculosis and leprosy. But in western Australia, scientists have concluded that the BCG vaccine will aid improvement in the immune system and decrease Sars-cov-2 infection rates. But a live attenuated vaccine safety examination is required. Because there are possibilities for transfer of viruses or reversion to the pathogenic form. They are rarely used in immunocompromised patients due to the possibility of vaccine contamination by the live virus in the vaccine. Live attenuated vaccines require cold chain distribution.

**Pre-Clinical Development:**

Several entities are reportedly pushing live attenuated vaccine candidates in pre-clinical development. Only a cold-adapted virus is available for pre-clinical testing.

**Clinical Development:**

Codegenix INC. and the Serum Institute of India are collaborating on the development of a codon-deuptimized live attenuated vaccine, which is currently in phase 1 testing.

**Regulatory update:**

There is currently no vaccine in the regulatory process.

### 2.2 Inactivated vaccine: -

Because they contain non-living viral particles, inactivated vaccines are also known as killing vaccines. The vaccines are complete virus preparations. Vaccines are produced by viruses in a cultured medium. They don't have the capability of replicating. They are inactivated by the method of treating viruses with chemicals beta-propiolactone and formaldehyde and also by heat or radiation. This vaccine contains all structural viral proteins and it also produces a broad immune response. These vaccinations are safer, more stable and non-infectious compared to the live-attenuated vaccine. They do not require a cold chain for distribution. But this inactivation results in lowered immunogenicity and so it is required for the multiple doses organized to establish long-lasting immunity

### Pre-clinical test: -

CoronaVac (Sinovac), BBIBP-CorV (Beijing Institute of Biological Products), and Covaxin (Bharat Biotech International Ltd [BBIL]) inactivated viral vaccine preparations from BPL were immunogenic in multiple species and protected rhesus macaques from challenge. Vaccines rendered inactive through gamma irradiation or photochemical inactivation

### Clinical Development: -

The CoronaVac vaccine demonstrated efficacy ranging from 50 to 91 percent in Brazil. It had earlier been shown to be safe in two phase 1/2 trials involving people aged 18–59 and over 60. Sinopharm has developed two vaccine candidates, and initial findings from a phase 1/2 first-in-human trial of these candidates revealed acceptable safety and reactogenicity profiles in the majority of vaccine recipients.

### Regulatory update: -

CoronaVac has received conditional approval in China, as well as approval for emergency use in Brazil, Chile, Turkey, Colombia, Indonesia, and Uruguay. BBIBP-CorV has already been authorised for use in China, the United Arab Emirates, and Bahrain, and is approved for emergency use in a number of other states. Sinopharm's CNBG-WIIBP vaccine has been authorised for limited use in China and the UAE. Authorisation was also granted by India.

### 2.3 Protein sub-unit vaccine: -

Subunit vaccines are basically protein, polysaccharides or peptide vaccines. These antigenic components are generated in vitro. Where one has selected more immunogenic protein or segments from the pathogens to induce the immune response. Subunit vaccine candidates have fewer structural components of Sars covid-2.

The protein can be expressed in various protein expression systems, such as yeast, mammalian, E.coli. After that, it is refolded in the correct three-dimensional structure and triggers the immune system. The spike protein of Sars covid-2 is the most suitable antigen to induce the neutralizing antibodies against the pathogen. By using advanced protein engineering technology, the expressed recombinant antigenic proteins can be combined together to form nano particles, and thus to increase the immune power. But they exhibit low immune response, and much needed for multiple dosing. Even for memory purpose. But the protein sub unit vaccine is considered as safe and has less adverse effects.

### Virus-like particles: -

These are hollow shells devoid of genetic material. They are thought to be safe, elicit a strong immune response, and are difficult to produce.

### Pre-clinical Trails: -

The nano particle vaccine NVX-CoV2373 (Novavax Inc.), which contained Matrix M adjuvant, was immunogenic in mice, baboons and macaques. There was no sgRNA in the BAL or nasal swabs of the vaccinated macaques, and there was no little or no inflammation in the lungs. SCB-2019(clover biopharmaceuticals) vaccine was developed with either ASO3 or CpG plus alum adjuvants, both of which were immunogenic in mice, rats, macaques and pythons.

### Clinical development: -

Interim findings from the NVX-CoV2372 phase 1 first-in-human clinical trial among Australian adults (n = 131) discovered that the vaccine candidate was safe and more immunogenic than the non-adjuvanted formulation. A phase 2b trial in South Africa is currently underway, as is a phase 3 trial (n = 15,000) in the United Kingdom. An interim analysis of data from a UK trial revealed that the vaccine was 90 percent effective.

### Regulatory update: -

The European Medicines Agency (EMA) has begun a rolling review of the NVX-CoV2373 vaccine.

## 2.4 DNA-Based vaccine: -

The DNA vaccines are discovered by introducing DNA encoding the antigen from the pathogen into a Plasmid. The DNA vaccine are Genetic engineering based. The vaccine is which gene encoding target antigens are transferred into host cells with the exceptions that in vivo transcription and expression of the antigen will induce immune response and thereby protect the host. These vaccines generate high of neutralizing antibodies. They are considered as safe. Also, they can make adverse events. The DNA vaccines offer higher stability over mRNA vaccine

### Pre-clinical test: -

Although INO-4800 (Inovio Pharmaceuticals) vaccinated macaques had lower viral loads in the lungs, peak sgRNA in nasal swabs was high, indicating significant viral replication in the upper respiratory tract. Rhesus macaques vaccinated with the GX-19 vaccine (Genexine, Inc.) performed similarly to hamsters vaccinated with another DNA vaccine administered via jet injection. DNA Vaccination with Multiple Spikes

### Clinical Development: -

In a phase 1 trial (n = 39), INO-4800 was shown to be safe and immunogenic when administered in two doses via intradermal (i.d.) injection followed by electroporation, out of the six DNA-based vaccine candidates in clinical testing (Table 1). A phase 3 trial has been put on hold indefinitely pending data on the use of the vaccine delivery device. ZyCov-D (Zydus Cadila), another i.d. candidate, has entered the race.

### Regulatory update: -

Based on publicly available information, none of the DNA candidates have been submitted for regulatory approval.

## 2.5 mRNA vaccine: -

Messenger RNA vaccines are a novel technology that had yet to be proven prior to the current pandemic. COVID-19 vaccine development programmes are based on self-amplifying and non-amplifying mRNA formats. RNA vaccines are lipid-coated mRNA of the SARS-CoV-2 spike protein expressing virus. These are thought to be safe and incapable of causing disease, but they do have the potential to cause ADE. The mRNA delivery into the cytoplasm is critical, several approaches have been used, including lipid nanoparticles (LNPs), cationic nano-emulsions (CNEs), and polyplexes.

## 2.6 Viral vector vaccine: -

These vaccines are made using recombinant DNA technology. The pathogen's DNA encoding an antigen is inserted into the bacteria or virus vectors. The antigen is then expressed in these cells by these bacteria or virus vectors. Antigens are extracted and purified from bacteria or virus vectors. Viral vector vaccines can be either replicating or nonreplicating

### Replicating: -

An unrelated virus, such as measles or adenovirus, is genetically engineered to encode the desired gene. These are considered safe and can elicit a strong T and B cell response. Hepatitis B, HPV, and pertussis vaccines are examples of such vaccines.

### Non-Replicating: -

An unrelated virus, such as measles or adenovirus (with the inactive gene), is genetically engineered to encode the gene of interest. These are considered safe, but require booster doses to induce long-term immunity. These vaccines are not yet approved. Ad5-nCoV by CanSino Biological Inc./Beijing Institute of Biotechnology is an example of a COVID-19 vaccine, as is ChAdOx-nCoV-1 by ChAdOx-nCoV-1 by ChAdOx-nCoV-1 by ChAdOx-nCoV-1 by ChAdOx-nCoV-1 by ChAdOx-nCoV-1

## 3. Vaccination Trails:
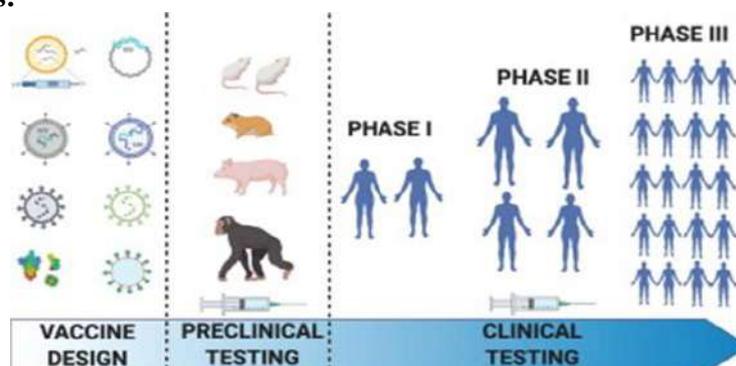
**3.1 Vaccine:** Sputnik V

**Developer company:** Gamaleya research institute

**Platform: Two non-** replicating viral vectors, adenovirus type5 (rAd5) and adenovirus type 26 (rAd26)

**Vaccine target:** - SARS COV-2 Full length Glycoprotein S

This is non-replicating viral vectored vaccine with two different adenoviral vectors (recombinant Ad26 [rAd26] and recombinant Ad5 [rAd5]), both carrying the gene for SARS-CoV-2 spike glycoprotein in a prime-boost regimen rationalized to overcome boosting of viral vector specific antibodies

**Route of administration:** Intramuscular.

**Clinical Trail: -**

**Phase I / Phase II:**

**Placebo control:** - No

**Participants: -** healthy adults 18-60 years of age.

Participants in the study were given either a frozen vaccine formulation or a lyophilized vaccine formulation. During Phase I, participants received one dose of either rAd26-S or rAd5-S and were monitored for safety for 28 days. A separate subset of participants in Phase II received one dose of rAd26-S on day 0 and one dose of rAd5-S on day 21. In Phase I, the prime-only regimen resulted in 100% seroconversion to anti-RBD antibodies 21 days after vaccination. nAb titers were 61% and 77% in the rAd26-S and rAd5-S vaccinated groups, respectively.

When measured with RBD binding antibodies, the seroconversion rate for Phase II participants was also 100 percent. In the Phase II study's prime-dose regimen, all participants developed nAb titers. There was no significant relationship between baseline nAb titer against the viral vector and RBD-specific IgG titer after vaccination. Furthermore, vaccination with one recombinant vector did not increase titers for the other vector, indicating a lack of cross-reactivity between the two distinct viral vectors. Following PBMC stimulation, antigen-specific CD4+ and CD8+ T cell responses were observed.

Flow cytometry and IFN- secretion were detected in 100 percent of the volunteers, particularly by d28. S protein stimulation also resulted in significant cell proliferation. While IFN- is a marker of Th1-biased cellular responses, Phase III clinical trials will include more emphasis on Th1 and Th2 polarisation. The small number of participants' data revealed that both frozen and lyophilized vaccine formulations were equally immunogenic

During both phases of the trial, the vaccine was well tolerated, with the majority of adverse events (AEs) reported being transient, self-limiting, and mild in severity. There were no serious adverse events reported.

Sputnik V received a highly contentious approval from Russian regulatory authorities, limiting the vaccine's rollout in the general population in the absence of a larger Phase III study. The vaccine, according to Gamaleya, was used in high-risk "red zones" of Russian hospitals. To date, the release claims that 10,000 people have received the vaccine under this authorization, with an efficacy rate of more than 90%, but no data to back up these claims has been published.

**Phase III:**

**Placebo control:** Yes

**Participants**: Healthy adults 18-111 years of age (stratified as 18–30, 31–40, 41–50, 50–60 and 60+)

**Immunization schedule**: Prime boost, intramuscular.

A Phase III trial is currently underway in Russia, with participants randomly assigned to one of two groups: those receiving the Sputnik V combined vector vaccine in a prime-boost regimen on days 1 (component I rAd26-S) and 21 (component II rAd5-S) or those receiving two placebo doses. The primary outcome is the occurrence of PCR-confirmed COVID-19 infection within 6 months of the first vaccine dose. The Gamaleya National centre of Epidemiology and Microbiology in Moscow and the Russian Direct Investment Fund released data from an interim analysis that showed 91.4 percent vaccine efficacy from 22,714 participants, though more data from more participants is needed to determine final vaccine efficacy.

**3.2 Vaccine:** mRNA - 1273

**Developer company: -** Moderna

**Platform: -** Lipid nanoparticles encapsulate mRNA encoding a stabilised Spike protein

**Vaccine target: -** SARS-CoV-2 full-length S protein with two proline mutations (S-2P) to aid in the stabilisation of the prefusion conformation.

**Route of administration: -** intramuscular.

**Clinical Trails data:**

**Phase: -** I

**Placebo control:** no

**Immunization schedule: -** prime boost, intramuscular.

A prime/boost regimen of 25 g, 100 g, or 250 g mRNA per dose was given to healthy adults aged 18–55 years. As measured by ELISA, all participants had seroconverted by day 15, and median antibody levels in participants after one shot of either 100 g or 250 g mRNA-1273 were comparable to the median magnitude observed in convalescent serum specimens. NAb titers were measured in 25g and 100g dose recipients, and dose-dependent increases in nAb titer were observed at day 43 post vaccination. All participants had a reduction in SARS-CoV-2 infectivity of 80% or more (PRNT80), with geometric mean PRNT80 responses of 339.7 in the 25 g group and 654.3 in the 100 g group. When compared to three convalescent specimens from COVID-19 patients, the neutralising activity of these sera was superior. Positive correlations were found between binding to the vaccine antigen S-2P and neutralisation titers. ICS was used to measure T cell responses to the S protein. For 6 hours, PBMCs were stimulated with two peptide pools (S1 and S2) made up of 15-mer peptides that overlapped by 10 amino acids. The S1 pool represented the N-terminus of the SARS-CoV-2 S protein up to the furin cleavage site, while the S2 pool represented the C-terminus of the SARS-CoV-2 S protein up to the furin cleavage site. In both the 25 g and 100 g dose groups, CD4+ T cell immune profiles were Th1 biassed (TNF- > IL-2 > IFN-), which was consistent with preclinical NHP studies. Only the 100 g dose group showed low levels of CD8+ T cell responses to the S2 peptide pool after the second vaccination.

All study participants reported at least one adverse event (AE), but only one participant in the 25 g dose group was withdrawn due to vaccine-associated transient urticaria and did not receive a second dose. The majority of the adverse events (AEs) were mild to moderate, with some severe AEs associated with the 250g dose group and reported after the second vaccination. Thus, in this small cohort, mRNA-1273 was safe and immunogenic in adults of all age.

The durability of the vaccine's elicited humoral response was investigated in a subset of 34 participants who received two 100g doses of the vaccine 28 days apart and were spread across all three age groups (18–55, 56–70, and > 71). [249] RBD-binding antibody titers measured by ELISA and neutralisation titers measured by both live-virus plaque-reduction neutralisation and pseudovirus neutralisation assays remained elevated in all participants 90 days after the second dose (119 days after the first dose), demonstrating the induction of a robust and durable antibody response.

**Phase: -** III

**Placebo controlled: -** Yes

**Participants: -** Adults > 18 years of age with no history of SARS-cov-2 infection

**Immunization schedule: -** 100 μg mRNA-1273 or placebo prime-boost, intramuscular

The trial of a prime/boost regimen containing two 100 g doses of mRNA-1273 has concluded. The primary outcome measures were the number of participants who developed symptomatic COVID-19 14 days after receiving the second vaccine dose and the number of participants who developed AEs or ARs up to 2 years after the second dose. The first results of the Phase III trial have been released. The vaccine had a low reactogenicity profile. similar to what was reported in Phase I trials The number of serious adverse events (AEs) reported was comparable in the vaccine and placebo arms. There was no evidence of a vaccine-related increase in respiratory disease. mRNA-1273 met the statistical criteria for efficacy specified in the study protocol, with an estimated vaccine efficacy of 94.1 percent (95 percent CI, 89.3 to 96.8 percent) based on 196 COVID-19 cases diagnosed for primary analysis, of which 185 cases of COVID-19 were observed in the placebo group versus 11 cases in the mRNA-1273 group. There were 30 severe cases reported, with all of them occurring in the placebo group and none in the mRNA-1273 vaccinated group. Demonstrating complete efficacy in preventing severe COVID-19 Age, gender, race, ethnicity, and the presence of severe COVID-19 risk factors had no effect on vaccine

efficacy. The FDA approved mRNA-1273 for distribution and use in people aged 18 and up under an EUA on December 18, 2020.

## 4.  The vaccines which is currently approved in India: -

### 4.1  Covishield: -

Covishield vaccine was developed using an entirely different technology, the viral vector platform. ChAdOx1 is a chimp adenovirus that has been modified to carry the COVID-19 spike protein into human cells. This cold virus, while unable to infect the recipient, can teach the immune system to prepare a defence mechanism against such viruses.

**Development: -**

Covishield Vaccine was developed by AstraZeneca in collaboration with Oxford University in the United Kingdom and is manufactured by the Serum Institute of India (SII) in Pune. Successful clinical trials were conducted in South Africa, Brazil, and the United Kingdom, with bridging study results in the Indian population based on which DCGI granted approval

**Doses: -**

The Covishield Vaccine is administered via injection into the upper arm muscle. The vaccination course is divided into two doses. The Indian government has increased the time between the first and second doses to 12-16 weeks.                                       Clinical trials revealed that when the two doses are given 4 to 6 weeks apart, the Covishield Vaccine has an average efficacy of 54%. Furthermore, if the time interval between two doses is increased, the efficacy is reported to increase to around 79 percent to 90 percent.

**Storage Protocols: -**

Covishield can be stored at 2-8° Celsius, which is the temperature of a standard refrigerator. Because most vaccines in India are kept at the same temperature range, these vaccines are best suited for Indian conditions.

**Side Effects: -**

Most side effects do not require any medical attention

**The common side effects of the Covishield vaccine are: -**

• Headache

• Vomiting

• Muscle pain

• Joint pain

• Fatigue

• Feeling of discomfort

• Fever

• Chills

• Nausea

**Efficiency: -**

According to the results of the third phase trial, the Covishield is nearly 90% effective.

**Mode of administration: -**

The Covishield is intramuscular vaccine.

### 4.2  Covaxin: -

The vaccine was created using platform technology derived from Whole-Virion Inactivated Vero Cells. Because inactivated vaccines do not replicate, they are unlikely to revert and cause adverse effects. They contain dead viruses that are unable to infect people but can still instruct the immune system to mount a defensive response against an infection.

**Developer: -**

Covaxin was developed in collaboration with the Indian Council of Medical Research (ICMR) and the National Institute of Virology by Hyderabad-based Bharat Biotech International Ltd. (NIV).

**Doses: -**

In terms of dosage, there is no difference between the two vaccines. Both are given as 0.5ml injections in the upper arm.

**Storage Instructions: -**
Covaxin can be stored in a household refrigerator at temperatures ranging from 2 to 8 degrees Celsius. Because most vaccines in India are kept at the same temperature range, these vaccines are best suited for Indian conditions.

**Efficacy: -**
According to the 3rd phase clinical trial Covaxin results 81 percentage effectiveness.

**Side effects:** -
You may experience pain at the injection site after getting vaccinated. Some people may also experience side effects like headaches, joint pain, and fever. These side effects do not last lo

**Mode of administration: -**
The Covaxin are intramuscular vaccine.

## 5.    Benefits of Vaccination: -
### 5.1    COVID-19 vaccination will be a critical tool in bringing the pandemic to a close: -
- Wearing masks and keeping 6 feet apart from others can help reduce your chances of being exposed to the virus or spreading it to others, but these precautions are insufficient. Vaccines will work with your immune system to prepare it to fight the virus if you become infected.

- A growing body of evidence suggests that fully vaccinated people are less likely to be infected without exhibiting symptoms (referred to as an asymptomatic infection) and, thus, less likely to spread the virus that causes COVID-19 to others. However, additional research is being conducted.

- Stopping a pandemic necessitates the use of all available tools. As experts learn more about how COVID-19 vaccination may help reduce the spread of the virus that causes COVID-19, the CDC will continue to update its recommendations to protect communities based on the most recent scientific findings.

### 5.2    COVID-19 vaccination is a more secure method of assisting in the development of immunity: -
- COVID-19 has the potential to cause serious, life-threatening complications, and there is no way to predict how it will affect you. If you become ill, you may infect your friends, family, and others around you.

- Obtaining COVID-19 may provide some protection, referred to as natural immunity.    According to current evidence, reinfection with the virus that causes COVID-19 is uncommon in the months following initial infection, but may increase over time. The risk of serious illness and death from COVID-19 outweighs any benefits from natural immunity. The COVID-19 vaccination will help protect you by eliciting an antibody (immune system) response without the need for you to become ill.

- Both natural immunity and vaccine-induced immunity are important components of the COVID-19 disease that experts are working to understand, and the CDC will keep the public updated as new evidence becomes available.

**CONCLUSIONS:**
We understand that now that COVID-19 vaccines are available in the United States, some people may be hesitant to get vaccinated. While more COVID-19 vaccines are being developed as quickly as possible, routine processes and procedures continue to be in place to ensure the safety of any vaccine that has been authorised or approved for use. Safety is paramount, and there are numerous reasons to get vaccinated.

**REFERENCES:**
1.    Future science-overview of vaccine development Seyed H Shahcheraghi, Jamshid Ayatollahi, Alaa AA Aljabali, Madhur D Shastri, Shakti D Shukla, Dinesh K Chellappan, Niraj K Jha, Krishnan Anand, Naresh K Katari, Meenu Mehta, Saurabh Satija, Harish Dureja, Vijay Mishra, Abdulmajeed G Almutary, Abdullah M Alnuqaydan, Nitin Charbe , Parteek Prasher , Gaurav Gupta , Kamal Dua , Marzieh Lotfi, Hamid A Bakshi & Murtaza M Tambuwala

2.    Chiranjib Chakraborty,corresponding author1,2,† Ashish Ranjan Sharma,2,† Manojit Bhattacharya,3,† Garima Sharma,4 Rudra P. Saha,1 and Sang-Soo Leecorresponding author2 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7937508/

3. Covid vaccine development Arun Kumar, William E. Dowling, Raúl Gómez Román, Amol Chaudhari, Celine Gurry, Tung Thanh Le, Stig Tollefson, Carolyn E Clark, Valentina Bernasconi & Paul A Kristiansen

4. COVID-19 vaccine development and a potential nanomaterial path forward. Matthew D. Shin, Sourabh Shukla, Young Hun Chung, Veronique Beiss, Soo Khim Chan, Oscar A. Ortega-Rivera, David M. Wirth, Angela Chen, Markus Sack, Jonathan K. Pokorski & Nicole F. Steinmetz

5. SARS-CoV-2 vaccines in advanced clinical trials: Where do we stand? Author links open overlay panelSaborniChakrabortyaVamseeMallajosyulabCristina M.TatocGene S.TandeTaia https://www.sciencedirect.com/science/article/pii/S0169409X21000247#bb1235

6. Benefits of Getting a COVID-19 Vaccine https://www.cdc.gov/coronavirus/2019-ncov/vaccines/vaccine-benefits.html

7. COVID-19 vaccines: rapid development, implications, challenges and future prospects. Shivaji Kashte, Arvind Gulbake, Saadiq F. El-Amin III & Ashim Gupta

8. n mRNA Vaccine against SARS-CoV-2 — Preliminary Report Lisa A. Jackson, M.D., M.P.H., Evan J. Anderson, M.D., Nadine G. Rouphael, M.D., Paul C. Roberts, Ph.D., Mamodikoe Makhene, M.D., M.P.H., Rhea N. Coler, Ph.D., Michele P. McCullough, M.P.H., James D. Chappell, M.D., Ph.D., Mark R. Denison, M.D., Laura J. Stevens, M.S., Andrea J. Pruijssers, Ph.D., Adrian McDermott, Ph.D., et al.,

9. Potential of live pathogen vaccines for defeating the COVID-19 pandemic: History and mechanism Ji-Wang Chen, Ji-Ming Chen

10. Recent advances, approaches and challenges in targeting pathways for potential COVID-19 vaccines development Daniela Calina, Chandan Sarkar, Andreea Letitia Arsene, Bahare Salehi, Anca Oana Docea, Milon Mondal, Muhammad Torequl Islam, Alireza Zali & Javad Sharifi-Rad https://link.springer.com/article/10.1007/s12026-020-09154-4

## INNOVATIVE BANKING SERVICES IN INDIA

**[1]N. Jannifer Rani and [2]Dr. Anli Suresh**
[1]Research Scholar, University of Madras, 600059
[2]Assistant Professor, Commerce, Madras Christian College, 600059

**ABSTRACT**
*Banking sector has a tremendous change in the recent years. The technological changes have impacted on the financial sector of the country too. The banks play a major role in the business and also the economy's growth. The services extended by the banks should have a target and also to improve the economy on the whole. Banks started to use the technology in a wide manner to provide quality of service in a greater speed. The study aims to find out the innovative banking services which are used by the Indian banks and also the consumer perception towards the drastic change. The study highlighted the key innovations such as checking account balances and transactions, transferring money between bank accounts, asking a customer service question, deposited money, applied for credit card or loans, SMS service.The focus of this paper is on the innovative banking services and the type of services availed by the customer. The statistical tools used were reliability analysis, correlation analysis and regression analysis. Based on the literature survey the key innovative services factors were identified. This paper makes a descriptive study among 100 respondents. The concluding observations of the study were there is significant relationship between age and mobile banking services. The customers tend to use more of the innovative banking services after the demonetization.*

*Keywords: ATM, Credit card, Digital, Innovation, Transactions.*

## INTRODUCTION

With the view to the huge advancement in technology, the banking sector is more focussed strategically in the aim of growth of the country. This in turn helps in defending market share against increasing competition and also helps to meet the customer expectations. The critical part in setting up the advanced analytics, digital technologies and new delivery platforms have paved the way through new innovations and also through developing new solutions. New traits and new practices have been evolved from the2019 that has seen the banking industry innovate in various areas and include the traits and practices that were already the trademark of fintech start-ups. Using block chain technology the faster innovations by bank and credit unions by targeting, expanding their services, delivering the proactive advices, re-configuring delivery channels and integrating payments. Something new or something which has not been used or done before is known as innovation. The same only replicates for the banking sector as well. There are many innovations which have been going through or gone through in various sectors of the country in the recent years. There are no more old traditional methods. These innovations are to increase the business avenues and also to capture new market banks are undergoing a drastic change through innovation in technology. This is being termed as innovative banking and also used in various sectors nowadays. Mobile banking has been a revolt in the past few years. It has totally changed the way banking systems are working. Therefore mobile banking is a very good system that allows the customers to perform all the financial related activities through their mobile phone. Internet coverage in the previous years has improved a very drastic manner. The services include online banking, web banking and virtual banking. With the help of the internet service, the users are allowed to perform and execute the banking operations. These innovative banking facilities are available traditionally at the banking outlet. These innovative services include bills payments, deposit of money, borrowing of money and all the other services which are available at one place. All the services take place with the help of internet banking facility. In India the facility of internet banking was first introduced by ICICI bank. Five basic technological innovations which have a drastic change in the banking sector are as follows:

1. Expanding Open Banking

2. Commitment to Physical and Digital Delivery

3. AI-Driven Predictive Banking

4. More control on the data by customers

5. Card less ATM service

## REVIEW OF LITERATURE
**Subhranghsu S.Sarkar (2016)** the study has highlighted on the cash and non-cash payment methods which has a huge impact in the banking sector. The non-cash payments play a vital role in each and every individual

having a bank account. The Innovative banking services include the framework of CBS, CTS, ECS, RTGS, EFT, NEFT, ATM, debit and credit cards, internet banking and mobile banking.

**Malini.A Menon, Dileep G (2017)** in their study they have identified the important paradigm shift that has occurred is the digitalization of banks which aim at providing customers with a broad scope of benefits. The key determinant in offering customized banking services and offering diversified services to their varied customer's portfolios at a reduced cost is the technology based innovations in our country.

**Sandeep Kaur (2015)** Banking has evolved largely in the pace of e-banking in order to have an object to satisfy the customers and value them. Even non-banking institutions have adopted some of these innovations. The researcher has also stated that technology will make the engagement with banks more multi-dimensional and Indian banks will continue to develop and expand banking services.

**Sanchit Sikka, UpadrastaVenkataSrinath (2018)** they have identified new bank products like mobile banking apps, new methods of client verification, card less payment, digital payments, and use of data, AI and analytics to improve operations. The key determinant for the development of sophisticated products is by using low cost and robust technology.

**Aruna R. Shet (2016)** Challenging business environment within the banking system create more innovation in the fields of product, process and market. Our economy has both cash and non-cash transaction. Financial sector is slightly moving into a very developmental stage, where it can have new mechanisms along with fluidity and security. Internet banking mobile banking and point of sale has evolved largely in a greater manner.

## RESEARCH GAP
In considering the above literature studies there have been a number of studies carried out in order to find out the innovations in the banking sector. But there was very few studies relating to consumers point of view towards the innovation in the Indian banking scenario. The researcher has taken the entire study towards the consumer perception and the importance of the innovations and technology improvement in the banking sector.

## OBJECTIVES OF THE STUDY
The main aim of this paper is to identify the consumer perception on the innovative services provided by the banks and also to determine the awareness levels of the consumers on the innovative banking services.

## HYPOTHESES FOR THE STUDY
$H_{01}$: There is no significant relationship between Age and mobile banking services.

$H_{02}$: There is no significant association between Gender and ATM banking services.

## RESEARCH METHODOLOGY

| Table-1 Research methodology | |
|---|---|
| Research Design | Descriptive Study |
| Sampling area | Chennai city |
| Sampling method | Simple random sampling |
| Type of research | Quantitative Research |
| Collection of Data | Primary data- Questionnaire; Secondary data- Journals, articles, web blogs, Reviews |
| Sample Size | 100 |
| Research Instrument | Self-designed structured questionnaire with scored using a five - Point Likert scale circulated through Google forms |
| Statistical Tools | SPSS 20 software |
| Period of Study | May to July 2021 |
| Statistical Techniques | Correlation analysis, Factor Analysis, Reliability Analysis |

## DATA ANALYSIS AND INTERPRETATION
### Demographic profile

| Table-2 Age of the respondents | | |
|---|---|---|
| Variables | Frequency | Percent |
| 21-25 years | 24 | 24.0 |
| 26-30 | 27 | 27.0 |
| 31-35 | 11 | 11.0 |
| 36-40 | 17 | 17.0 |
| Above 40 years | 21 | 21.0 |

| Total | 100 | 100.0 |
| Source: Primary Data Analysis | | |

Interpretation: Table2 shows that out of total 100 respondents in which 24% fall under the age group of 20-25 years where as 27% fall under the age group of 26-30 years, 11% of the respondents belong to 31-35 years, 17% of the respondents belong to the age group of 36-40 years and the remaining respondents are from the age group of above 40years.

| **Table-3 Gender of the respondents** | | |
|---|---|---|
| Variables | Frequency | Percent |
| Female | 63 | 63.0 |
| Male | 37 | 37.0 |
| Total | 100 | 100.0 |
| Source: Primary Data Analysis | | |

Interpretation: Table3 shows that there are 37% male respondents taken for the study and 63% of the study was done with female respondents

| **Table-4 Educational qualification of the respondents** | | |
|---|---|---|
| Variables | Frequency | Percent |
| UG | 31 | 31.0 |
| PG | 24 | 24.0 |
| Diploma | 23 | 23.0 |
| Doctorate | 22 | 22.0 |
| Total | 100 | 100.0 |
| Source: Primary Data Analysis | | |

Interpretation:   Table4 shows that Out of 100 respondents, 31% belong to under graduation, 24% is from post-graduation, and 23% belong to Diploma and the remaining respondents are Doctorates.

| **Table-5 Occupation of the respondents** | | |
|---|---|---|
| Variables | Frequency | Percent |
| Research scholar | 11 | 11.0 |
| House wife | 8 | 8.0 |
| Own business | 15 | 15.0 |
| Public sector | 19 | 19.0 |
| Private sector | 47 | 47.0 |
| Total | 100 | 100.0 |
| Source: Primary Data Analysis | | |

Interpretation: Table5 shows that majority of the respondents were working in the private sector. 11% of the respondents were research scholar, 8% of the respondents were house wife, 15% of the respondents were having own business, 19% of the respondents were working in public sector.

| **Table-6 Family Monthly Income of the respondents** | | |
|---|---|---|
| Variables | Frequency | Percent |
| 25000-30000 | 31 | 31.0 |
| 31000-35000 | 26 | 26.0 |
| 36000-40000 | 17 | 17.0 |
| Above 40000 | 26 | 26.0 |
| Total | 100 | 100.0 |
| Source: Primary Data Analysis | | |

Interpretation: Table6 shows that Out of 100 respondents, 31% of the respondents have monthly income of Rs.25000-Rs.30000, 26% of the respondents have Rs.31000-Rs.35000, 17% of the respondents have Rs.36000-Rs40000 and 26% of the respondents have a monthly income of above Rs.40000.

**Reliability Analysis**

| **Table-7 Reliability Statistics** | | |
|---|---|---|
| Cronbach's Alpha | N of Items | No. of cases |
| .969 | 17 | 100 |

Source: Primary Data Analysis

Interpretation: The above table explains the Cronbach's alpha value which is about 0.969 which is approximately 97% and an acceptable one.

## Correlation Analysis

**$H_{01}$: There is no significant relationship between Age and mobile banking services**

| Table-8 Correlations | | Age | Checking account balance and transactions | Transferring money between bank accounts | Asking a customer service question | Depositing money | Applied for a credit card or loans |
|---|---|---|---|---|---|---|---|
| Age | Pearson Correlation | 1 | .635** | .553** | .496** | .820** | .746** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 | .000 |
| Checking account balance and transactions | Pearson Correlation | | 1 | .475** | .975** | .375** | .175** |
| | Sig. (2-tailed) | | | .000 | .000 | .000 | .000 |
| Transferring money between bank accounts | Pearson Correlation | | | 1 | 1.000** | 1.000** | 1.000** |
| | Sig. (2-tailed) | | | | .000 | .000 | .000 |
| Asking a customer service question | Pearson Correlation | | | | 1 | 1.000** | 1.000** |
| | Sig. (2-tailed) | | | | | .000 | .000 |
| Depositing money | Pearson Correlation | | | | | 1 | 1.000** |
| | Sig. (2-tailed) | | | | | | .000 |
| Applied for a credit card or loans | Pearson Correlation | | | | | | 1 |
| | Sig. (2-tailed) | | | | | | |
| Source: Primary Data Analysis | | | | | | | |

Interpretation:

**$H_{01}$–There is no significant relationship between Age and Mobile banking services.**

**There is no significant relationship between Age and Mobile banking services (Checking out balance and transactions):** The correlation table reveals that the Pearson's coefficient value for the relationship between age and checking out balance and transactions is 0.653 which shows a moderate positive correlation. The significant value for checking out balance and transactions is 0.000 which is less than 0.05 and shows that there is significant relationship between age and checking out balances and transactions. Thus the $H_0$ is rejected.

**There is no significant relationship between Age and Mobile banking services (Transferring money between bank accounts):** The correlation table reveals that the Pearson's coefficient value for the relationship between age and Transferring money between bank accounts is 0.553 which shows a moderate positive correlation. The significant value for Transferring money between bank accounts is 0.000 which is less than 0.05 and shows that there is significant relationship between age and Transferring money between bank accounts. Thus the $H_0$ is rejected.

**There is no significant relationship between Age and Mobile banking services (Asking a customer service question):** The correlation table reveals that the Pearson's coefficient value for the relationship between age and Asking a customer service question is 0.496 which shows a moderate positive correlation. The significant value for Asking a customer service question is 0.000 which is less than 0.05 and shows that there is significant relationship between age and asking a customer service question. Thus the $H_0$ is rejected.

**There is no significant relationship between Age and Mobile banking services (Depositing Money):** The correlation table reveals that the Pearson's coefficient value for the relationship between age and Depositing Money is 0.820 which shows a high positive correlation. The significant value for Depositing Money is 0.000 which is less than 0.05 and shows that there is significant relationship between age and Depositing Money. Thus the $H_0$ is rejected.

**There is no significant relationship between Age and Mobile banking services (Applied for a credit card or loan):** The correlation table reveals that the Pearson's coefficient value for the relationship between age and Applied for a credit card or loan is 0.746 which shows a high positive correlation. The significant value for Applied for a credit card or loan is 0.000 which is less than 0.05 and shows that there is significant relationship between age and Applied for a credit card or loan. Thus the $H_0$ is rejected.

## Regression Analysis
**$H_{02}$: There is no significant association between Gender and ATM banking services**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | Sig. F Change |
|---|---|---|---|---|---|---|---|
| 1 | 0.061 | 0.004 | -0.006 | 1.357 | 0.004 | 0.364 | 0.048 |
| 2 | 0.072 | 0.005 | -0.005 | 1.252 | 0.005 | 0.516 | 0.474 |
| 3 | 0.113 | 0.013 | 0.003 | 1.369 | 0.013 | 1.275 | 0.262 |
| 4 | 0.047 | 0.002 | -0.008 | 1.286 | 0.002 | 0.218 | 0.042 |
| 5 | 0.060 | 0.004 | -0.007 | 1.437 | .004 | 0.354 | 0.553 |
| Source: Primary Data | | | | | | | |

**Table-9Model summary**

**Interpretation:** The above shows the regression analysis of the Dependent variable: Withdrawal of money, Money deposited and transfer, SMS service, Balance enquiry, Mini statement service. Independent variable: Monthly Income.

The R square change value for model 1 is 0.004, which shows that only 4% of the variation in ATM banking services with regard to withdrawal of money which is not significant at 0.05 levels. For model 1 multiple determination factor R square (Goodness of fit) value is 0.004, F-value of the regression is 0.364 (p = 0.000) and Factor R of multiple cross-correlation 4% shows low cross correlation which is less than the acceptance level of 0.01.

The R square change value for model 2is 0.005, which shows that only 5% of the variation in ATM banking services the with regard to money deposited and transfer which is not significant at 0.05 levels. For model 2 multiple determination factor R square (Goodness of fit) value is 0.072, F-value of the regression is 0.516 (p = 0.000) and Factor R of multiple cross-correlation 72% shows high cross correlation which is less than the acceptance level of 0.01.

The R square change value for model 3is 0.113, which shows that only 11.3% of the variation in ATM banking services the with regard to SMS service which is not significant at 0.05 levels. For model 3 multiple determination factor R square (Goodness of fit) value is 0.113, F-value of the regression is 1.275 (p = 0.000) and Factor R of multiple cross-correlation 11.3% shows less cross correlation which is less than the acceptance level of 0.01.

The R square change value for model 4is 0.002, which shows that only 2% of the variation in ATM banking services the with regard to SMS service which is not significant at 0.05 levels. For model 4 multiple determination factor R square (Goodness of fit) value is 0.002, F-value of the regression is 0.218(p = 0.000) and Factor R of multiple cross-correlation 2% shows very low cross correlation which is less than the acceptance level of 0.01.

The R square change value for model 5is 0.005, which shows that only 5% of the variation in ATM banking services the with regard to SMS service which is not significant at 0.05 levels. For model 5 multiple determination factor R square (Goodness of fit) value is 0.005, F-value of the regression is 0.516 (p = 0.000) and Factor R of multiple cross-correlation 5% shows low cross correlation which is less than the acceptance level of 0.01.

**Table-10ANOVA**

| | Model | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .669 | 1 | .669 | .364 | .048[b] |
| | Residual | 180.331 | 98 | 1.840 | | |
| | Total | 181.000 | 99 | | | |
| 2 | Regression | .810 | 1 | .810 | .516 | .474[b] |
| | Residual | 153.700 | 98 | 1.568 | | |

| | | Total | 154.510 | 99 | | | |
|---|---|---|---|---|---|---|---|
| 3 | Regression | | 2.388 | 1 | 2.388 | 1.275 | .262[b] |
| | Residual | | 183.612 | 98 | 1.874 | | |
| | Total | | 186.000 | 99 | | | |
| 4 | Regression | | .360 | 1 | .360 | .218 | .042[b] |
| | Residual | | 162.000 | 98 | 1.653 | | |
| | Total | | 162.360 | 99 | | | |
| 5 | Regression | | .730 | 1 | .730 | .354 | .553[b] |
| | Residual | | 202.230 | 98 | 2.064 | | |
| | Total | | 202.960 | 99 | | | |
| a. Dependent Variable: Withdrawal of money, Money deposited and transfer, SMS service, Balance enquiry, Mini statement service. | | | | | | | |
| b. Predictors: (Constant), Monthly Income | | | | | | | |
| Source: Primary Data | | | | | | | |

**Interpretation:** The hypotheses are further tested by ANOVA.

In model 1, the F value and significance value, p indicates that there is significant relationship between Monthly Income and withdrawal of money since, the value is lesser than 0.05. Thus, the null hypothesis is rejected.

In model 2, the F value and significance value, p indicates that there is no significant relationship between Monthly Income and money deposited and transfer, the value is higher than 0.05. Thus, the null hypothesis is accepted.

In model 3, the F value and significance value, p indicates that there is significant relationship between Monthly Income and SMS service, the value is lesser than 0.05. Thus, the null hypothesis is rejected.

In model 4, the F value and significance value, p indicates that there is no significant relationship between Monthly Income and balance enquiry since, the value is greater than 0.05. Thus, the null hypothesis is accepted.

In model 5, the F value and significance value, p indicates that there is significant relationship between Monthly Income and withdrawal of money since, the value is lesser than 0.05. Thus, the null hypothesis is rejected.

| Table-11Coefficients | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **T** | **Sig.** |
| | | **B** | **Std. Error** | **Beta** | | |
| 1 | (Constant) | 2.471 | .314 | | 7.860 | .000 |
| | Monthly Income | -.074 | .123 | -.061 | -.603 | .048 |
| 2 | (Constant) | 2.618 | .290 | | 9.020 | .000 |
| | Monthly Income | -.082 | .114 | -.072 | -.719 | .474 |
| 3 | (Constant) | 2.723 | .317 | | 8.584 | .000 |
| | Monthly Income | -.140 | .124 | -.113 | -1.129 | .262 |
| 4 | (Constant) | 2.545 | .298 | | 8.542 | .000 |
| | Monthly Income | -.055 | .117 | -.047 | -.467 | .042 |
| 5 | (Constant) | 2.659 | .333 | | 7.985 | .000 |
| | Monthly Income | -.078 | .131 | -.060 | -.595 | .553 |
| a. Dependent Variable: Withdrawal of money, Money deposited and transfer, SMS service, Balance enquiry, Mini statement service. | | | | | | |
| Source: Primary Data | | | | | | |

Five regression equations were derived from the analysis

| Table-12Regression equations | |
|---|---|
| Withdrawal of money | $Y=2.471-0.074x_1$ |
| Money deposited and transfer | $Y=2.618-0.082x_1$ |
| SMS service | $Y=2.723-0.140x_1$ |
| Balance enquiry | $Y=2.545-0.055x_1$ |
| Mini statement service | $Y=2.659-0.078x_1$ |
| Source: Primary Data | |

## FINDINGS FROM THE STUDY

**Demographic profile:** The majority respondents for the study were female from the age group of 26-30 years have completed their under-Graduation and working in the private sector with monthly earnings of Rs.25000-Rs30000.

**Correlation Analysis**There is significant relationship between Age and mobile banking services like Checking account balance and transactions, Transferring money between bank accounts, Asking a customer service question, Depositing money and Applied for a credit card or loans.

**Regression Analysis** The regression analysis is performed for the ATM banking services and further supports the Anova analysis by rejecting the null hypothesis and reinstates that monthly Income as a predictor in explaining withdrawal of money, SMS service and mini statement service. In this regression analysis five models were derived for understanding the ATM banking services in order to identify the innovative banking services in India. In model 1, Withdrawal of money accounted for 4% of variance in innovative banking services. In the model 2, Money deposited and transfer accounted for 5% of variance in innovative banking services. In the model 3, SMS service for 13% of variance in innovative banking services. In the model 4, Balance enquiries accounted for 2% of variance in innovative banking services. In the model 5, Mini statement services accounted for 4% of variance in innovative banking services.

## CONCLUSIONAND SUGGESTIONS

Banking sector and the technology have increased in a fast pace which have paved the way for cash to non-cash economy and further to tap and go technology. In current scenario, people go with innovation and technology to get their work done much smarter and faster. Frugal innovations that are sustainable and accessible will be able to generate more revenue and increase the growth of the economy while significantly reducing the resource requirements and cost.

## SCOPE FOR FUTURE RESEARCH

The researcher has highlighted some of the key points relating to innovations with regard to banking innovations and technologies. The future researchers can focus on many other innovations like banking loan services, innovative banking credit services and also banking activities with their products and services. The other areas where the future researchers can concentrate is that reason why they do not prefer the innovative technologies like online payments and other things. The challenges involved in implementing the innovative technology all over the country.

## REFERENCES

1. Aruna R. Shet Technological Innovations in Indian Banking Sector International Journal of Scientific Engineering and Research (IJSER) www.ijser.in ISSN (Online): 2347-3878, Impact Factor (2015): 3.791 Volume 4 Issue 5, May 2016.

2. Malini.A Menon, Dileep G (2017) Technological innovations in the banking sector in India: An analysisInternational Conference on Technological Advancements in Power and Energy (TAP Energy) DOI- 10.1109/TAPENERGY.2017.8397342.

3. Sanchit Sikka, UpadrastaVenkataSrinath (2018) Innovation in Banking Products and Services International Conference on "Paradigm Shift in Taxation, Accounting, Finance and Insurance IOSR Journal of Business and Management (IOSR-JBM) e-ISSN: 2278-487X, p-ISSN: 2319-7668 PP 21-27 www.iosrjournals.org.

4. Sandeep Kaur (2015) International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2015): 78.96 Impact Factor (2015): 6.391 Volume 5 Issue 11, November 2016 www.ijsr.net Licensed under Creative Commons Attribution CC BY a Study on New Innovations in Banking Sector Volume 5 Issue 11, November 2016.

5. Subhranghsu S.Sarkar (2016) Technological Innovations in Indian Banking Sector-A Trend Analysis Journal of Commerce and Management Thought 7(1):171 DOI: 10.5958/0976-478X.2016.00012.4.

6. V. M. Nair and D. G. Menon, "Fin Tech firms- A new challenge to Traditional Banks:  A Review," International Journal of Applied Business and Economic Research, vol. 15, pp. 173-184, 2017.

## INNOVATIVE WAYS OF TEACHING AND LEARNING MATHEMATICS

**Dr. Varsha D. Chapke**
Assistant Professor, Smt. Shobhatai Bansod Art's, Commerce & Science College, Khedmakta, Bramhapuri,
Dist. Chandrapur (MS)

**ABSTRACT**
*This observe sheds mild at the diverse techniques to educate arithmetic and whether or not they may be hired or not. The observe investigates the hired arithmetic-coaching techniques in Maharashtra colleges, and the obstacles that save you instructors from making use of numerous powerful techniques of their school rooms. The researcher follows the qualitative method primarily based totally on in-intensity interviews and tips of preceding research and statement to gain the most benefits. Teachers assert that using the one of a kind revolutionary techniques are crucial and green in coaching arithmetic, however there are numerous handicaps that save you instructors from exploiting them including, among others, the imposed responsibilities to finish the whole quantity of loaded observe fabric for the duration of the semester, in addition to the dearth of to be had gear to computerize training and coaching method in general, the dearth of constructing tangible gear, and the low talent stage of a few instructors. The effects of the interviews confirmed that era is not often hired in coaching arithmetic – if ever, in addition to revolutionary and contemporary-day techniques. The observe concludes that the heavy burden of coaching arithmetic need to be lightened to permit area for creativity in coaching techniques, as they want extra time to be hired. In addition, for arithmetic to be understood properly, the coaching method need to be thrilling to draw college students. Besides this, the advised techniques are nice to be carried out with inside the coaching method*

### INTRODUCTION :
The function of training in recent times is undeniable. It is the using pressure that movements society from the nation of inertia and sluggish increase to the speedy motion of development and improvement in financial and human assets. Education is an problem of countrywide safety and the primary line of protection in opposition to the risks and drawbacks of globalization. It is likewise the primary device for the funding of human assets, that is now the primary foundation for financial development and globalization (Algani, 2018). Mathematics is an quintessential a part of technology; in truth, it's far the middle aspect of technology. If we recognize its significance and the vital function of its packages in existence, we are able to use it withinside the proper methods with the intention to make a contribution to the clinical and technical development of our nation. However, the truth that the big majority of college students don't forget it a hard difficulty to analyze makes it pressing for colleges to make the most all assets and techniques to assist college students recognize it (Algani, 2018). In addition, the findings display that withinside the questionnaire which tested the placement of faculty scholars closer to the 2 subjects, approximately 80% of the scholars in Grade eight gave better significance to the observe of the 2 subjects, even though most effective a median of 55% mentioned that they loved studying sciences and arithmetic. It need to be remembered that most effective a small percent of the scholars who persevered their research in excessive colleges are analyzing withinside the technology track, and maximum of them observe arithmetic on the 3-unit stage (National authority for dimension and assessment in training in Israel-RAMA, 2018). Thus, all to be had approach need to be hired to enhance coaching all materials, in particular arithmetic. Furthermore, a few crucial boundaries stand withinside the face of using powerful techniques in coaching arithmetic in colleges, which might be manifested specifically withinside the burden of finishing the whole loaded observe fabric of the textbook. This manner, the remaining goal could be to manipulate coaching the whole textbook in a single semester on the cost of using diverse techniques even as coaching.

### GENERAL OBJECTIVES OF TEACHING MATHEMATICS :
It is typically agreed that the primary goal of coaching arithmetic is, on the only hand, to put together college students for public existence irrespective of their paintings or destiny aspirations, and on the opposite hand, to provide college students the cappotential to recognize arithmetic itself in faculty or after graduation. However, there are extra targets that need to be borne in thoughts inclusive of to offer college students with the cappotential to apply right questioning methods, to use inductive and deductive reasoning, to be contemplative and reflective, and to gather trouble fixing competencies.

Teachers need to emphasize the significance of arithmetic in public existence through coaching college students approximately the effect of arithmetic on cultural improvement. Moreover, it's far crucial to offer college

students with the essential competencies to recognize what they may be analyzing and to find out new relationships, in addition to to assist them in shaping fine tendencies and attitudes closer to arithmetic.

## REVIEW OF LITERATURE :

Review of literature Penina Kamina and Nithya Iyer (2009) approve this truth: The manner wherein it's far taught withinside the school rooms of primary training makes summary contents prevail, with out help in assets that permit constructing knowledge, going from concrete and semi-concrete representations of mathematical thoughts and concepts, to synthesis sports that facilitate the abstraction and generalization of the mathematical contents of the extent. The manner Mathematics is taught is as crucial because the content. However, so as for the revolutionary techniques to be powerful, the connection among the instructor and scholar need to be exact, because it facilitates to "enhance educational success" (Coe, 2018, p.29) because "college students attempt harder, understanding a person cares approximately the outcomes. Students experience extra cushty searching for assist whilst the connection is fine and supportive" (ibid). In this manner, instructors have an impact on scholar's attitudes and outcomes. Students can be "inclined to exert extra electricity studying the lesson and assisting their peers" (ibid).

Teachers need to be innovative in deciding on examples near the residing revel in of college students. They need to additionally join arithmetic with summary notion in addition to the actual matters in existence for college kids to recognize and love arithmetic. Teaching arithmetic this manner enables college students' integration into society and facilitates them to analyze the artwork of questioning. If arithmetic isn't always associated with the person in any manner, studying it is going to be vain and simply contain memorizing for the exams. Students have many talents, and instructors need to assist them to apply them and offer them with all of the to be had approach of illustration, in particular contemporary-day ones (Algani, 2019).

## METHODS :

The series of studies records turned into completed thru semi-dependent interviews carried out with every of the members by myself in a observe room withinside the faculty. Each interview prolonged from 1/2 of an hour to fifty minutes. The appointed time of the interview turned into constant in advance, and at the start of the assembly every student acquired quick records approximately the difficulty of the interview and turned into requested to comply with its recording, with the reason that the studies turned into nameless and confidential. Agreement turned into given verbally through the scholars, mother and father and instructors. The private questions made use of the narrative interview approach that allowed for the presentation of tales and movie scripts of a arithmetic lesson that could give an explanation for the revel in of scholars with inside the transition from the intermediate to the excessive faculty stage.

Participants with inside the studies blanketed forty eight students from college at some stage in their first time period in one of a kind college stages (number one stage, center stage, and excessive stage). All of them are of the one of a kind socio-financial history. According to the file in their teachers, their success in arithmetic ranged in stage from low to excessive (all of the names of the interviewees are fictitious).

## FINDINGS :

In this phase the findings of the interviews are provided in an try to recognize the strategies the lecturers implemented of their arithmetic lessons. The studies findings suggest 5 classes: software of positive mastering principles, use of plenty of coaching and comparing strategies, differential coaching, use of virtual gear and applications, and assessment for the sake of mastering. In order to perceive the coaching practices that sell mastering, the interviews on this studies contained a crucial query: What, to your opinion, are the varieties of coaching practices that sell great mastering which the trainer has implemented in coaching the challenge you're studying? Analysis of the scholars' solutions to the above query changed into made in line with a formerly defined qualitative evaluation. The classes have been made out of an evaluation of the content material of the interviews with the scholars in line with key words. The content material evaluation which changed into amassed from the interviews and categorised into classes changed into primarily based totally at the expert literature. The findings of the query have been in comparison to the literature history and to different studies studies.

## RESULTS :

The effects of the interviews confirmed that generation is not often hired in coaching arithmetic – if ever, in addition to revolutionary and present day techniques. The examine concludes that the heavy burden of coaching arithmetic ought to be lightened to permit area for creativity in coaching techniques, as they want extra time to be hired. In addition, for arithmetic to be understood properly, the coaching method ought to be exciting to draw

college students. Besides this, the advised techniques are positive to be implemented withinside the coaching method.

**CONCLUSION :**

This examine highlights the techniques which can be utilized in colleges to educate arithmetic. It stresses a few revolutionary techniques to educate arithmetic and examines whether or not they're implemented in colleges or not. The techniques are divided into 5 subcategories. The effects of the interview found out the low applicability of the blanketed techniques in classrooms. The examine concluded that extra interest ought to be paid to the techniques hired in coaching arithmetic, and generation. Also, revolutionary and present day techniques ought to be taken into consideration in colleges due to the fact they proved positive in coaching arithmetic. Moreover, this examine concludes that the burden of arithmetic curricula is to be reconsidered, and the concern ought to be college students information of arithmetic through exploiting diverse manner and using present day technological revolutionary techniques in coaching arithmetic.

**REFERENCES :**

1. Algani, Y., M. & Eshan, J. (2019). Reasons and advised answers for low-stage instructional success in arithmetic. International e-Journal of Educational Studies (IEJES), 6 (3), 142-151. DOI: 10.31458/iejes.571751.

2. Algani, Y. (2018). Applying innovative abilties in coaching math on the number one college stage. Journal of International Economy and Business, 6, 26-33.

3. Ashburn, E.A. & Floden, R.E. (2006). Meaningful mastering the usage of generation: what educators want to understand and do? New York: Teachers College Press.

4. Gabrielle Emanuel (23 Jul 2016). "Why We Learn Math Lessons That Date Back 500 Years". National Public Radio.

5. "Why We Learn Math Lessons That Date Back 500 Years". NPR.org.

6. William L. Schaaf (1941) A Bibliography of Mathematical Education, Forest Hills, N.Y. : Stevinus Press, hyperlink from HathiTrus

## PERSONALITY TRAITS AND FINANCIAL BEHAVIOR

**[1]Khaira Amalia Fachrudin, [2]Dina Liviana Tarigan and [3]Muhammad Faidhil Iman**
[1,2]Faculty of Economic and Business, Universitas Sumatera Utara, Medan, Indonesia, 20154
[3]Faculty of Psychology, Universitas Sumatera Utara, Medan, Indonesia, 20154

**ABSTRACT**

*The present research aims to obtain empirical evidence of the effect of personality types including openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism on individual financial behaviors such as investment behavior, debt behavior, purchasing behavior, and herding behavior. This study involved a total of 400 Indonesian respondents. The data in this study were obtained from questionnaires. The data were analyzed using structural equation modeling-partial least squares (SEM-PLS). This research indicated that openness to experience positively and significantly affects investment behavior, while neuroticism has a negative and significant impact on investment behavior. Conscientiousness has a positive and significant effect on debt behavior. Conscientiousness and agreeableness have a positive and significant impact on purchasing behavior. Neuroticism, in the meantime, has a positive and significant impact on herding behavior. This study implies that investment managers, employers, and advertisers need to consider their clients, consumers, and employees' personality traits.*

*Keywords: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, Neuroticism, Financial Behaviour*

## I. INTRODUCTION

Each individual has to bear responsibility for his own finances as financial management is an integral part of daily life. Financial management may also be determined by each individual's behavior. An individual's ability to manage finance serves as one of the key factors in achieving a successful life. *Financial behavior* is human behavior related to financial management (Xiao, 2008). Someone who assumes the responsibility for his financial behavior would use his money effectively by creating a budget, saving up and keeping control of his expenses, making investments and paying off debt on time.

Financial behavior includes investment, expenses, savings, and financial planning (Mutlu & Ozer, 2019), loan management (Alkaya & Ibrahim, 2015), bill payoff, budgeting (Akben-Selcuk, 2015). In this paper, *the financial behavior under study is limited to* investment behavior, debt behavior, purchasing behavior and *herding behavior.* Herding referred to here is related to purchasing behavior, instead of investing in the capital market.

Investment behavior is the behavior prioritizing for keeping an individual's property or assets into a financial product or real sectors with bigger value in the future. Debt behavior is indicated in cash flow management indicators which measures the ability of a person to pay for all of his expenses on time. An individual's *financial behavior* is reflected to the extent of how he spends on a regular basis including the types of items that he bought and why he bought it (Ida & Dwinta, 2010). *Herding behavior* is one of the types of bias, in which individuals tend to imitate others' actions and or base decisions on other's actions. The indicators in measuring the variable *of herding behavior* includes buying a trend item, and buying investment goods, services or products due to the influence of their friends.

Suryanto (2017) asserts that each individual has different characteristics and tendencies *of financial behavior* as a result of the factors that affect the individual either internally or externally. One of the internal factors affecting financial behavior is personality. Traits or characteristics of an individual that are relatively attached to psychology are called personality. Each individual is different and has different financial goals. Individuals can be categorized by their individual psychology or called personality types, that affect investor risk behavior, and which consequently affect investment value (Xiao et al., 2010). *Personality traits* are an important aspect of psychology in determining individual financial behavior.

*Traits* is a will from within the individual that oftentimes affects his behavior (Abood, 2019). The initial taxonomy *of personality traits* was based on a combination of lexical approach and statistical approach proposed by Allport and Odbert in 1936. Catell (1943) classified some traits into smaller units. Some researchers such as Tupes & Christal (1961), Norman (1963), Digman & Inouye (1981), McCrae & Costa (1985), Botwin & Buss (1989), replicated, simplified, gave descriptions in each structure into *five-factor model* (Larsen & Buss, 2017).

*The Big Five Personality Traits Model* was first introduced by Lewis Goldberg. *Big Five Personality Traits* comprises five key dimensions, *viz. Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism,* or commonly abbreviated as OCEAN.

*This five-factor model dimension* represents an important way, in which every human being has a different perspective in predicting the behavior being shown and future actions (McCrae & John, 1992). *Openness to experience* is *a* personality trait of a person interested in new things and having the desire to learn new things. An individual with such personality trait will be obsessed with new things of which he has not done (Costa & McCrae, 1989). *Conscientiousness* is a person's personality who tends to think carefully before doing something new or take some consequences into consideration before making a decision (Costa & McCrae, 1989). *Extraversion* is an individual known as a hard worker, easily motivated, ambitious, gregarious, easily challenged and have the tendency for boredom at the same time (Friedman &Schusack, 2016).- *Extraversion* is associated with one's level of comfort in interacting with others (Costa & McCrae, 1989). *Agreeableness* is the trait of an individual that tends to be more compliant and/or agree with others and tends to avoid conflicts (Costa & McCrae, 1989). Neuroticism reflects the individual with emotional instability related to high anxiety and sensitivity (John et al., 2008). *Neuroticism is* the individual that gets nervous easily, unconfident, gets infatuated easily and fear (Costa & McKrae, 1989).

A range of studies reported *that personality traits* have a significant effect on one's financial behavior. A study conducted by Ozel & Mutlu (2019) revealed *conscientiousness, agreeableness,* and *openness to experience* has a positive and significant effect on *financial behavior*. This is in line with research results of (Mayang (2021), Andriyani (2018), Humaira & Sagoro (2018), Donnelly, Lyer & Howel (2012) showing that personality (*extraversion, neuropathy, openness to experience, conscientiusness,* and *agreeableness)* has a significant effect on financial behavior. However, this finding differs from (Pinjisakikool, 2018) research which discovered that *big five personality traits* as instrumental variables could not directly predict the *financial behavior of a household*.

The research that previously mentioned examines the effect of personality on financial behavior as a whole. There have been no studies investigating the effect of such personality traits on financial behavior comprising investment behavior, debt behavior, purchasing behavior and herding behavior. Therefore, the aim of this study is to obtain more detailed empirical evidence compared to previous studies.

## II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT
### Literature Review
### 2.1 Financial behavior
*Financial behavior* is the capability of an individual in managing (budgeting, planning, checking, managing, controlling, making, and keeping) funds or finances in everyday life (i.e., Kholilah & Iramani, 2013). According to (Dew & Xiao, 2013), *financial behavior* covering three financial dimensions, which are:

*1. Consumption*
Consumption is the expense of various goods and services. An individual's *financial behavior* is reflected to the extent of how he spends on a regular basis including the types of items that he bought and why he bought them (Ida & Dwinta, 2010).

*2. Cash-flow management*
Cash flow management can be measured from whether one pays the bill on time, noticing the invoices and creating a financial budget and future planning (Hogarth & Hilgert, 2003).

*3. Saving and Investment*
Savings can be defined as part of unconsumed income for a given period. Investment is allocating or cultivating current resources with the aim of getting benefits in the future.

*Financial behavior* is an individual's behavior when he manages his own personal finances viewed from the psychological perspective and the habits that individual has in making his financial decisions (Humaira & Sagoro, 2018). *Financial behavior* was established based upon a range of assumptions and ideas of economic behavior. Emotional involvement, joy, nature and a range of other factors inherent in human beings have the potential to lead to irrational decision-making (Budiarto and Susanti, 2017). Psychological influence such as traits and character is the strongest factor that affects a person's financial behavior.

Many factors contribute to individual financial behavior characteristics, either from external factors or internal factors. One of the internal factors affecting financial behavior is personality. Today, a number of psychologists believe that the best representation of *personality traits is under* the *Big Five Model.* John, Donahue, & Kentle

(1991) divides personality dimension into five, including *openness to experience, conscientiousness, extraversion, agreeableness and neuroticism (OCEAN)*.

According to Herdjiono and Damanik (2016), the financial behavior variable is measured in reference to the indicators of making an investment, paying off the dues or debt on time, making careful consideration before purchasing goods, and financial budget planning. In this study, financial behavior variables are accessible by investment behavior, debt behavior, purchasing behavior and herding behavior.

### 2.1.1 Investment behavior

Investment is keeping some funds at the current time with the hope of making profits in the future. In making investment decisions, investors need detailed information which holds an important factor as a basis to determine investment choices. Investors consider *trade-offs* between the expected return rate and potential risk that may be faced in their investment decision making.

Investment behavior is the behavior prioritizing for keeping an individual's property or assets into a financial product or real sectors with bigger value in the future. In this research, the indicators used to measure the investment behavior variable include:

1. Investment for future welfare

2. Looking for a myriad of information on the investment choices

3. Considering the potential return rate of the investment

4. Considering potential investment risks

An investor's psychological strait as reflected from his personality has the potential to influence an individual's perception of his investment risk. A study carried out by Pak and Mahmood (2013) proved that *extraversion, conscientiousness and openness to experience* will be more likely to choose an investment instrument with high risk, while the personality traits of *agreeableness* and *neuroticism* will be more likely to choose an investment instrument with low risk.

Based on the findings of Helena & Widjaja (2020), it was discovered that *conscientiousness* and *neuroticism* have an effect on investor investment decisions. This is because the individuals with the conscientiousness trait will be more careful in making decisions, while the positive neuroticism trait tends to be more calm in making funding decisions. In the meantime, *openness to experience, extraversion,* and *agreeableness* have no effect on investor's investment decision making as investors tend to be rational in making investment decisions. Investors may seek a myriad of information and have no tendency to hear others' opinions.

### 2.1.2 Debt behavior

Each individual's personality affects and plays an active role in daily activities. This can be reflected in the behavior of individuals in managing their own debt. An individual's debt behavior is related to the ability of a person to pay off and tackle debts and their bills in a timely manner.

According to a study conducted by Kurnia (2012), *conscientiousness* has a significant effect on credit card use, while *neuroticism* has no significant effect on the use of credit cards. With regard to making shopping decisions, *people with a conscientiousness trait*, seriously consider buying an item within his means and benefits, how much money or salary he currently has, and the monthly credit card bills (Kurnia, 2012). As a result, individuals with a conscientiousness trait have efficient financial management in making purchase decisions which will enhance their ability to pay off debts and bills in a timely manner.

*Neuroticism* is a personality characteristic that has the tendency of failing to control himself during shopping, and has high satisfaction after doing it. This would in the end lead to the mounting credit card bill every month, or credit card interests. Therefore, *neuroticism may potentially lose an individual's* ability to pay off his debts and bills.

### 2.1.3 Purchasing behavior

Personality may affect an individual's purchase behavior, in which the consumer's personality leads to his behavior, making it the tendency for the individual to choose a product that matches his personality. A number of studies demonstrate varying results in the relationships between personality and purchasing decisions (Jariah, 2012; Onu J. C, Akhimien E, 2014; Santy, 2018; Shakaib Farid & Ali, 2018; Udo-Imeh, 2015; Verplanken & Herabadi, 2001)

Udo-Imeh (2015) posited that there is a relationship between personality type and purchase decision, including *openness to experience, extraversion, conscientiousness, agreeableness and neuroticism* despite neuroticism giving the slightest contribution compared to other personality traits. Quintelier (2014) added that openness could specifically direct customers to behave. Individuals with a high conscientiousness trait in buying a product will gain as much information as possible about the product (Ali & Mohammad, 2014). Individuals with a conscientiousness *trait* have a negative relationship with impulsive purchase (Shakaib Farid & Ali, 2018; Verplanken & Herabadi, 2001). Verplanken and Herabadi (2001) reveals that an individual who has an *extraversion trait* has a positive relationship with the purchase behavior. However, these dimensions have no relationship with impulsive purchase. Individuals with a positive neuroticism trait have a positive relationship with impulsive purchases (Shakaib Farid & Ali, 2018). However, Sofi and Najar (2018) findings were opposite where *neuroticism* is found to have a negative relationship with impulsive purchases.

### 2.1.4 Herding behavior

*Herding behavior* is one of the approaches used to indicate investor's behavior. *Herding* in the financial sector is defined as driving behavior which means the process where an economic agent imitates others' action and bases their decision on the actions of others.

Based on the results of the research conducted by Fitriati et al. (2020), it was discovered that the conscientiousness trait has a positive and significant effect on *herding behavior*. This is due to the fact that individuals with high *conscientiousness* tend to be compliant, self-controlled and ambitious individuals that have the tendency to have herding behavior. Investors with an openness *to experience* trait will choose to seek out new investment information through newspapers and institutional investors in order to generate herding behavior (Bashir & Tanvir, 2013). Individuals with extravert personalities tend to be gregarious, firm and sociable. They have many friends and enjoy exchanging information that may lead *to a herding behavior.* According to Zaidi & Tauni (2012) *agreeableness trait* is characterized by being friendly, kind, generous, helpful and loving to compromise and work with others. As a result, individuals with *agreeableness* traits may be affected by herding behavior.

Investors with *neuroticism* tend to feel anxious, i'll-emotional and nervous and easily depressed thus denting self-confidence (Lin, 2011). Low self-confidence reflects an individual's uncertainty about his abilities, thus allowing *neuroticism* to affect *herding behavior.*

### 2.2 Personality Traits

Personality is a set *of traits* and psychological mechanisms within an organized individual that last a long time and influences interaction, adaptability, physical environment, intrapsychic environment and social environment (Larsen & Buss, 2017).

According to Crysel et al. (2013) personality is how an individual interacts, reacts and acts with other individuals and is often demonstrated through measurable characteristics. Personality is a critical psychological aspect of defining individual behavior.

One of *the most* popular personality traits theories is the "*Big Five Personality Traits Model*" put forward by a famous Psychologist Lewis Goldberg. *The big five personality traits* are *the traits* of the basic personality of a person that predicts and explains one's behavior in performing an action. This personality dimension comprises five factors, viz.: *openness to experience, conscientiousness, extraversion, agreeableness* and *neuroticism* (OCEAN).

1. *Openness to Experience* (O) is the personality that loves new things. This individual has imaginative, creative and knowledgeable traits. The personality with these characteristics also reflects an idealist, highly intellectual and cunning individual who enjoys adventure (John et al., 2008). These individuals tend to harness their emotions and fantasies in their decision-making approach (Joyce & L, 2013).

2. *Conscientiousness* (C) is an individual who shows a stable and unaffected behavior. This personality is owned by those who are prudent in taking an action or are full of consideration when making a decision. This personality *trait is* described as being diligent, disciplined, and conscious in making a decision, and tend to be more rational in determining their investments choices (Joyce & L, 2013).

3. *Extraversion* (E) is a personality that is oriented towards an external environment. The characteristics of this trait include being sociable, firm, and having strong leadership qualities (John et al., 2008). Individuals with these characteristics tend to be optimistic, have strong ambition and are over confident in making investment decisions (Joyce & L, 2013).

4.   *Agreeableness* (A) reflects individuals with warm, courteous, welcoming and forgiving personality. These individuals are humble and tend to put other's interests first as they have high empathy, so that they make easier and simpler decisions (Joyce & L, 2013).

5.   *Neuroticism* (N) reflects individuals with emotional instability associated with high and overly sensitive anxiety(John et al., 2008). These individuals tend to have pessimistic paradigms that may potentially influence their willingness to assume investment risk (Joyce & L, 2013).

**Hypotheses development**

*Opens to experience* trait has insatiable curiosity and inquisitiveness making the individuals active to find as much information on potential investment choices as possible. (Mayfield et al., 2008) discovered that individuals *with this trait* have the tendency to engage themselves in a long-term investment. *Openness to experience* has a strong relationship with risk-taking (Kowert & Hermann, 1997).

**H1: *Openness to experience have a positive effect* on investment behavior**

Individuals with *openness to experience* have tolerance to risk (Costa & McCrae, 1989). *Risk tolerance* is the parameter of individuals' willingness to receive results that may have gain or loss potentials (Halim & Astuti, 2015). It can be inferred that *openness trait* considers decision making based on risks. Paying debt and bills is an obligation that requires timely execution, and late payment contributes to a loss, thus, *openness to experience* may affect individuals in their debt behavior.

**H2: *Openness to experience has a positive effect* on investment behavior**

Openness *to experience* reflects a dynamic, flexible, action-oriented and knowledgeable individual. As a result, these individuals will drive individuals to take some consequences into consideration before making any purchase decision, and purchase within their means. The research undertaken by Santy (2018) discovered that *openness to experience has* a positive relationship with the purchase of the product of interest.

**H3: *Openness to experience has a positive effect* on purchasing behavior**

Individuals with these characteristics tend to harness their emotions and fantasies in their decision-making approach (Joyce & L, 2013).  Investors with *openness to experience* trait will choose to seek out new investment information through newspapers and institutional investors in order to generate herding behavior (Bashir & Tanvir, 2020)

**H4: *Openness to experience has a positive effect* on herding behavior**

*Conscientiousness* reflects individuals with discipline, conscientiousness and soundness in making decisions. This personality trait tends to do work thoroughly, diligently and efficiently, and do everything in a well organized manner.  As a result, this personality trait encourages individuals to consider return on investment rate and the risks that may be faced in their investment decisions. Personality *with these traits* tend to be more rational in determining their investments (Joyce & L, 2013).

**H5: *Conscientiousness* has a positive effect on investment behavior**

*Conscientiousness* is the personality that shows punctuality by doing everything efficiently. According to (Donnelly et al., 2012), meticulous individuals succeed in managing their money and finance, and have a positive retirement plan and savings behavior. This means that individuals with this personality trait are endowed with the ability to manage their money by paying bills and debts on time.

**H6: *Conscientiousness* has a positive effect on debt behavior**

*Conscientiousness* is a person's personality who tends to think carefully before doing something new or take some consequences into consideration before making a decision (Costa & McCrae, 1992). As a result, individuals with this personality trait will consider some consequences before making purchasing decisions, by choosing to buy the items corresponding to the functions and needs.

**H7: *Conscientiousness* has a positive effect on purchasing behavior**

Conscientiousness trait is an individual who acts with prudence before deciding to do something. Thus, these individuals are less likely to be affected by their packs or public information in purchasing decisions or making an investment.

**H8: *Conscientiousness* has a negative effect on herding behavior**

Individuals with these characteristics tend to be optimistic, have strong ambition and are over confident in making investment decisions (Joyce & L, 2013). In this case, individuals will tend to take higher investment risk and allow them to lose more profitable opportunities due to *their overconfidence (*Pak & Mahmood, 2013).

**H9: Extraversion has a negative effect on investment behavior**

Individuals with extroverted personalities prefer to make an investment on risky financial instruments such as mutual funds and shares (Pinjisakikool, 2017). These individuals prefer to buy higher-priced financial assets (Oehler et al., 2018). *Extraversion personality might* have credit cards (Brown & Taylor, 2014). Over self-confidence and the courage of taking higher risks may bring investors to bear greater risk, with the possibility of experiencing loss and causing the individuals to be unable to pay off their debts and their bills in a timely manner.

**H10: Extraversion has a negative effect on debt behavior**

Individuals *with an introverted personality trait* will fulfill his social needs by buying the desired items that seemingly fulfills his social needs, whereas an extrovert personality cares more about social needs than his own needs, making him buy the items that he really needs rather than he wants.

**H11: *Extraversion* have a positive effect on purchasing behavior**

*Extraversion* is a personality that is oriented towards an external environment. Individuals with this characteristic are seen as someone who is outgoing and sociable. *Extraversion personality* with many friends and keen to exchange information will be more easily affected by the people around and has the potential to develop *herding behavior.*

**H12: *Extraversion* has a positive effect on herding behavior herding**

*Agreeableness* reflects individuals who are skeptical — hesitant, easily influenced by opinions of close people, and avoid conflict. Consequently, individuals with this characteristic will tend to choose lower risk assets (Pak & Mahmood, 2013). This means that *agreeableness* affects individuals in their investment behavior by choosing lower risk assets.

**H13: *Agreeableness* has a positive effect on investment behavior**

According to Costa & McCrae (1988), and Mowen (2000), individuals with a*greeableness* traits tend to spend on the basis of impulse, empathic behavior, pity, and sociableness, making financial transactions based on the willingness to help and kindness. The outcome of Subiaktono's study (2013) revealed that agreeableness has a negative effect on family financial planning.

**H14: *Agreeableness* has a negative effect on debt behavior**

*Agreeableness* are individuals who are humble and tend to put other's interests first ahead of their interests as they have high empathy, so that they make easier and more efficient decisions (Joyce & L, 2013). According to Rammstedt & John (2007) *agreeableness* is individuals with friendly, honest behavior and tend to put others first ahead of their own interests, obedient, modest and sincere. This personality reflects a behavior that can control himself in purchasing decisions.

**H15: *Agreeableness* has a positive effect on purchasing behavior**

*Agreeableness* are individuals who show the pleasure of working with others, trustworthy, cooperative and tolerant (Neuman, Wagner, & Christiansen, 1999). *Agreeableness traits* tend to trust easily and have high social adaptability. The research results of Bashir, et al. (2013) suggest that individuals with high *agreeableness* tend to trust someone easily and therefore potentially fall into *herding behavior.*

**H16: *Agreeableness* has a positive effect on herding behavior**

Individuals with this personality tend to have low analytical and critical thinking capabilities which make them tend to take lower risks due to excessive anxiety when making high risk decisions. (Mayfield et al., 2008) discovered that individuals *with this trait* have the tendency to avoid themselves in a short-term investment. These individuals tend to have pessimistic paradigms that may potentially influence their willingness to assume investment risk (Joyce & L, 2013).

**H17: *Neuroticism* has a negative effect on investment behavior**

Individuals *with neuroticism traits* are easily nervous, unable to control their emotional stability, and are not able to control themselves when their purchasing desires are high. This type of individuals can potentially increase their consumptive behavior, in the end increase their debt, and consequently have no ability to manage their debt and bills effectively.

**H18: *Neuroticism* has a negative effect on debt behavior**

*Neuroticism* is closely related to the decision-making process to use goods or services not out of necessity but to satisfy the desire (Kurnia, 2012). The higher the influence of *neuroticism trait, the more* consumptive behavior is created that demonstrates poor purchasing behavior. *In this case, neuroticism* has a negative effect on purchasing behavior.

**H19:** *Neuroticism* **has a negative effect on purchasing behavior**

*Neuroticism* is individuals who cannot control their emotional stability, thus these types of individuals are easily fooled with their emotion to buy trending things, and are affected by the decision of their herds to buy things, services, or investment products.

**H20:** *Extraversion* **has a positive effect on herding behavior**

Based on the development of the hypothesis, the conceptual framework is described as follows :
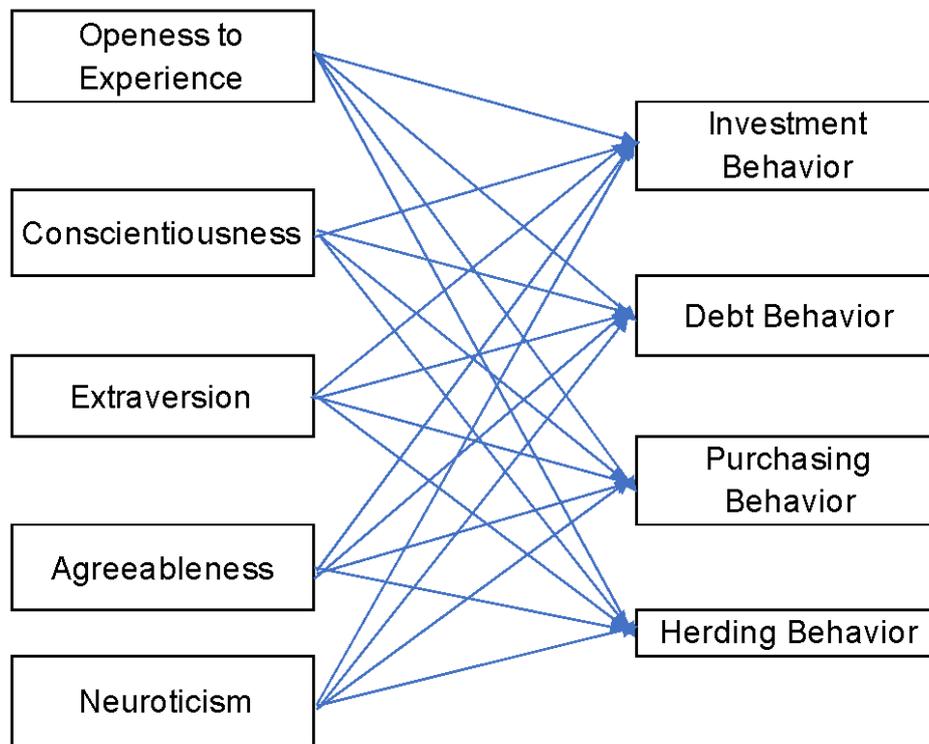


**Figure 1. Conceptual Framework**

## III. RESEARCH METHODOLOGY

This research is a quantitative research to examine the influence of personality on financial behavior. A total of 400 Indonesians were involved as respondents in this study. The data were gathered through questionnaires. To record the score for each personality type, we used commonly known instruments by professional psychologists. Measurement of financial behavior is done through questions in the questionnaire. In this research, the method of data analysis used is *structural equation modeling-partial least square* (SEM-PLS) using SmartPLS software.

The variables used are as follows:

X1 = openness to experience

X2 = conscientiousness

X3 = extraversion

X4 = agreeableness

X5 = neuroticism

Y1.1 = investment behavior

Y1.2 = debt behavior

Y1.3 = purchasing behavior

Y1.4 = herding behavior

## IV. RESULTS AND DISCUSSION

*Outer Model Evaluation*: Validity and Reliability Tests

Convergent validity is part of *the measurement model* which is commonly referred to as *Outer Model* in SHEM-PLS and *referred to as Confirmatory Factor Analysis* (CFA) *in covariance-based* SEM.

There are two criteria to assess whether *the* measurement model meets the convergent validity requirement for the reflective construct, namely (1) *loading* of above 0.7 and (2) significant p value (<0.05).

If the indicators with *loading value* below 0.40, it should be removed from the model. But for the indicator with *loading values* between 0.40 and 0.70, an analysis can be done on the impact of the decision to remove the indicator in *average variance extracted* (AVE) and *composite reliability*. We can remove the indicator with *loading values of* between 0.40 and 0.70, if the indicator can increase *the average variance extracted* (AVE) and *composite reliability* above the *threshold*. The AVE threshold value is 0.50 and *the composite reliability* is 0.7. Table 4.1 presents *loading values* for each indicator.

### Table 4.1 Validity Test based on Loading Factors Level 1

|  | X1 | X2 | X3 | X4 | X5 | Y1.1 | Y1.2 | Y1.3 | Y1.4 |
|---|---|---|---|---|---|---|---|---|---|
| X1 | 1,000 |  |  |  |  |  |  |  |  |
| X2 |  | 1,000 |  |  |  |  |  |  |  |
| X3 |  |  | 1,000 |  |  |  |  |  |  |
| X4 |  |  |  | 1,000 |  |  |  |  |  |
| X5 |  |  |  |  | 1,000 |  |  |  |  |
| Y1.1.1 |  |  |  |  |  | 0,679 |  |  |  |
| Y1.1.2 |  |  |  |  |  | 0,869 |  |  |  |
| Y1.1.3 |  |  |  |  |  | 0,895 |  |  |  |
| Y1.1.4 |  |  |  |  |  | 0,876 |  |  |  |
| Y1.2.1 |  |  |  |  |  |  | 0,848 |  |  |
| Y1.2.2 |  |  |  |  |  |  | 0,951 |  |  |
| Y1.3.1 |  |  |  |  |  |  |  | 0,927 |  |
| Y1.3.2 |  |  |  |  |  |  |  | 0,783 |  |
| Y1.4.1 |  |  |  |  |  |  |  |  | 0,933 |
| Y1.4.2 |  |  |  |  |  |  |  |  | 0,862 |
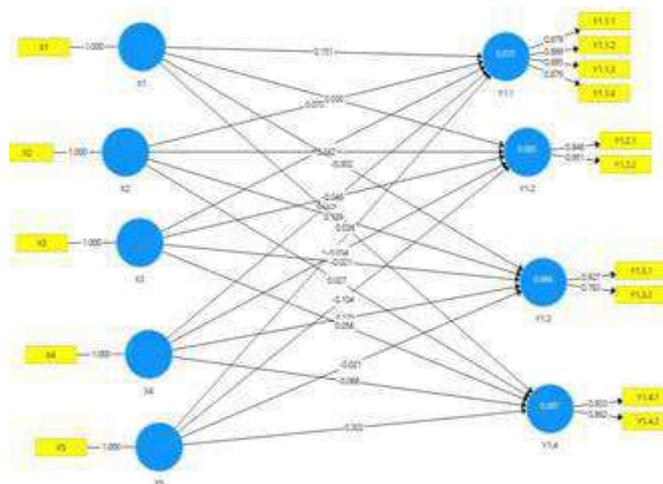


**Figure 4.2 Validity Test based on Loading Factors Level 1**

Based on validity testing of the loading factor in Table 4.1 and Figure 4.2, indicator Y1.1.1 was found as invalid since the loading factor value = 0.679 < 0.7. Next, the loading factor test was reperformed without involving indicator Y1.1.1.

### Table 4.2 Validity Test based on Loading Factors Level 2

| 5.5 | X1 | X2 | X3 | X4 | X5 | Y1.1 | Y1.2 | Y1.3 | Y1.4 |
|---|---|---|---|---|---|---|---|---|---|
| X1 | 1,000 |  |  |  |  |  |  |  |  |
| X2 |  | 1,000 |  |  |  |  |  |  |  |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **X3** | | | 1,000 | | | | | | |
| **X4** | | | | 1,000 | | | | | |
| **X5** | | | | | 1,000 | | | | |
| **Y1.1.2** | | | | | | 0,887 | | | |
| **Y1.1.3** | | | | | | 0,907 | | | |
| **Y1.1.4** | | | | | | 0,890 | | | |
| **Y1.2.1** | | | | | | | 0,848 | | |
| **Y1.2.2** | | | | | | | 0,951 | | |
| **Y1.3.1** | | | | | | | | 0,927 | |
| **Y1.3.2** | | | | | | | | 0,783 | |
| **Y1.4.1** | | | | | | | | | 0,933 |
| **Y1.4.2** | | | | | | | | | 0,862 |
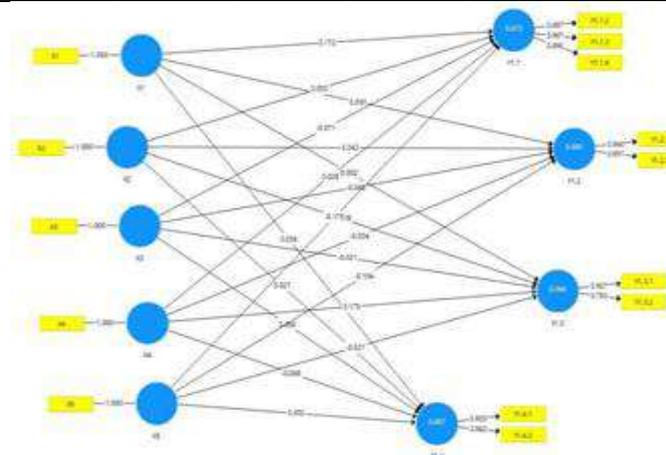


**Figure 4.3 Validity Test based on Loading Factors Level 2**

Based on validity testing of the loading factor in Table 4.2 and figure 4.3, it was found that all loading values > 0.7, which means that the validity requirements are met based on loading value. Then, a validity test was perform*ed based on the average variance extracted* (AVE) value.

**Table 4.3 Validity Test based on Average Variance Extracted (AVE)**

| | **Average Variance Extracted (AVE)** |
|---|---|
| **X1** | 1,000 |
| **X2** | 1,000 |
| **X3** | 1,000 |
| **X4** | 1,000 |
| **X5** | 1,000 |
| **Y1.1** | 0,800 |
| **Y1.2** | 0,811 |
| **Y1.3** | 0,736 |
| **Y1.4** | 0,806 |
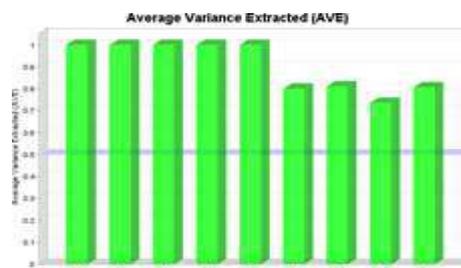


**Figure 4.4 Validity Test based on Average Variance Extracted (AVE)**

The suggested AVE values are above 0.5. All AVE values are found > 0.5, thus the validity requirements are met. Then, the validity test was performed *based on composite reliability* (CR) value.

**Table 4.4 Reliability Test based on Composite Reliability (CR)**

|  | Composite Reliability |
|---|---|
| X1 | 1.000 |
| X2 | 1.000 |
| X3 | 1.000 |
| X4 | 1.000 |
| X5 | 1.000 |
| Y1.1 | 0.923 |
| Y1.2 | 0.895 |
| Y1.3 | 0.847 |
| Y1.4 | 0.893 |
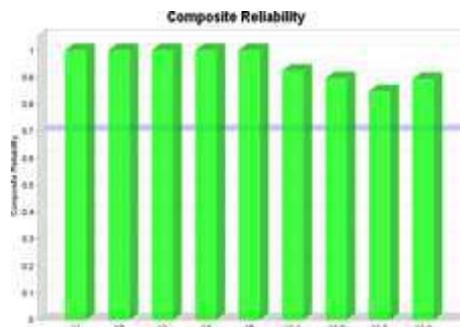


**Figure 4.5 Reliability Test based on Composite Reliability (CR)**

The suggested CR values are above 0.7 . All CR values are found > 0.7, thus they meet the CR based reliability requirements. Then, discriminatory validity test was performed with Fornell-Larcker approach. Table 4.5 presents the discriminant validity test results.

**Table 4.5 Discriminant Validity Test**

|  | X1 | X2 | X3 | X4 | X5 | Y1.1 | Y1.2 | Y1.3 | Y1.4 |
|---|---|---|---|---|---|---|---|---|---|
| X1 | 1,000 |  |  |  |  |  |  |  |  |
| X2: | 0,388 | 1,000 |  |  |  |  |  |  |  |
| X3: | 0,387 | 0,402 | 1,000 |  |  |  |  |  |  |
| X4: | 0,392 | 0,321 | 0,138 | 1,000 |  |  |  |  |  |
| X5: | -0,015 | -0,477 | -0,252 | -0,068 | 1,000 |  |  |  |  |
| Y1.1: | 0,179 | 0,184 | 0,064 | 0,115 | -0,187 | 0,895 |  |  |  |
| Y1.2: | 0,094 | 0,273 | 0,083 | 0,056 | -0,206 | 0,468 | 0,901 |  |  |
| Y1.3: | 0,113 | 0,196 | 0,063 | 0,217 | -0,094 | 0,260 | 0,249 | 0,858 |  |
| Y1.4: | 0,037 | -0,103 | -0,005 | -0,058 | 0,279 | -0,008 | -0,131 | -0,230 | 0,898 |

In the discriminant validity test, the AVE square root value of a latent variable, compared to the correlation value between the latent variable and the other latent variables. It is found that the square root value of AVE for each latent variable is greater than the correlation value between the latent variable and the other latent variables. It is therefore concluded that the validity requirements are met.

## 4.1 Effect Significance Test (Bootstrapping)

The following are the results of the effect significant test as can be seen in Table 4.6:

**Tabel 4.6 Significance Test**

|  | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|---|---|---|
| X1 -> Y1.1 | 0.151 | 0.154 | 0.055 | 2.756 | 0.006 |
| X1 -> Y1.2 | 0.030 | 0.030 | 0.069 | 0.430 | 0.668 |
| X1 -> Y1.3 | -0.002 | 0.000 | 0.065 | 0.028 | 0.977 |
| X1 -> Y1.4 | 0.036 | 0.036 | 0.058 | 0.619 | 0.537 |
| X2 -> Y1.1 | 0.070 | 0.072 | 0.072 | 0.974 | 0.331 |
| X2 -> Y1.2 | 0.242 | 0.242 | 0.073 | 3.314 | 0.001 |
| X2 -> Y1.3 | 0.139 | 0.142 | 0.065 | 2.140 | 0.033 |
| X2 -> Y1.4 | 0.027 | 0.034 | 0.067 | 0.404 | 0.687 |
| X3 -> Y1.1 | -0.043 | -0.046 | 0.074 | 0.577 | 0.564 |
| X3 -> Y1.2 | -0.048 | -0.045 | 0.063 | 0.752 | 0.452 |
| X3 -> Y1.3 | -0.021 | -0.021 | 0.061 | 0.351 | 0.725 |
| X3 -> Y1.4 | 0.056 | 0.055 | 0.059 | 0.946 | 0.345 |
| X4 -> Y1.1 | 0.025 | 0.029 | 0.057 | 0.440 | 0.660 |
| X4 -> Y1.2 | -0.034 | -0.036 | 0.061 | 0.562 | 0.575 |
| X4 -> Y1.3 | 0.175 | 0.175 | 0.058 | 2.997 | 0.003 |
| X4 -> Y1.4 | -0.068 | -0.067 | 0.059 | 1.163 | 0.245 |
| X5 -> Y1.1 | -0.162 | -0.168 | 0.064 | 2.519 | 0.012 |
| X5 -> Y1.2 | -0.104 | -0.106 | 0.073 | 1.418 | 0.157 |
| X5 -> Y1.3 | -0.021 | -0.021 | 0.064 | 0.328 | 0.743 |
| X5 -> Y1.4 | 0.302 | 0.304 | 0.059 | 5.102 | 0.000 |

### 1. *The effect of Openness to Experience* on Investment behavior

*Openness to experience* (X1) has a beta coefficient value of 0.151 and t-statistic of 2.756 with P-values = 0.006 < 0.05. Thereby, the *variable of openness to experience* has a positive and significant effect on investment behavior. If *openness to experience* increases, then individual investment behavior will increase significantly, the vice versa.

*Openness to experience* is *a* personality trait of a person interested in new things and having the desire to learn new things. Insatiable curiosity and inquisitiveness make the individuals active to find as much information on potential investment choices as possible. *Openness to experience* is an individual who is tolerant of risks (Donnelly et al., 2012). This means that investors with this personality will still be willing to accept risks that may arise in an investment instrument. In this case, individuals with an openness *to experience trait* affects their behavior to consider the risks that might be faced in their investment decision.

The higher the level of risk tolerance that investors have, the more inclined the investor to invest in risky assets (Hariharan et al, 2000).

The findings of Pinjisakool (2018) demonstrates that *openness to experience trait* preferred risky financial instruments including mutual funds and shares. This is congruent with the findings of Pak & Mahmood (2013) which asserts that *openness to experience tends* to choose investment instruments with high risks. A study undertaken by Mayfield, et. al. (2008) discovered that individuals *with this trait* have the tendency to engage themselves in a long-term investment.

### 2. *The effect of Openness to Experience* on Debt behavior

It was found that *Openness to Experience* (X1) has a beta coefficient value of 0.030 and t-statistic of 0.430 with P-values = 0.668 < 0.05. Accordingly, the *variable of openness to experience* has a positive and significant effect on debt behavior.

*Openness* is the personality that tends to be creative, adaptive, more curious and tend to do new experiments, thus making them curious and tend to take higher risks (Pak & Mahmood, 2013). Individuals with these

characteristics tend to harness their emotions and fantasies in their decision-making approach (Joyce & L, 2013).

In this research, there is no significant effect between *openness to experience* and debt behavior. This may happen as those with *openness* have high risk tolerance, making them willing to tolerate the risks that might arise once their debts and bills fail to be paid in time.

### 3. *The Effect of Openness to Experience* on Purchasing Behavior
It was found that *Openness to Experience* (X1) has a beta coefficient value of -0.002 and t-statistic of 0.028 with P-values = 0.977 < 0.05. As such, the *variable of openness to experience* has a negative and insignificant effect on purchasing behavior.

*Openness to experience has* high curiosity, original, imaginative, dynamic, flexible, action-oriented and knowledgeable.

Our study leads to the findings that *openness to experience* has a negative and insignificant effect on purchasing behavior. The negative influence can be caused by this personality being more dominant in preferring things that have artistic and esthetic values, music, art and literature, where individual that tend to make it a hobby and be fanatic in a certain way will have the tendency to buy goods that are not really needed, or just driven by his passion and insistence. However, in this research, there is no significant effect between *openness to experience* and purchasing behavior.

These findings are inconsistent with Santy's (2018) which found *that openness to experience trait* has a positive relationship with the purchase of the products of interest and Quintelier (2014) which discovered that individuals with *openness to experience* will specially guide the consumer toward their behavior.

### 4. The Effect of *Openness to experience on* Behavior Herding
It was found that *Openness to Experience* (X1) has a beta coefficient value of 0.036 and t-statistic of 0.619 with P-values = 0.537 < 0.05. Accordingly, the *variable of openness to experience* has a positive and insignificant effect on herding behavior.

According to Hamlet & John (2007)*, the openness* trait is the personality with fantasy, acting on feelings, and appreciating the others' opinions. In this research, there is no significant effect between *openness to experience* and herding behavior. This is triggered by the fact that investors with higher scores of openness to experience traits are more open-minded, leaving them to stick to their decision or avoid herding behavior.

The results of this study are congruent with the findings of Fitriati, Mansyur and Pradita (2020) which discovered that *openness to experience has no* significant effect on *herding behavior.*

### 5. The Effect *of Conscientiousness on* Investment behavior
It was found that *Conscientiousness* (X2) has a beta coefficient value of 0.070 and t-statistic of 0.974 with P-values = 0.331 < 0.05. Accordingly, *conscientiousness* has a positive and insignificant effect on investment behavior.

Individuals with *conscientiousness traits* show neatness, accuracy, and efficiency. According to Pak & Mahmood (2013) *conscientiousness* is shown by an individual who tends to be well organized, reliable, persistent and timely, and makes careful consideration when it comes to making a decision.

In the present study, individuals with *conscientiousness are not* affected by investment behavior. This might occur due to the fact that individuals with this personality trait prefers a banking deposit instrument to a capital market instrument (share, mutual fund, and obligation). This could be possibly due *to* its more stable, less susceptible personality and making decisions based on knowledge and efficiency.

### 6. The Effect *of Conscientiousness on Debt* Behavior
It was found that *conscientiousness* (X2) has a beta coefficient value of 0.242 and t-statistic of 3.314 with P-values = 0.001 < 0.05. Accordingly, conscientiousness has a positive and significant effect on debt behavior. If *conscientiousness* increases the better an individual's behavior in controlling their debts.

*Conscientiousness* is shown by the individuals who are diligent, disciplined and conscientious in making a decision. According to Donnelly et al. (2012), individuals with conscientiousness traits are more careful to control their money. According to Donnelly et al. (2012), meticulous individuals succeed in managing their money and finance, and have a positive retirement plan and savings behavior.

The effect of *conscientiousness* on one's personality shows that the more accurate, careful and organized a person, the higher sense of responsibility and sensitivity he has to manage his finances by always paying off debt and bills on time.

Kurnia's findings (2012) inferred that there is a positive relationship between credit card use and conscientiousness, where an individual with *conscientiousness trait* tends to be more careful and cautious when using credit cards. In line with Supramono & Idriani's research (2008) on misappropriation of credit card use, *that conscientiousness* will give positive drive during decision-making and when purchasing with credit card. Individuals with *conscientiousness* traits take risks into careful consideration whenever credit cards are to be used.

### 7. *The effect of conscientiousness* on [purchasing behavior

It was found that *conscientiousness* (X2) has a beta coefficient value of 0.139 and t-statistic of 2.140 with P-values = 0.033 < 0.05. Accordingly, conscientiousness has a positive and significant effect on purchasing behavior. It shows that the higher *the consciousness of an individual*, the better the individual in his purchasing behavior.

According to Feist & Gregory (2008), individuals with *conscientiousness traits* are generally careful, reliable and organized and responsible for decisions. Individuals with high conscientiousness trait

in buying a product will get as much information as possible about the product, on the other hand, individuals with a conscientiousness trait in buying a product, will make them less likely to find information about the products to purchase (Ali & Mohammad, 2014). In this case, an individual will consider purchasing decision by searching for information related to the products to be chosen so that he will choose what is appropriate based on its function and necessity, and within his means.

Individuals with conscientiousness trait have higher lifetime income, greater financial wealth, and higher net worth (Aesbedo, 2018). This means that individuals with *conscientiousness traits* have an efficient behavior in managing their money, thereby improving their purchasing behavior.

This finding is in line with that of Setiawati & Nasution (2019) which found that *conscientiousness* has a positive and significant effect on purchasing decisions.

### 8. *The Effect of Conscientiousness* on
### Herding Behavior

It was found that *conscientiousness* (X2) has a beta coefficient value of 0.027 and t-statistic of 0.404 with P-values = 0.687 < 0.05. Accordingly, conscientiousness has a positive and insignificant effect on herding behavior. According to Rammstedt & John (2007), *a conscientiousness* trait is shown by individuals who are compliant, instruction-oriented, and hard-working. In the present study, *conscientiousness has a* positive or insignificant effect on *herding behavior*. The positive effect occurs since one of the characteristics owned by individuals with a conscientiousness trait is that the individual has a tendency to follow the same action as his herd. However, there is no significant effect between *conscientiousness* and herding behavior as this personality trait tends to be more oriented on rationality in determining their investments (Pak & Mahmood, 2013).

This finding is not in line with that of Fitriati et al. (2020) which found that *conscientiousness trait* has a positive and significant effect on herding decision.

### 9. The Effect *of Extraversion on* Investment Behavior

It was found that *extraversion* (X3) has a beta coefficient value of -0.043 and t-statistic of 0.577 with P-values = 0.564 < 0.05. Thereby, *extraversion* has a negative and insignificant effect on investment behavior.

Individuals with these characteristics tend to be optimistic, have strong ambition and are over confident in making investment decisions (Joyce & L, 2013). Pak & Mahmood (2013) found *that extraversion personality* tends to choose investment instruments with high risks. This is in line with the study conducted by Pinjisakool (2017) which found that the extraversion *trait* prefers to invest in risky financial instruments such as mutual funds and shares.

However, the present study found no significant effect between *extraversion* and investment behavior. This might occur since the individual with *extraversion traits* tends to take a higher risk of investment, thus enabling them to lose unparalleled opportunity due to overconfidence traits (Pak & Mahmood, 2013). Thus, the experience of his investment enables the individual to be rational in his decision-making.

This finding is not consistent with the finding of (Oehler et al., 2018) which revealed that *extraversion has a positive and significant effect on* individual behavior *in the experimental asset market*.

## 10. The Effect *of Extraversion on Debt* Behavior
It was found that extraversion (X3) has a beta coefficient value of -0.048 and t-statistic of 0.752 with P-values = 0.452 < 0.05. Thereby*, extraversion* has a negative and insignificant effect on debt behavior.

(Brown & Taylor, 2014) assert that individuals with *extraversion personality traits tend to* have credit cards. According to (Oehler et al., 2018), extrovert personality tends to buy risky financial assets at a higher price. Based on the results of this research*, extraversion traits* have a negative and insignificant effect on debt behavior. This is because extrovert's personalities tend to take higher risks to their financial assets, thus creating the possibility of greater loss which can reduce the individuals' ability to pay their debts and their bills on time.

However, in the present study, there is no significant effect between *extraversion and* debt behavior, meaning that the higher an individual's extraversion, no effect is created on individuals' ability to manage their debts.

11. The effect of extraversion on Purchasing behavior It was found that extraversion (X3) has a beta coefficient value of -0.021 and t-statistic of 0.351 with P-values = 0.725 < 0.05. Thereby*, extraversion* has a negative and insignificant effect on purchasing behavior.

*Extraversion trait* has high enthusiasm, is sociable, has positive emotion, is energetic, ambitious, friendly, love making relationships with others, dominant in their herd, and can predict the development of social relationships (McCrae & John, 1992); Pervin & John, 2005). It can be concluded that individuals with *extraversion traits* will find more information about the products to be purchased (Iskandar and Zulkarnain, 2013).

However, *in this study, extraversion traits* have a negative effect and insignificant effect on purchasing behavior. This may be because extrovert trait is the individual who dares to take a high risk and tend to withhold their lose, in the hope of getting back up (Jamshidi David et al.2012), therefore such behavior reflects individuals with lack capacity to manage its finances and consequently drive purchasing behavior that is beyond his means. In this study, there is no significant effect between *extraversion traits and purchasing* behavior. The results are in line with that of Setiawati & Nasution (2019) who claimed *that extraversion traits* have a negative effect and insignificant on purchasing decisions.

## 12. The Effect *of Extraversion on Herding* Behavior
It was found that extraversion (X3) has a beta coefficient value of 0.056 and t-statistic of 0.946 with P-values = 0.345 < 0.05. Accordingly, extraversion has a positive and insignificant effect on herding behavior. *Extraversion* is a personality that is oriented towards an external environment. *Extraversion* trait is individuals who are friendly, active, talkative, social-oriented, optimistic, lovely, affectionate and friendly (Pak & Mahmood, 2013).

In this research, it was found that there is no significant effect between *extraversion trait and herding behavior*. This might happen because the extraversion *trait has* high optimism and self confidence, so that they are not easily affected by the trend and purchasing decision of their herd.

13. The effect of *Agreeableness* on Investment Behavior It was found that *agreeableness* (X4) has a beta coefficient value of 0.025 and t-statistic of 0.440 with P-values = 0.660 < 0.05. Thereby*, extraversion* has a positive and insignificant effect on investment behavior.

Agreeableness trait is individuals who are humble and tend to put other's interests first ahead of theirs as they have high empathy, so that they make easier and more efficient decisions (Joyce & L, 2013). According to Pak & Mahmood (2017), personality with this trait tends to choose low risk assets. Pinjisakool (2018) added that *agreeableness trait* prefers to invest in safe instruments like fixed-income products. *Agreeableness traits* include *investors with risk averse*, i.e. investors who look for low risk opportunities to reduce potential loss. In can be inferred that individuals with *agreeableness personality* is conservative investors who give priority to security guarantee on return, generating no effect between *agreeableness* on investment behavior as the individual consider no *potential return rate which is* in line with investment principle of *high risk high return, where the higher the risk the higher* the return.

## 14. The Effect *of Agreeableness on Debt* Behavior
It was found that agreeableness (X4) has a beta coefficient value of -0.034 and t-statistic of 0.562 with P-values = 0.575 < 0.05. Thereby*, extraversion* has a negative and insignificant effect on debt behavior.

According to Costa & McCrae (1988), and Mowen (2000), individuals with a*greeableness* traits tend to spend on the basis of impulse, empathetic behavior, pity, and sociableness, making financial transactions based on the willingness to help and kindness.

According to (Nyhus & Webley, 2001), individuals with *agreeableness* tend to save less.

In the current study, it was found that there is no significant effect between *agreeableness and* debt behavior. This might occur since individuals with *agreeableness* are more sensitive to give help and show sympathetic behavior, but they still show lack sensitivity and high awareness in managing their finances, thus they fail to pay their debts and bills in a timely manner. It can be seen from their behavior of not saving on a regular basis.

### 15. The Effect *of Agreeableness on Purchasing* Behavior
It was found that agreeableness (X4) has a beta coefficient value of 0.175 and t-statistic of 2.997 with P-values = 0.003 < 0.05. Accordingly, agreeableness has a positive and significant effect on purchasing behavior.

*Agreeableness* (A) reflects individuals with warm, courteous, welcoming and forgiving personality. These individuals are humble and tend to put other's interests first as they have high empathy, so that they make easier and simpler decisions (Joyce & L, 2013).

Individuals who are weak, forgiving, sincere, obedient, show high empathy, tend to put others' interests ahead of theirs, and simply reflect behavior that does not have a passion, desire or high satisfaction in their purchasing behavior, thus these individuals with agreeableness trait tend to control themselves whenever they make purchasing decisions. This trait drives the individuals to purchase the goods that are functional and really needed as well as making a purchase within their means.

However, this finding is different from the finding of Setyoningrum (2020) which states that there is a positive relationship between *agreeableness and* impulsive buying. In *impulsive buying*, the purchase is made spontaneously and carelessly. In this study, individuals with *agreeableness traits* tend to buy something that they do not really need.

### 16. The Effect *of Agreeableness on Herding* Behavior
It was found that agreeableness (X4) has a beta coefficient value of -0.068 and t-statistic of 1.163 with P-values = 0.245 < 0.05. *Consequently, agreeableness* has a negative and insignificant effect on *herding behavior.*

Agreeableness is individuals who show the pleasure of working with others, are trustworthy, cooperative and tolerant (Neuman et al., 1999). In the present study*, agreeableness trait* that tends to trust easily and have high *social adaptability* does not necessarily encourage *herding behavior*. In fact, with *high social adaptability*, this individual can receive public information so as not to easily follow others or fall into herding behavior.

The results of this study are in line with the findings of Fitriati et al. (2020), which suggest that *agreeableness* trait has no significant effect on *herding behavior.*

### 17. The Effect *of Neuroticism on* Investment Behavior
It was found that Neuroticism (X5) has a beta coefficient value of -0.162 and t-statistic of 2.519 with P-values = 0.012 < 0.05. *Accordingly, the Neuroticism variable* has a negative and significant effect on investment behavior. If *neuroticism* increases, investment behavior will decrease significantly at the same time, vice versa.

*Neuroticism* reflects individuals with emotional instability associated with high anxiety and stress. These individuals tend to have pessimistic paradigms that may potentially influence their willingness to assume investment risk (Joyce & L, 2013).

This personality tends to have low analytical and critical thinking skills, that make them take a lower risk due to excessive anxiety when making high risk decisions (Pak & Mahmood, 2013).

According to the research, *it was found that neuroticism* has a negative and significant effect on investment behavior. This means that individuals who are easily nervous, over-anxious, and get panicked easily in making a decision may lead investors to be irrational in searching for investments related information, and consider high *return* and potential risks, as it is influenced by that psychological factor. *Consequently, neuroticism* can influence investors to make inaccurate investment decisions.

The higher the influence of *neuroticism trait* in any individual, the poorer the investment behavior as it is influenced by that personality.

Mayfield et al. (2008) discovered that individuals *with this trait* have the tendency to avoid themselves in a short-term investment.

## 18. The Effect *of Neuroticism on Debt* Behavior

It was found that Neuroticism (X5) has a beta coefficient value of -0.104 and t-statistic of 1.418 with P-values = 0.157 < 0.05. Accordingly, *the neuroticism* variable has a negative and insignificant effect on debt behavior.

John et al., (2008) describes *neuroticism as* being easily anxious, emotional, discomfort, less adaptable, and unreasonably sad. These individuals tend to have pessimistic paradigms that may potentially influence their willingness to assume investment risk (Joyce & L, 2013).

Individuals *with neuroticism* traits are unable to control themselves when shopping desire is at its peak and this individual can fall into consumptive behavior and consequently mount their debt.

There is, however, no significant effect of *neuroticism* on debt behavior. This might be due to being overly pessimistic, panicked and easily anxious and having no responsibility and high awareness of financial management, including the ability to pay off debts and bills on time.

The research findings of Kurnia (2012) inferred that *neuroticism as* characterized by *emotional instability has no effect on* credit card use.

## 19. The effect of Neuroticism on Purchasing behavior

It was found that Neuroticism (X5) has a beta coefficient value of -0.021 and t-statistic of 0.328 with P-values = 0.743 < 0.05. Accordingly, *neuroticism* variable has a negative and insignificant effect on purchasing behavior.

*Neuroticism* (N) reflects individuals with emotional instability associated with high and overly sensitive anxiety (John et al., 2008).

Hoch (1991) and Bougham (2011) state *that neuroticism is* related to compulsive purchase. Compulsive purchase is the tendency for someone to make impulsive purchases, and to buy the goods that aren't beyond their means.

Kurnia (2012) said that individuals with *neuroticism have* a strong willingness to do shopping, they will feel satisfied after doing shopping activities and cannot control themselves when they have a high shopping mood.

In this study, however, there is no significant effect of *neuroticism* on debt behavior. This might occur since the individual can still control himself when it comes to buying a product.

The results of the study are in line with (Quintelier, 2014), and Setiawati & Nasution (2019) which stated *that neuroticism* has no significant effect on purchasing decisions.

## 20. The Effect *of Neuroticism on Herding* Behavior

It was found that agreeableness (X5) has a beta coefficient value of 0.302 and t-statistic of 5.102 with P-values = 0.000 < 0.05. *Thus, the neuroticism variable* has a positive and significant effect on *herding behavior*. If *neuroticism* increases, then *herding behavior* would also increase significantly, vice versa.

According to Rammstedt & John (2007), *neuroticism* is an anxious, angry, depressed, easily affected, and irritable individual. Investors with *neuroticism tend* to sell shares following the suggestions from professional investors and have no confidence in their own ability (Putranti, 2020). Individuals *with neuroticism trait* will seek advice in his decision-making (Tauni, 2016)

This theory supports the results of the research indicating that neuroticism trait has a positive and significant effect on herding *behavior*, that individuals are easily affected by others, are encouraged to buy goods due to trend, and follow the decision of their group or herd to buy goods, services or investment products. This finding is in line with that of Bashir, Azam, Butt, Javed & Tanvir (2013) and Lin (2011) which suggest *that neuroticism* has a positive and significant effect on *herding behavior*.

### Result of Coefficient of Determination Test ($R^2$)

Table 4.7 below presents the results of coefficient of determination test:

### Table 4.7 Results of Coefficient of Determination Test

|        | R Square |
|--------|----------|
| Y1.1:  | 0,072    |
| Y1.2:  | 0,085    |
| Y1.3:  | 0,066    |
| Y1.4:  | 0,087    |

According to table 4.8 above, it can be seen that:

1. The value of the coefficient of determination (R-Square) for Y1.1 is 0.072, which means that X1, X2, X3, x4 and X5 could explain the investment behavior (Y1.1) by 7.2%.

2. The value of the coefficient of determination (R-Square) for Y1.2 is 0.085, which means that X1, X2, X3, x4 and X5 could explain debt behavior (Y1.2) by 8.5%.

3. The value of the coefficient of determination (R-Square) for Y1.3 is 0.066, which means that X1, X2, X3, x4 and X5 could explain the investment behavior (Y1.3) by 6.6%.

4. The value of the coefficient of determination (R-Square) for Y1.4 is 0.087, which means that X1, X2, X3, x4 and X5 could explain the investment behavior (Y1.4) by 8.7%.

## V  CONCLUSIONS AND SUGGESTION

Based on the results of the present study, the following conclusions can be drawn:

1. Openness *to experience* has a positive and significant effect on investment behavior, and *neuroticism* has a negative and significant effect on investment behavior, while *conscientiousness,* and *agreeableness* have a positive and insignificant effect on investment behavior, and *extraversion* has a negative and insignificant effect on investment behavior.

2. *Conscientiousness* has a positive and significant effect on debt behavior, while openness *to experience, agreeableness* has a positive and insignificant effect on debt behavior, and *extraversion, neuroticism* has a negative and insignificant effect on debt behavior.

3. C*onscientiousness* and agreeableness has a positive and significant effect on purchasing behavior, while *openness to experience, extraversion, and neuroticism* have a negative and insignificant effect on purchasing behavior.

4. N*euroticism* has a positive and significant effect on *herding behavior*, while openness *to experience, conscientiousness, extraversion* have a positive and insignificant effect on herding *behavior, and agreeableness* has a negative and insignificant effect on herding *behavior.*

Based on the results of the research and discussions, the following suggestions are drawn:

1. Further research is suggested to add other personality variables or behavioral biases to be tested theoretically that may affect *financial behavior.*

2. Additionally, it is suggested that further research be undertaken to investigate the difference in the effects of each personality type on *financial risk tolerance*, investment decision, consumptive behavior and purchasing decision.

## REFERENCES

- Ali, M., & Mohammad, A. (2014). Psikologi Remaja: Perkembangan Peserta Didik. Jakarta: Bumi Aksara

- Akben-Selcuk, E. (2015). Factors Influencing College Students' Financial Behaviors in Turkey: Evidence from a National Survey. *International Journal of Economics and Finance*, *7*(6). https://doi.org/10.5539/ijef.v7n6p87

- Alkaya, A., & Ibrahim, Y. (2015). Financial Literacy, Financial Information, Behaviour and Attitudes : an Application on Nevesehir Haci Bektas Veli University IIBF Students. . *Journal of International Social Research*, *8*(40). https://doi.org/10.17719/jisr.20154013941

- Andriyani, N. S. (2018). Pengaruh Literasi Keuangan, Personality Traits dan Sikap Terhadap       Uang Pada Perencanaan Keuangan Keluarga. Artikel Ilmiah. Management-STIE    Perbanas Surabaya, 1-10.

- Bashir, T., Azam, N., Butt, A. A., Javed, A., & Tanvir, A. (2013). Are Behavioral Biases       Influenced By Demographic Characteristics & Personality Traits? Evidence From       Pakistan. European Scientific Journal, 9(29), 277–293.

- Brown, S., & Taylor, K. (2011). Household Finances and the 'Big Five' Personality Traits.    Germany: IZA - Institute of Labor Economics.

- Brown, S., & Taylor, K. (2014). Household finances and the "Big Five" personality traits. *Journal of Economic Psychology*, *45*. https://doi.org/10.1016/j.joep.2014.10.006

- Budiarto, A., & Susanti. (2017). Pengaruh Financial Literacy, Overconfidence, Regret Aversion Bias, dan Risk Tolerance terhadap keputusan investasi. *Jurnal Ilmu Manajemen,* 5(2), 1-9.

- Costa, P. T., & McCrae, R. R. (1989). The neo-PI/Neo-FFI manual supplement. *Odessa, FL: Psychological Assessment Resources.*

- Costa, P. T., & McCrae, R. R. (1992). Normal Personality assessment in clinical practice: The NEO personality inventory. Psychological Assessment, 4(1), 5–13.

- Crysel, L. C., Crosier, B. S., & Webster, G. D. (2013). The Dark Triad and Risk Behavior. Personality and Individual Differences 54, 35-40.

- Davey, J., & George. (2011). *Personality and Finance: The Effects of Personality on Financial Attitudes and Behaviour. International Journal of Interdisciplinary Social Sciences*, 5(9).

- Dew, J., & Xiao, J. J. (2011). The Financial Management Behavior Scale : Development and Validation. Journal of Financial Counseling and Planning Volume, 22(1), 43–59.

- Dew, J., & Xiao, J. J. (2013). The Financial Management Behavior Scale: Development and Validation. *Journal of Financial Counseling and Planning*, *7*(10), 43–59.

- Donnelly, G., Iyer, R., & Howell, R. T. (2012). The Big Five personality traits, material values, and financial well-being of self-described money managers. *Journal of Economic Psychology*, *33*(6). https://doi.org/10.1016/j.joep.2012.08.001

- Fitriati, I. R., Mansyur, A., & Pradita, D. N. (2020). Deteksi *Behavioral Biases* Investasi Melalui *Personality Traits*. Proceeding Sendiu, 690-696

- Friedman, H., & Schustack, M. (2016). Personality: Classic Theories and Modern Research (6 th ed.). Pearson Education Inc.

- Halim, Y. E., & Astuti, D. (2015). Financial Stressors, Financial Behavior, Risk Tolerance, Financial Solvency, Financial Knowledge dan Kepuasan Finansial. FINESTA 3(1), 19- 23

- Helena & Widjaja, I. (2020). Pengaruh *Big Five Personality* Terhadap *Investment Decision* Pada Perusahaan *Peer To Peer Lending*. Jurnal Manajemen Bisnis Dan Kewirausahaan, 5(3), 319-324

- Herdjiono, I., & Damanik, L. A. (2016). Pengaruh Financial Attitude, Financial Knowledge, Parental Income Terhadap Financial Management Behavior. Jurnal Manajemen Teori dan Harapan, 226-241

- Humaira, I., & Sagoro, E. M. (2018). Pengaruh Pengetahuan Keuangan, Sikap Keuangan, Dan Kepribadian Terhadap Perilaku Manajemen Keuangan Pada Pelaku UMKM Sentra Kerajinan Batik Kabupaten Bantul. Nominal: Barometer Riset Akuntansi dan Manajemen, 7(1), 96-110

- Hogarth, J. M., & Hilgert, M. A. (2003). Financial Knowledge, Experience, and Learning Preferences: Preliminary Resultd from a New Year Survey on Financial Literacy. Federal Reserve Bulletin, 1-7.

- Ida, & Dwinta, C. Y. (2010). Pengaruh Locus of Control, Financial Knowledge, Income Terhadap Financial Management Behavior. Jurnal Bisnis Dan Akuntansi, 12(3), 131- 144

- Iskandar, L. M., & Zulkarnain. (2013). Penyesalan Pasca Pembelian Ditinjau dari Big Five Personality. Jurnal Psikologi, 40(1), 81–91

- Jariah, A. (2012). Analisis Faktor-Faktor Pribadi Yang Mempengaruhi Keputusan Pembelian Sepeda Motor. Jurnal WIGA. 2(2), 1-18

- Joyce, K., & L, N. K. (2013). The Influence of Personality Trait and Demographics on Financial Decision Making among Generation Y. Young Consumers, 230-243

- John, O. P., Robins, R. W., & Pervin, L. A. (2008). Handbook of Personality : Theory and Research. Third Edition. New York: The Guilford Press.

- John, O. P., Hampson, S. E., & Goldberg, L. R. (1991). Is there a Basic Level of Personality Description? Journal of Personality and Social Psychology, 60, 348-361.

- Larsen, R., Buss, D. M. (2017). Personality Psychology : Domains of Knowledge About Human Nature, Sixth Edition. McGraw-Hill Education, New York.

- Lin, H. (2011). Elucidating the Influence of Demographics and Psychological Traits on Investment Biases. World Academy of Science, Engineering and Technology, 5(5), 424–429.

- Kholilah, N. A., & Iramani, R. (2013). Studi Financial Management Behavior Pada Masyarakat Surabaya. Journal of Business and Banking, 69-80.

- Kowert, P. A., & Hermann, M. G. (1997). Who takes risks? Daring and caution in foreign policy making. Journal of conflict Resolution, 41(5), 611-637.

- Kurnia, L, L. (2012). Pengaruh Personality Traits Terhadap Penggunaan Kartu Kredit. Artikel Ilmiah. Universitas Kristen Satya Wacana. 2-45

- McCrae, R. R., & John, O. P. (1992). An Introduction to the Five-Factor Model and Its Applications. *Journal of Personality*, *60*(2). https://doi.org/10.1111/j.1467-6494.1992.tb00970.x

- McCrae, R. R., & Costa, P. T. J. (1996). Toward a new generation of personality theories : A theoretical contexts for the Five-Factor Model. Theoretical Contexts.

- McCrae, R. R. & Costa, P. T. (1997). Conceptions And Correlates Of Openness To Experience. In the Handbook Of Personality Psychology. London: AcademicPress.

- Mayfield, C., Perdue, G., & Wooten, K. (2008). Investment Management and Personality Type. Financial Services Review 17, 219-236.

- Mowen, John C., & Nancy Spears. 1999. "Compulsive Buying Among College Students: A Hierarchical Model Approach." Journal Of Consumer Psychology, 8(4), 407-430

- Mowen, John C. 2000. The 3M Model of Motivation and Personality: Theory and Empirical Application to Consumer Behavior, Boston: Kluwer Academic.

- Mutlu, U., & Ozer, G. (2019). *The Effects Of Personality Traits On Financial Behaviour. Journal of Business, Economics And Finance*, 8(3), 155-164

- Neuman, G.A., Wagner, S.H., & Christiansen, N.D. (1999). The Relationship Between Work-Team Personality Composition And The Job Performance Of Teams. Group & Organization Management, 24, 28-45.

- Nofsinger, J. (2010). *The Psychology Of Investing Fourth Edition. New Jersey: Precentice- Hall Inc.*

- Nule, R. C., Fanggidae, R. E., & Ndoen, W. M. (2021). Analisis Literasi Keuangan, Faktor Demografi, Dan *Personality Traits* Terhadap Perilaku Pengelolaan Keuangan. *Business Management, Economic, And Accounting National Seminar*, 2, 459-478

- Nyhus, E. K., & Webley, P. (2001). The role of personality in household saving and borrowing behaviour. *European Journal of Personality*, *15*(1 SUPPL.). https://doi.org/10.1002/per.422

- Oehler, A., Wendt, S., Wedlich, F., & Horn, M. (2018). Investors' Personality Influences Investment Decisions: Experimental Evidence on Extraversion and Neuroticism. *Journal of Behavioral Finance*, *19*(1). https://doi.org/10.1080/15427560.2017.1366495

- Onu J. C, Akhimien E, O. M. G. (2014). Assessing the Relationship between Personality Factors and Consumer Buying Behavior in South Eastern Nigeria. International Journal of Business and Social Science, 5(11), 231–242.

- Pinjisakikool, T. (2018). The Influence of Personality Traits on Households' Financial Risk Tolerance and Financial Behaviour. *Journal of Interdisciplinary Economics*, *30*(1). https://doi.org/10.1177/026010791773103

- Pak, O., & Mahmood, M. (2013). Impact of Personality on Risk Tolerance and Investment Decisions. International Journal of Commerce and Management, 370-384.

- Pervin, L. A., Cervone, D., & John, O. P. (2010). Psikologi Kepribadian, Teori, dan Penelitian Edisi kesembilan. Jakarta: Kencana.

- Putranti, L. (2020). *Big Five Personality Traits, Demography And Overconfidence. The Journal Of Business And Management,* 3(1), 13-27

- Quintelier, E. (2014). The Influence Of The Big 5 Personality Traits On Young People's Political Consumer Behavior. Young Consumers. 15(4), 342–352

- Rammstedt, B., & John, O. P. (2007). Measuring Personality in one minute or less: a 10 item short version of The Big Five Inventory in English And German. Journal of Research in Personality

- Setiawati, F. S., & Nasution, D. I. N. (2019). Kepribadian *Big Five* Terhadap Keputusan Pembelian Kosmetik Korea Pada Remaja Fandom Korea. Psychopolytan (Jurnal Psikologi), 3 (1), 23-30

- Subiakto (2013). Pengaruh *Personality Traits* Terhadap Perencanaan Keuangan Keluarga. Jurnal Dinamika Manajemen, 4(2), 150-163

- Santy, R. D. (2018). Pembelian Impulsif Ditinjau Dari Faktor Kepribadian Konsumen Dengan Menggunakan Trait The Big Five Personality (Survey Pada Pengunjung Mall Di Kota Bandung). Skripsi. Bandung. Universitas Komputer Indonesia

- Setiawati, F. S., & Nasution, D. I. N. (2019). Kepribadian *Big Five* Terhadap Keputusan Pembelian Kosmetik Korea Pada Remaja Fandom Korea. Psychopolytan (Jurnal Psikologi), 3 (1), 23-30

- Setyoningrum, R. (2020). Hubungan Antara Big Five Personality dengan Kecenderungan Impulsive Buying Pada Wanita. Artikel ilmiah. Universitas Mercu Buana Yogyakarta.

- Shakaib Farid, D., & Ali, M. (2018). Effects of Personality on Impulsive Buying Behavior: Evidence from a Developing Country. Marketing and Branding Research, 5(1), 31–43

- Sina, P. G. (2014). Tipe Kepribadian Dalam Personal Finance. Jurnal Jibeka, 8(1), 54-59

- Sofi, S. A., & Najar, S. A. (2018). Impact Of Personality Influencers On Psychological Paradigms: An Empirical-Discourse Of Big Five Framework And Impulsive Buying Behaviour. European Research On Management And Business Economics, 24(2), 71–81.

- Subiaktono. (2013). "Pengaruh Personality Traits terhadap Perencanaan Keuangan Keluarga", Jurnal Dinamika Manajemen. 4(2), 150-163

- Suryanto. (2017). Pola Perilaku Keuangan Mahasiswa di Perguruan Tinggi. Jurnal Ilmu Politik dan Komunikasi, 11-20.

- Tauni, M. Z., Fang, H, X., Rao, Z. R., & Yousaf, S. (2015). *The Influence Of Investor Personality Traits On Information Acquisition And Trading Behavior: Evidence From Chinese Futures Exchange. Personality And Individual Differences* 87, 248–255

- Udo-Imeh, P. T. (2015). Influence of Personality on the Buying Behaviour of Undergraduate Students in Universities in Cross River State, Nigeria. International Journal of Marketing Studies, 7(4), 64–77

- Verplanken, B., & Herabadi, A. (2001). Individual differences in impulse buying tendency: feeling and no thinking. European Journal of Personality, 15(S1), S71–S83.

- Xiao, J. J. (2008). Applying behavior theories to financial behavior. In the Handbook *of Consumer Finance Research*. https://doi.org/10.1007/978-0-387-75734-6_5

- Zaidi, F. B., & Tauni, M. Z. (2012). Influence of Investor's Personality Traits and Demographics on Overconfidence Bias. Interdisciplinary Journal of Contemporary Research in Business, 4(6), 730–746.

- Zaimah, R., Sarmila, M., Lyndon, N., Azima, A., Selvadurai, S., Saad, S., & A. C. Er. (2013). Financial Behaviors of Female Teachers in Malaysia. Asian Social Science, 34-41

# ASSESSMENT OF AVIAN DIVERSITY AND FEEDING HABIT IN DIFFERENT FOREST AREAS IN JASHPUR (C.G.)

**[1]Jyoti Tirkey, [2]K.R. Sahu and [3]Pratibha Pandey**
[1]Department of Zoology Govt. R.B.R. N.E.S. P.G. College Jashpur Nagar, Dist.-Jashpur (C.G.)
[2]Department of Zoology Govt. Pt. Madhav Rav Saprey College, Pendra Road (C.G.)
[3]Department of Zoology Dr. C.V. Raman University Kota Dist.- Bilashpur (C.G.)

**ABSTRACT**
*The study on feeding habit of bird diversity in Jashpur dietrict of Chhattisgarh was carried between January 2021 to June 2021. During the study total 61 species of birds were observed of which majority were residential and few were migratory. The feeding habits of these bird species were Carnivorous, omnivorous, insectivorous, graminivorous and fructivorous.*

*Key words— Avifauna, bird diversity, feeding habit, Jashpur.*

## INTRODUCTION
Birds are considered as indicator species that serve as monitors of changes in habitat. They are very important ecological indicators to understand the quality of habitats. Present status of bird diversity has been decreasing due to the destruction of natural habitats and anthropogenic activities (Greewal B 2000), forest destruction is a direct determination leading to bird diversity loss. Some birds are migratory and are responsible for fluctuation in the population of bird that occurs during different season of the year. Avian diversity always changes with different vegetation Area.

The distribution and occurrence of avifauna correlate well with the vegetation pattern of the area. The present investigation is carried out in forest area of jashpur .The district Jashpur lies in North Eastern part of C.G. Northern region of district has a long series of hill and mountains . The district is geographically situated between $22^0$ 17' and $23^0$ 15' North Latitude and $8324^{0~0}$ 30' and  $84^0$ 24' East Longitude.  The present study focused not only on preparing the checklist of birds but also to find out their occurrence status of avifaunal diversity and feeding habit in different forest area.

## MATERIAL AND METHOD
The report is based on the observation made from Jan 2021 to June 2021. The birds are observed and recorded at the 3 different sites. Sightings were carried out for 3 days in a week during all the months. The observations were done from early morning to late evening in the study areas. The field guides were used for Identification of the bird (Ali 2002, Grimmett.) DSLR camera (Nikon 5600) Utilized to take Image of unidentified bird Species.

### TABLE I.  CHEKLIST OF STATUS & FEEDING HABIT IN JASHPUR

| SN. | COMMON NAME | SCIENTIFIC NAME | STATUS | FEEDING HABIT |
|---|---|---|---|---|
| | **Family Anatidae** | | | |
| 1 | **Ruddy Shelduck** | *Tadorna Ferruginea* | **M** | **I** |
| 2 | **Bar-Headed Goose** | *Anser Indicus* | **R** | **I,C** |
| 3 | **Lesser Whistling-Duck** | *Dendrocygna Javanica* | **M** | **G** |
| 4 | **Northern Pintail** | *Anas Acuta* | **M** | **O** |
| | **Family Psittaculidae** | | | |
| 5 | **Rose-Ringed Parakeet** | *Psittacula Krameri* | **R** | **C** |
| 6 | **Plum-Headed Parakeet** | *Psittacula Cyanocephala* | **R** | **F** |
| | **Family Strigidae** | | | |
| 7 | **Jungle Owlet** | *Athene Brama* | **R** | **Cv** |
| 8 | **Spotted Owlet** | *Athene Brama* | **R** | **Cv** |
| 9 | **Rock Eagle Owl** | *Bubo Bengalensis* | **R** | **Cv** |
| | **Family Accipitridae** | | | |
| 10 | **Black-Winged Kite** | *Elanus Caeruleus* | **R** | **Cv** |
| 11 | **White-Eyed Buzzard** | *Butastur Teesa* | **R** | **Cv** |
| | **Family Ardeidae** | | | |
| 12 | **Indian Pond-Heron** | *Ardeola Grayii* | **R, M** | **Cv** |
| 13 | **Little Egret** | *Egretta Garzetta* | **R** | **Cv** |

| 14 | Cattle Egret | *Bubulcus Ibis* | R | Cv |
|---|---|---|---|---|
| | **Family Jacanidae** | | | |
| 15 | Bronze-Winged Jacana | *Metopidius Indicus* | R, M | O |
| | **Family Zosteropidae** | | | |
| 16 | Indian White-Eye Oriole | *Zosterops Palpebrosus* | R | In,F |
| | **Family Cuculidae** | | | |
| 17 | Asian Koel | *Eudynamys Scolopaceus* | R | O |
| 18 | Common Hawk-Cuckoo | *Hierococcyx Varius* | R | Cv,In |
| 19 | Greater Coucal | *Centropus Sinensis* | R | Cv,In |
| 20 | Banded Bay Cuckoo | *Cacomantis Sonneratii* | R | Cv,In |
| 21 | Indian Cuckoo | *Cuculus Micropterus* | R | Cv,In |
| 22 | Common Cuckoo | *Cuculus Canorus* | R | Cv,In |
| | **Family Threskiornithidae** | | | |
| 23 | Red-Naped Ibis | *Pseudibis Papillosa* | M | Cv |
| | **Family Upupidae** | | | |
| 24 | Eurasian Hoopoe | *Upupa Epops* | R, M | In |
| | **Family Laniidae** | | | |
| 25 | Long-Tailed Shrike | *Lanius Schach* | R | In |
| | **Family Artamidae** | | | |
| 26 | Ashy Woodswallow | *Artamus Fuscus* | R | In |
| | **Family Muscicapidae** | | | |
| 27 | Black Redstart | *Phoenicurus Ochruros* | | In |
| 28 | Oriental Magpie-Robin | *Copsychus Saularis* | R | Cv |
| 29 | Indian Robin | *Copsychus Fulicatus* | R | In |
| 30 | Pied Bushchat | *Saxicola Caprata* | R | |
| | **Family Paridae** | | | |
| 31 | Indian Black Loret Tit | *Machlolophus Xanthogenys* | R | In |
| | **Family Campephagidae** | | | |
| 32 | Scarlet Minivet | *Pericrocotus Speciosus* | R | F |
| | **Family Corvidae** | | | |
| 33 | Rufous Treepie | *Dendrocitta Vagabunda* | R | O |
| 34 | Crow | *Corvus Splendens* | R | O |
| | **Family Oriolidae** | | | |
| 35 | Indian Golden Oriole | *Oriolus Kundoo* | R | In,F |
| | **Family Sturnidae** | | | |
| 36 | Common Myna | *Acridotheres Tristis* | R | O |
| 37 | Asian Pied Starling | *Gracupica Contra* | R | O |
| | **Family Alcedinidae** | | | |
| 38 | White-Throated Kingfisher | *Halcyon Smyrnensis* | R | In |
| | **Family Passeridae** | | | |
| 39 | House Sparrow | *Passer Domesticus* | R | I,G |
| | **Family Pycnonotidae** | | | |
| 40 | Red-Vented Bulbul | *Pycnonotus Cafer* | R | In |
| | **Family Charadriidae** | | | |
| 41 | Red-Wattled Lapwing | *Vanellus Indicus* | R | In |
| | **Family Columbidae** | | | |
| 42 | Spotted Dove | *Spilopelia Chinensis* | R | G |
| 43 | Dove | *Collumdalivia* | R | G |
| 44 | Laughing Dove | *Spilopelia Senegalensis* | R | G |
| | **Family Dicruridae** | | | |
| 45 | Black Drongo | *Dicrurus Macrocercus* | R | O |
| | **Family Ciconiidae** | | | |
| 46 | Asian Openbild Stork | *Anastomus Oscitans* | M | Cv |

| | Family Nectariniidae | | | |
|---|---|---|---|---|
| 47 | **Purple Sunbird** | *Cinnyris Asiaticus* | **R** | **In,F** |
| | **Family Meropidae** | | | |
| 48 | **Green Bee-Eater** | *Merops Orientalis* | **R** | **In** |
| | **Family Rallidae** | | | |
| 49 | **Common Moorhen** | *Gallinula Chloropus* | **M** | **O** |
| | **Family Motacillidae** | | | |
| 50 | **Tawny Pipit** | *Anthus Campestris* | **R** | **In** |
| 51 | **Western Yellow Wagtail** | *Motacilla Flava* | **R** | **In** |
| | **Family Phasianidae** | | | |
| 52 | **Gray Francolin** | *Francolinus Pondicerianus* | **R** | **O** |
| 53 | **Red Junglefowl** | *Gallus Gallus* | **R** | **O** |
| | **Family Campephagidae** | | | |
| 54 | **Small Minivet** | *Pericrocotus Cinnamomeus* | **R** | **In** |
| 55 | **Large Cuckooshrike** | *Coracina Macei* | **R** | |
| | **Family Phalacrocoracidae** | | | |
| 56 | **Little Cormorant** | *Microcarbo Niger* | **M** | **Cv** |
| | **Family Leiothrichidae** | | | |
| 57 | **Jungle Babbler** | *Argya Striata* | **R** | **In** |
| | **Family Scolopacidae** | | | |
| 58 | **Common Sandpiper** | *Actitis Hypoleucos* | **R** | **In** |
| | **Family Coraciidae** | | | |
| 59 | **Indian Roller** | *Coracias Benghalensis* | **R** | **Cv** |
| | **Family Rallidae** | | | |
| 60 | **White-Breasted Waterhen** | *Amaurornis Phoenicurus* | **R** | **O** |
| | **Family Megalaimidae** | | | |
| 61 | **Coppersmith Barbet** | *Megalaina haemacephalus* | **R** | **F** |

**Status**

R-Resident

M-Migratory

RM-Resident migratory

F-Fruigivorous

G-Granivorous

**Feeding Habits**

Cv-Carnivorous

I-Insectivorous

O-Omnivorous
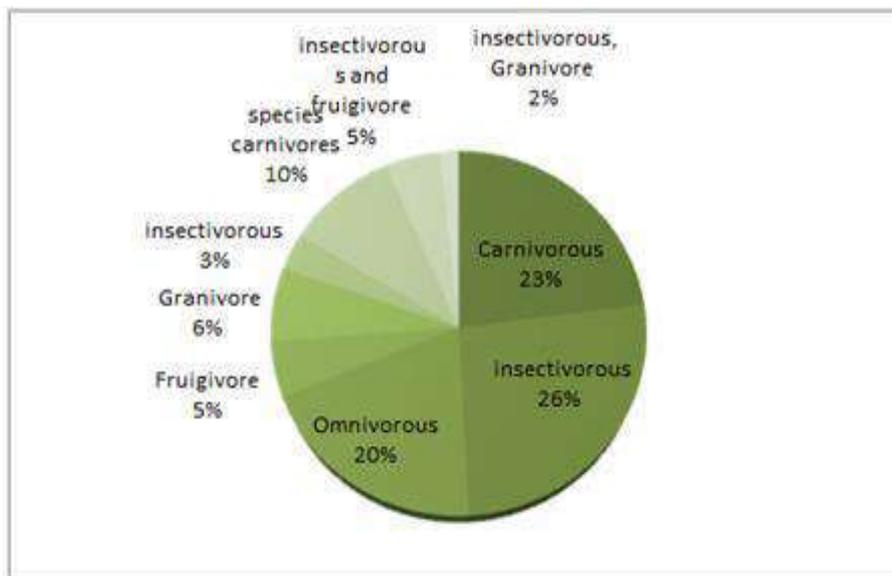


**GRAPH 1 FEEDING HABIT OF BIRDS FOUND IN SITE AREA OF JASHPUR**

## DISCUSSION

The extensive observation conducted at the 3 sampling sites site A, site B and site C showed the different numbers of birds and their feeding habits. The maximum number and species of birds were observed and recorded at site A which had most dense forest area with least human intervention. While site C which had meagre forest area and highest human intervention showed the presence of least number and species of birds.

There were 61 species of birds observed and recorded from the selected sites.

## CONCLUSION

The result of this study showed the bird species and feeding habit. The maximum number of birds species were recorded in A site and minimum birds species found in C site. 61 species of birds were recorded from the different habitats in Jashpur. Out of 61 bird species 16 bird species were insectivorous 14 Carnivorous 12 Omnivorous 4 Granivore 3 Fruigivore and 3 Insectivorous ,Fruigivore 6 Species Cornivors, Insectivors , 2 Insectivors, Cornivorus and 1 Insectivorus, Granivore.

## REFERENCES

[1] Ali, Salim (2002). The book of Indian Birds, BNHS, Oxford University Press Mumbai.

[2] Dhindsa MS , Saini HK {1994} Agriculture ornithology : an Indian perspective Journal of biosciences 19: pp. 391-402

[3] Diversity and status of birds in Bonai Forest Division Odisha ,H.S.PALEI, S DEBATA, PRATYUS P. MOHAPATRA AND A K MISHRA

[4] Furness RW and Greenwood JJD (1993). Birds asb a Monitor of Environmental Change . Chapman and Hall , London

[5] Grimmett R, Inskipp C and Imskipp T (2016). Hinds of the Indian subcontinent. Oxford University.

[6] Joshi, k k, Bhatt Dinesh, Arya Ashish Kumar 2021 Avian Diversity in forest, agriculture and water stream habitats of dehradun valley, Uttarkhand, india Biodiversity Data Journal 9:e61422

[7] Joshi P.P. (2015) Assessment of Avian population in different habbats around amolakchand mahavidyalaya campus, Yuyatmal,Maharastra,india Journal of Global Biosciences

[8] Palei H.S. Debata S. Mohapatra P.P. Mishra A.K. (2017 ) Diversity and status of birds in Bonai Forest Division, Odisha, India e-planet 15 (2): 166-177

[9] Pradhan, R.N. Palei,H,S and Sahu, H.K 2012 Checklist of waterbirds in angul district Orrissa, India Tiger Paper 39:31-32.

[10] Tandan, H.N Maheshwari , R and S Tandan Avifaunal diversity of Pt. Ravishankar Shukla University campus Raipur C.G (IOSR-JESTFT) Volume. 1 Issue 6. PP 41-44

[11] Tomer Virat Singh, Chouksey', Sandeep, Kerketta Neeta Shweta (2017) Study on the status of avifaunal diversity in social forestry division bareilly ,Uttar Pradesh Asian Journal of Biological and Life Sciences

## GENE EXPRESSION STUDIES IN HYPOXIA INDUCED RETINAL EPITHELIAL CELLS

**Archana Jeevan and Punniavan Sakthiselvan\***

Department of Bio-Engineering, School of Engineering,Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai, Tamil Nadu, India

**ABSTRACT**

*Most living creatures are exposed to oxygen which make up 20.9% of earth's atmosphere. oxidative stress is caused by oxygen which can lead to cell death and damage of cells. In order to cope with different oxygen requirements, the organisms have developed several strategies. One such strategy is triggered upon exposure of cells to low oxygen environment which is called as hypoxic response. Under hypoxic conditions certain transcription factors are activated. Hypoxia inducible factor (HIF) is a central player in regulation of hypoxic responses. In this review article, we focus on, the hypoxia inducible factor pathway and its role in hypoxia induced retinal pigment epithelial (RPE) cells. Eukaryotes are often subjected to different kinds of stress. In order to adjust to such circumstances, eukaryotes activate stress–response pathways and regulate gene expression. HIF is a common transcription factor for many angiogenic proteins. This work summarizes and discusses the emerging studies on the expression of HIF, its regulation by prolyl hydroxlases (PHD) enzymes and expression of genes such as vascular endothelial growth factor (VEGF) and EPO under chemically induced hypoxia in RPE cells in order to determine some of the molecular mechanisms underlying ischaemic retinal diseases.*

*Keywords: Hypoxia, Prolyl hydroxlases, Enzymes, Retinal pigment epithelium, Vascular Endothelial Growth Factor.*

## INTRODUCTION

Most living creatures are exposed to oxygen which makes up 20.9% of earth's atmosphere. On the other hand, oxidative stress is caused by oxygen which can lead to cell death and damage of cells. In order to cope with different oxygen requirements, the organisms have developed several strategies. One such strategy is triggered upon exposure of cells to low oxygen environment which is called as hypoxic response [1].

## HYPOXIA

Oxygen is a necessary requirement to support oxidative phosphorylation in eukaryotic organisms for efficient adenosine triphosphate production. In mammals, a constant oxygen supply is maintained for proper tissue development and homeostasis. A balance between oxygen supply and demand generated by metabolic outputs of tissues is the foundation which governs tissue oxygenation. When changes in supply or demand occur, it leads to hypoxia. Vessel occlution or rupture leads to vascular dysfunction which causes decreased oxygen delivery and is the main reason for diabetic retinopathy, peripheral artery disease and ischemic heart diseases [2]. In order to satisfy the needs of the tissue during inefficient vascular supply and resultant reduction in tissue oxygen tension neovascularization occurs [3].

Hypoxia is defined as a condition in which the region of a body is deprived of oxygen at tissue level. It is classified as generalized and local. Hypoxia develops gradually in the case of altitude sickness and symptoms include fatigue, numbness and cerebral anoxia. In accordance to a pressure gradient the oxygen passively diffuses in the lung alveoli. Oxygen is bound to hemoglobin in the blood and its binding capacity is influenced by oxygen-hemoglobin dissociation curve. Oxygen diffuses down a pressure gradient into mitochondria of the cells, in peripheral tissues, where it is used to produce energy. If there is failure at any stage in delivery of oxygen to cells it leads to hypoxia. Hypoxia is a potent stimulus of angiogenesis, a process in which neovascularization occurs from existing blood vessels. Hypoxia is an important regulator of blood vessel tone and is reported to regulate the expression of many genes but the mechanisms are not clear. Several studies report that hypoxia increases the transcriptional rate of VEGF gene also known as vascular endothelial growth factor in vascular endothelial cells [4]. Hypoxia is often associated with poor prognosis and is a common condition found in a wide range of solid tumors. By activating relevant gene expressions through hypoxia inducible factors, hypoxia increases tumor glycolysis, angiogenesis and other survival responses as well as invasion and metastasis [5].

## HYPOXIA INDUCIBLE FACTORS

Under hypoxic conditions certain transcription factors are activated. Hypoxia inducible factor is one such factor that is a central player in regulation of hypoxic responses. They contain two subunits: α and β. The hypoxia inducible factors contain three α subunits which are HIF-1α, hif-2α and HIF-3α respectively. It contains two β

subunits which are HIF-β and ARNT2 respectively. In HIF, the expression of α subunit is regulated in an oxygen dependent manner, which is an important characteristic to be noted [6].

Oxygen is freely available under non-toxic conditions, during which HIF-α is degraded by the ubiquitin-proteasome pathway [7]. By contrast, oxygen is limited under hypoxic conditions which leads to the stabilization of HIF-α. HIF-α was thought to sense oxygen due to its expression and activation which was observed to be oxygen-dependent. The oxygen dependent expression of this subunit is due to the fact that HIF-α contains an oxygen-dependent degradation domain which was revealed through biochemical analyses [8, 9]. The oxygen-dependant degradation domain contains proline residues which was demonstrated by subsequent analysis. Proline residues are critical for this oxygen dependency and are hydroxylated and determine the fate of HIF-α [10, 11]. The proline residues of HIF-α are hydroxylated by the enzyme prolyl hydroxylase domain-containing protein (PHD) [12]. The cofactors of this enzyme are Fe2, 2-OG and oxygen. PHD functions as an oxygen-sensing molecule because it requires oxygen as a co-factor [13]. pVHL is a subunit of the ubiquitin ligase complex to which the HIF-α binds when it is prolyl-hydroxylated [14]. Together with elongin B, elongin C, Cullin2 and Rbx1, pVHL forms an active ubiquitin ligase complex in normoxia condition [15].

Under normoxia, the HIF-1α is hydroxylated within the oxygen-dependant degradation domain. After which the hydroxylated HIF-1α interacts with the β domain of von Hippel-Lindau tumour suppressor protein. The pVHL-E3 ligase complex ubiquilates the interaction and subsequently marks HIF-1α for degradation by 26s proteasome [16]. The oxygen-dependant proteolytic destruction of the hypoxia-inducable factor-α subunit is abrogated under hypoxic conditions, thereby getting accumulated in the nucleus leading to the dimerization with HIF-β. They form a transcriptional complex after interacting with transcriptional coactivators p300/Creb-binding protein [17]. This transcriptional complex binds to hypoxia response elements and promotes the transcription of hypoxia-response genes which regulates the cellular adaptive response to hypoxia [18].
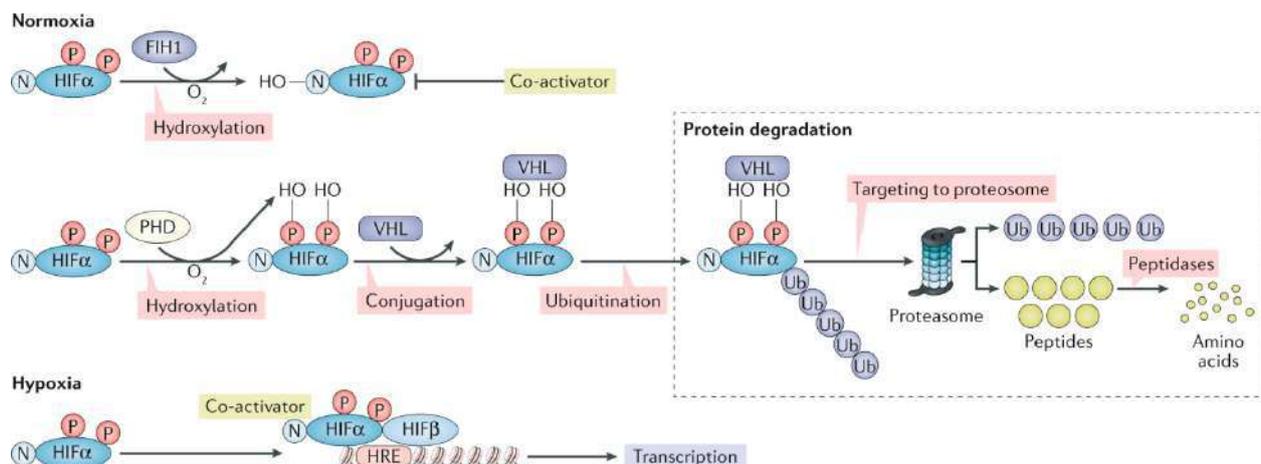


**Figure 1:** The hypoxia-inducible factor (HIF) system

## VASCULAR ENDOTHELIAL GROWTH FACTOR

VEGF is a homodimeric glycoprotein which was isolated in the 1980s. It was initially known as a tumour-derived factor that increased vascular permeability and subsequently as an endothelial mutagen. A variety of signaling molecules such as VEGF-VEGFRs, angiopoietin-Tie and the Delta-Noch system, have been identified as playing important roles in angiogenesis in the recent decades. Among these, vascular endothelial growth factors and receptors regulate both angiogenesis, the formation of blood vessels from pre-existing blood vessels at a later stage and vasculogenesis, the development of blood vessels from precursor cells during embryogenesis [19]. The expression of VEGF is upregulated by a number of growth factors, including epidermal growth factor, keratinocyte growth factor, fibroblast growth factor and platelet-derived growth factor. The VEGF family comprises of five members in mammals: VEGF-A, VEGF-B, VEGF-C, VEGF-D and placental growth factor. The members of the VEGF family stimulate cellular response by binding to tyrosine kinase receptors on the cell surface, causing them to dimerize and become activated through transphosphorylation. Three receptor tyrosine kinases have been identified for VEGF: VEGFFR3 mediates the angiogenic effects on lymphatic vessels ; VEGFFR2 is the primary mediator of the mitogenic, angiogenic and vascular permeability effects of VEGF-A; VEGFR1 has both positive and negative angiogenic effects  VEGF-A is the only member in the gene family which is induced by hypoxia and it signals through two receptor tyrosine kinases, VEGFR1 and VEGFR2. VEGFB has a role in the regulation of extracellular matrix degradation and selectively binds VEGFR1. Both

VEGF-C and VEGF-D bind VEGFR2 and VEGFR3 respectively and regulate lymphangiogenesis. PIGF is the most abundantly expressed VEGF family member in endothelial cells and selectively binds VEGFR1 [20].

VEGF acts through direct and indirect mechanisms which results in promoting pathological neovascularization. VEGF is involved in the pathogenesis of neovascular eye diseases such as neovascular age-related macular degeneration, diabetic macular edema (DME), proliferative diabetic retinopathy (PDR), retinal vein occlusion (RVO) and retinopathy of prematurity (ROP). The retinal pigment epithelium (RPE) is believed to play a key role in regulating VEGF levels which was observed in ischemic retinal disorders where the VEGF secretion by cultured RPE was found to be strikingly increased by hypoxia [21]. Therefore, the inhibition of VEGF action can prevent the development of ocular neovascularization. By analyzing the modulation of gene expression levels in VEGF-A, VEGF-B and HIF1-α in cultured RPE cells under time-dependant hypoxia, better therapeutic possibilities for preventing ischemic retinal diseases can be developed.

## THE RETINAL PIGMENT EPITHELIUM

The retinal pigment epithelium is a specialized epithelium which forms the outer blood-retinal barrier and is located in the interface between the neural retina and choriocapillaris. It is a monolayer of pigmented cells and is considered to be a part of the retina since it is of neuroectodermal origin. In order to control the fluids and solutes that cross the BRB and to prevent the entrance of toxic molecules and plasma components into the retina, tight junctions between neighbouring RPE cells and neighbouring endothelial cells is necessary [22]. The RPE contains apical membrane which faces the photoreceptors outer segments and also contains basolateral membrane which faces the Bruch's membrane (Figure 2). The functions of the RPE include transport of nutrients from the blood to the photoreceptors and transport of ions and water from subretinal space to blood or basolateral side. The energy for this transepithelial transport is provided by the Na-K-ATPase which is located in the apical membrane [23, 24].
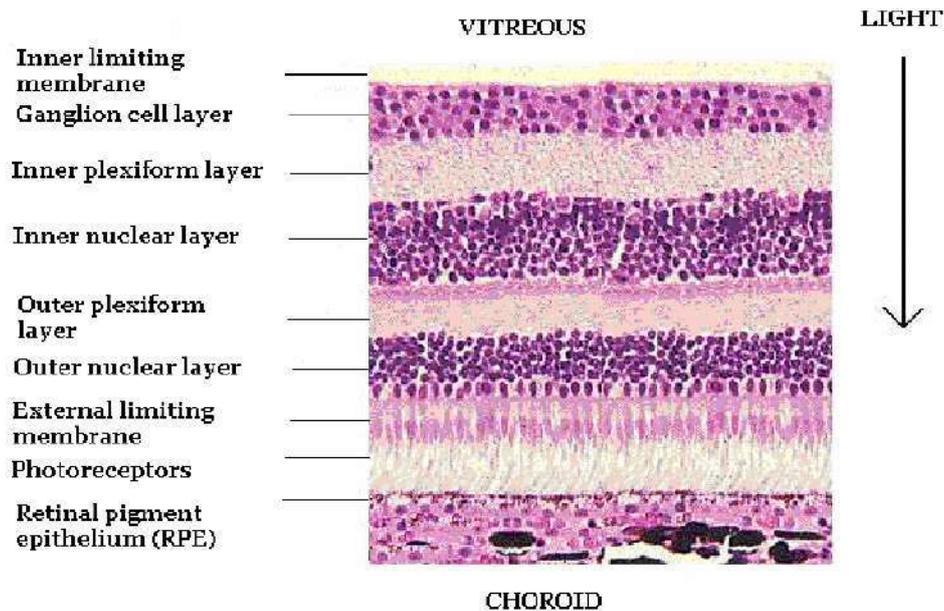


**Figure 2:** the retinal section of retina showing the location of the retinal pigment epithelium

The visual cycle of the RPE plays an important role in the maintenance of visual function and is adopted to different needs such as vision in darkness or lightness, where the functional aspects such as storage of retinal and the adaption of the reaction speed come into play. For the transition from darkness to light, large amount of 11-cis retinal is required which does not come directly from the visual cycle but from several retinal pools of retinal binding proteins which are connected together by the transportation and reaction steps involved in the visual cycle.

A variety of growth factors that are essential for the maintenance of the structural integrity of the retina is secreted by the RPE. The RPE also secretes pigment epithelium derived factor (PEDF), vascular endothelial growth factor (VEGF), nerve growth factor (NGF), platelet-derived growth factor (PDGF), colony-stimulating factors and neurotropin-3 [25] and insulin-like growth factor-1 [26]. The RPE secretes PEDF in the healthy eye which protects the neurons against glutamate-induced or hypoxia-induced hypoxia [27]. It stabilizes the endothelium of chorocapillaris and inhibits endothelial cell proliferation [28]. In the healthy eye, RPE secretes

VEGF in low concentrations, which acts as a permeability factor stabilizing the fenestrations of the endothelium and prevents endothelial cell apoptosis [29, 30]. The development of diabetic retinopathy is dependant on the balance between VEGF and PEDF and in RPE, advanced glycation end products increase retinal VEGF expression [31].

## ARPE-19

ARPE-19 (adult retinal pigment epithelium) is a cell line established by Dunn et al. from a 19 year old male donor from the Lions Eye and Tissue Bank, Sacremento, USA. The culture was noted to have a marked potential for growth, extensive pigmentation and large areas of polygonal cells when compared to other RPE cultures. The properties of the ARPE-19 line can be used for several lines of research such as studies on retinoid metabolism or the regulation of RPE-specific gene expression because these types of research requires stable, reproducible sources of RPE cells which have the ability to retain differentiated properties [32]. These cells exhibit epithelial cell morphology and hence is used as an alternative to native RPE. They express several genes specific for the RPE, such as cellular retinaldehyde-binding protein (CRALBP) and RPE65. CRALBP is a retinoid binding protein which is actively involved in the regeneration of visual pigment and RPE65 is a protein which is preferentially and abundantly expressed in the RPE [33, 34]. These cells perform functions such as assimilation of photoreceptor outer segments by phagocytosis which is a known function of the human RPE [35].

These cells are widely used as an alternative model to study various aspects of cell growth and differentiation. The culture models of the RPE are inherently heterogenous owing to the fact that RPE monolayer exhibits regional variation. ARPE19 is a dynamic cell line composed of a heterogenous mix of RPE-related phenotypes which presents a challenge [36]. ARPE-19 cells lose their specialized properties after multiple passages which makes it difficult to replicate some differentiated characteristics of the native RPE. Epithelial-mesenchymal transition is thought to play an important in role in this process in which the epithelial cells acquire migratory mesenchymal cell-like properties after shedding their epithelial characteristics [37]. Recent studies have reported that ARPE-19 cells cultured in Dulbecco's modified Eagle's Medium (DMEM) with high glucose and and pyruvate is an excellent model to study human RPE function since they restore pigmentation and the expression of mature RPE cells markers with western blotting [38].

## COBALT AND ITS ROLE IN MAMMALIAN CELLS

Cobalt is a ductile metal with symbol Co and atomic number 27. In terms of chemical properties, it is highly similar to iron and nickel. The most commercially available states is Co (11) and it predominantly occurs in two valence states [39]. Cobalt in the form of cobalamin (vitamin B12) is its primary function in mammals and it is an essential micronutrient for humans [40]. Two human enzymes, methionine synthase and methylmalonyl-CoA mutase, use cobalamin as a cofactor. It is reported that the inactivation of methionine synthase is responsible for megaloblastic anemia, one of the human diseases caused by vitamin B12 deficiency. The dysfunction of cobalamin-dependant enzymes is mainly caused due to the inadequate intake of vitamin B12 or failure of cobalamin delivery systems [41].

## STABILIZATION OF HYPOXIA INDUCABLE FACTOR 1 MEDIATED BY $CoCl_2$

HIF-$1\alpha$/$2\alpha$ increases in a dose and time dependant manner, when $CoCl_2$ is used in vitro. The susceptibility or resistance of the particular cells used determines the exact $CoCl_2$ concentration to be used and several observations have been reported regarding the comparisons of the cobalt chloride effect in different cell lines. For example, Horev-Azaria *et al.*, (2011) observed a completely different behavior and susceptibility to $CoCl_2$ concentrations and incubation time for each cell line treated with 1-1.0mM CoCl2 for 48 and 72 hours. Cell viability was determined in Cac0-2, MDCK, HepG2, A459 and NCIH441 cell lines [42].

The conditions for chemically induced hypoxia is 2 hours with a maximum of 12-48 hours and between 100 and 300μm for observing HIF-$1\alpha$/$2\alpha$ stabilization. It has been observed that, $CoCl_2$ exerts a toxic effect when used above 300m, depending on the cell type used, can lead to cell death oxidative DNA damage by ROS combined with inhibition of DNA repair [43, 44]. In addition, $CoCl_2$ has been observed to produce typical apoptotic changes, release of cytochrome, nuclear fragmentation, disruption of the mitochondrial transmembrane potential, cell shrinkage and upregulation of the voltage-dependant anion channel [45, 46]. Cobalt chloride has been widely used in studies of the genetic response modulated by HIF-1 and HIF-2 factors that mimic the hypoxic transcriptional response because it has shown a better effect on HIF-$1\alpha$/$2\alpha$ stabilization in contrast to DMOG and DFO [47]. Different possible mechanisms by which cobalt chloride stabilizes and promotes HIF-$1\alpha$/$2\alpha$ subunit protein accumulation have been proposed in several works.

One such replacement hypothesis proposes that the mechanism responsible for HIF-1α stabilization is the inhibition of PHD activity in the PHD active site through displacement of $Fe^{2+}$ by $Co^{2+}$, $Ni^{2+}$ or $Mn^{2+}$. In both in vivo and in Hep3B cells, it has been observed that EPO is synthesized in the kidney and liver in response to hypoxic conditions and that EPO upregulation was reproduced by $Co^{2+}$ and $Ni^{2+}$ [48, 49]. Later, it was observed that $Ni^{2+}$ enters the cell via the divalent metal ion transporter (DMT1), thus affecting the Fe-dependant activity of proteins such as PHDs by interfering with $Fe^{2+}$ homeostasis and depleting intracellular $Fe^{2+}$. A decrease in PHD activity is observed when $Ni^{2+}$ decreases the binding of pVHL to HIF-1α. $Ni^{2+}$ inhibited the activity of purified recombinant PHD, which confirmed this observation, suggesting a direct interference with the enzyme. The similarity between the ionic radius, ion structure and previous evidence that $Ni^{2+}$ and $Fe^{2+}$ compete for binding sites in other proteins is the possible explanation given by the authors for this observation [50]. Theoretical calculations explained that $Ni^{2+}$ and $Co^{2+}$ could mimic the hypoxia response mediated by HIF-1, since $Ni^{2+}$ could replace the $Fe^{2+}$ in PHD [51].

Based on experimental results several alternative explanations are reported. Chemical agents are used mimic hypoxia because they are more stable compared to hypoxic chamber, cheap and they maintain steady oxygen tension. By blocking the degradation of HIF-1α, hypoxia is artificially induced [52]. It has been reported that cobalt chloride inhibits the activities of HIF-P4Hs and FIH, suggesting that it blocks the degradation of HIF-1α by occupying their Fe binding site [53]. As a hypoxic pre-conditioning approach, pretreatment of 100µM $CoCl_2$ was performed on DPMSCs, UCMSCs and ADMSCs for 48 hours. $CoCl_2$ successfully mimicked the hypoxic condition in DPMSCs and UCMSCs which was confirmed by evaluating the presence of HIF-1α [54].

## HYPOXIA INDUCED GENE EXPRESSION IN RPE CELLS

Gene expression studies performed under hypoxia or hyperglycemia in retinal pigment epithelium show huge potential for modeling cell responses in retinopathy of prematurity, diabetic retinopathy and other retinal diseases. However, GAPDH or β actin are used as reference genes without any validation of thier expression stability for normalization of gene expression on RPE cells. It has been reported that HPRT1, GUSB and PPIA are the most suitable reference genes for RPE cell gene expression experiments subjected to hypoxia whose stability was ranked using geNorm and normfinder softwares. mRNA expression levels of hypoxia induced factor-1α were analyzed vs the best reference genes to emphasize the importance of selecting the most stably expressed reference genes in order to obtain reliable results [55].

The leading cause of blindness among the elderly in developed countries is age related macular degeneration [56]. During the end stage of AMD, choroidal neovascularization occurs beneath the macula which is caused due to the immature new blood vessels penetrating Bruch's membrane from choriocapillaries [57]. The effects of chemical hypoxia on the expression of tissue factor (TF), VEGF and HIF-1α was investigated to explore the possibility that TF participates in VEGF expression under hypoxia. The results from western blotting and ELISA showed the VEGF levels in the ARPE-19 cells increased consistently with HIF-1α and the TF expression was in accordance with the variations in the VEGF and HIF-1α levels [58].

Under the control of HIF-1α, ENO1 (alpha enolase) is reported to be up-regulated in the hypoxic cancer and brain cells [59, 60]. ENO1 is abundantly expressed in the ocular epithelial cells of the eye and is found at high concentrations in the corneal epithelial cells, which makes it a known marker for epithelial cell differentiation [61-63]. In accordance to experimental results, when the RPE cells are subjected to hypoxia, expression of ENO1 is up regulated in the RPE cells mediated by HIF-1α, which also increases VEGF secretion in the retinal pigment epithelium. It has been reported that ENO1 has no effect on influencing VEGF expression in the RPE cells, which means that they are independently regulated by HIF-1α without mutual interference. Over expression of ENO1 together with VEGF regulation in retinal pigment epithelium in response to hypoxia may suggest a potential positive role in the development of choroidal neovascularization [64].

Age related macular degeneration was shown to be associated with chronic local and systemic inflammation [65-67]. Inflammasomes are cytosolic protein-signaling complexes that recognize pathogens and damage-associated molecular patterns. Inflammatory processes are initiated by the activation of inflammasomes [68]. The presence of NLRP3 (nucleotide-binding oligomerization domain receptors-like receptor protein 3 inflammasome was seen in the RPE of patients with neovascular AMD and geographic atrophy [69]. Therefore, development of choroidal neovascularization is assumed to be due to the activation of NLRP3 inflammasome which mediates the degeneration of the RPE [70, 71]. Experimental results have reported that hypoxia induced retinal epithelial cells induced expression of NLRP3 and pro-IL-1β genes but not of the pro-IL-18 gene and that autocrine/paracine purinergic receptor signaling is involved in mediating the hypoxic priming of the NLRP3 inflammasome in RPE cells and the gene expression and secretion of VEGF [72].

## CONCLUSION

Angiogenesis is the formation and maintenance of blood vessel structures which is essential for the physiological functions of tissues and plays an important role in the progression of diseases such as inflammation and cancer. A variety of signaling molecules such as VEGF-VEGFRs, angiopoietin-Tie and the Delta-Noch system, have been identified as playing important roles in angiogenesis in the recent decades. Among these, vascular endothelial growth factors and receptors regulate both angiogenesis, the formation of blood vessels from pre-existing blood vessels at a later stage and vasculogenesis, the development of blood vessels from precursor cells during embryogenesis [73]. VEGF acts through direct and indirect mechanisms which results in promoting pathological neovascularization. VEGF is involved in the pathogenesis of neovascular eye diseases such as neovascular age-related macular degeneration, diabetic macular edema (DME), proliferative diabetic retinopathy (PDR), retinal vein occlusion (RVO) and retinopathy of prematurity (ROP). The retinal pigment epithelium (RPE) is believed to play a key role in regulating VEGF levels which was observed in ischemic retinal disorders where the VEGF secretion by cultured RPE was found to be strikingly increased by hypoxia [74]. Therefore, the inhibition of VEGF action can prevent the development of ocular neovascularization. By analyzing the modulation of gene expression levels in VEGF A, VEGFB and HIF1-α in cultured RPE cells under time-dependant chemically induced hypoxia, better therapeutic possibilities for preventing ischemic retinal diseases can be developed. In summary, this review provides a detailed description of genes expressed in ARPE-19 cells under chemically induced hypoxia. The use of CoCl2 is a reliable model that allows the study of hypoxic conditions without an expensive hypoxic incubator or chamber. As discussed in this review, it is observed that appropriately cultured and differentiated low passage ARPE-19 cells can be functional models for RPE-related studies. Gene expression studies performed under hypoxia or hyperglycemia in retinal pigment epithelium show huge potential for modeling cell responses in retinopathy of prematurity, diabetic retinopathy and other retinal diseases.

## REFERENCES:

[1] K Nakayama & N Kataoka. Regulation of Gene Expression under Hypoxic Conditions. *International journal of molecular sciences*, 2019; **20**(13), 3278.

[2] BL Krock, N Skuli & MC Simon. Hypoxia-induced angiogenesis: good and evil. *Genes & cancer*, 2011; **2**(12), 1117–1133.

[3] D Shweiki, A Itin, D Soffer, E Keshet. Vascular endothelial growth factor induced by hypoxia may mediate hypoxia-initiated angiogenesis. Nature, (Lond), 1992; **359**, 843-845.

[4] Y Liu, SR Cox, T Morita, & S Kourembanas. Hypoxia regulates vascular endothelial growth factor gene expression in endothelial cells. Identification of a 5'enhancer. *Circulation research*, 1995; **77**(3), 638.

[5] X Lu & Y Kang. Hypoxia and hypoxia-inducible factors: master regulators of metastasis. *Clinical cancer research*, 2010; **16**(24), 5928-5935.

[6] S Koyasu, M Kobayashi, Y Goto, M Hiraoka, & H Harada. Regulatory mechanisms of hypoxia-inducible factor 1 activity: Two decades of knowledge. *Cancer science*, 2018; **109**(3), 560-571.

[7] M Ohh, CW Park, M Ivan, MA Hoffman, TY Kim, LE Huang & WG Kaelin. Ubiquitination of hypoxia-inducible factor requires direct binding to the β-domain of the von Hippel–Lindau protein. *Nature cell biology*, 2000; **2**(7), 423-427.

[8] N Masson, C Willam, PH Maxwell, CW Pugh, & PJ Ratcliffe. Independent function of two destruction domains in hypoxia-inducible factor-α chains activated by prolyl hydroxylation. *The EMBO journal*, 2001; **20**(18), 5197-5206.

[9] K Tanimoto, Y Makino, T Pereira, & L Poellinger. Mechanism of regulation of the hypoxia-inducible factor-1α by the von Hippel-Lindau tumor suppressor protein. *The EMBO journal*, 2000; **19**(16), 4298-4309.

[10] M Ivan, K Kondo, H Yang, W Kim, J Valiando, M Ohh & WG Kaelin HIFα targeted for VHL-mediated destruction by proline hydroxylation: implications for O2 sensing. *Science*, 2001; **292**(5516), 464-468.

[11] P Jaakkola, DR Mole, YM Tian, MI Wilson, J Gielbert, SJ Gaskell, & PH Maxwell. Targeting of HIF-α to the von Hippel-Lindau ubiquitylation complex by O$_2$-regulated prolyl hydroxylation. *Science*, 2001; **292**(5516), 468-472.

[12] AC Epstein, JM Gleadle, LA Mc Neill, KS Hewitson, J O'Rourke, DR Mole & YM Tian. C. elegans EGL-9 and mammalian homologs define a family of dioxygenases that regulate HIF by prolyl hydroxylation. *Cell*, 2001; **107**(1), 43-54.

[13] WG Kaelin & PJ Ratcliffe. Oxygen sensing by metazoans: the central role of the HIF hydroxylase pathway. *Molecular cell*, 2008; **30**(4), 393-402.

[14] PH Maxwell, MS Wiesener, GW Chang, SC Clifford, EC Vaux, ME Cockman & PJ Ratcliffe. The tumour suppressor protein VHL targets hypoxia-inducible factors for oxygen-dependent proteolysis. *Nature*, 1999; **399**(6733), 271-275.

[15] T Kamura, DM Koepp, MN Conrad, D Skowyra, RJ Moreland, O Iliopoulos & JW Harper. Rbx1, a component of the VHL tumor suppressor complex and SCF ubiquitin ligase. *Science*, 1999; **284**(5414), 657-661.

[16] L Fan, J Li, Z Yu, X Dang & K Wang. The hypoxia-inducible factor pathway, prolyl hydroxylase domain protein inhibitors, and their roles in bone repair and regeneration. *BioMed research international*, 2014; **2014**:239356.

[17] N Sang, J Fang, V Srinivas, I Leshchinsky & J Caro. Carboxyl-terminal transactivation activity of hypoxia-inducible factor 1α is governed by a von Hippel-Lindau protein-independent, hydroxylation-regulated association with p300/CBP. *Molecular and cellular biology*, 2002; **22**(9), 2984-2992.

[18] M Ema, K Hirota, J Mimura, H Abe, J Yodoi, K Sogawa & Y Fujii-Kuriyama. Molecular mechanisms of transcription activation by HLF and HIF1α in response to hypoxia: their stabilization and redox signal-induced interaction with CBP/p300. *The EMBO journal*, 1999; **18**(7), 1905-1914.

[19] M Shibuya. Vascular endothelial growth factor (VEGF) and its receptor (VEGFR) signaling in angiogenesis: a crucial target for anti-and pro-angiogenic therapies. *Genes & cancer*, 2011; **2**(12), 1097-1105.

[20] N Ferrara, HP Gerber & J Le Couter. The biology of VEGF and its receptors. *Nature medicine*, 2003; **9**(6), 669-676.

[21] I Zampros, A Praidou, P Brazitikos, P Ekonomidis & S Androudi. Antivascular endothelial growth factor agents for neovascular age-related macular degeneration. *Journal of ophthalmology*, 2011; **2012**.

[22] O Strauss. The retinal pigment epithelium in visual function. *Physiological reviews*, 2005; **85**(3), 845-881.

[23] TJ Ostwald & RH Steinberg. Localization of frog retinal pigment epithelium Na$^+$-K$^+$ ATPase. *Experimental eye research*, 1980; **31**(3), 351-360.

[24] AD Marmorstein. The polarity of the retinal pigment epithelium. *Traffic*, 2001; **2**(12), 867-872.

[25] R Simo, E Carrasco, M Garcia-Ramirez & C Hernandez. Angiogenic and antiangiogenic factors in proliferative diabetic retinopathy. *Current diabetes reviews*, 2006; **2**(1), 71-98.

[26] MG Slomiany & SA Rosenzweig. Autocrine effects of IGF-I-induced VEGF and IGFBP-3 secretion in retinal pigment epithelial cell line ARPE-19. *American Journal of Physiology-Cell Physiology*, 2004; **287**(3), C746-C753.

[27] W Cao, J Tombran-Tink, W Chen, D Mrazek, R Elias & JF McGinnis. Pigment epithelium-derived factor protects cultured retinal neurons against hydrogen peroxide-induced cell death. *Journal of neuroscience research*, 1999; **57**(6), 789-800.

[28] AP Adamis, DT Shima, KT Yeo, TK Yeo, LF Brown, B Berse & J Folkman. Synthesis and secretion of vascular permeability factor/vascular endothelial growth factor by human retinal pigment epithelial cells. *Biochemical and biophysical research communications*, 1993; **193**(2), 631-638.

[29] WG Roberts & GE Palade. Increased microvascular permeability and endothelial fenestration induced by vascular endothelial growth factor. *Journal of cell science*, 1995; **108**(6), 2369-2379.

[30] MS Burns & MJ Hartz. The retinal pigment epithelium induces fenestration of endothelial cells in vivo. *Current eye research*, 1992; **11**(9), 863-873.

[31] M Lu, M Kuroki, S Amano, M Tolentino, K Keough, I Kim & AP Adamis. Advanced glycation end products increase retinal vascular endothelial growth factor expression. *The Journal of clinical investigation*, 1998; **101**(6), 1219-1224.

[32] KC Dunn, AE Aotaki-Keen, FR Putkey & LM Hjelmeland. ARPE-19, a human retinal pigment epithelial cell line with differentiated properties. *Experimental eye research*, 1996; **62**(2), 155-170.

[33] AJ Eisenfeld, AH Bunt-Milam & JC Saari. Localization of retinoid-binding proteins in developing rat retina. *Experimental eye research*, 1985; **41**(3), 299-304.

[34] CP Hamel, E Tsilou, BA Pfeffer, JJ Hooks, B Detrick & TM Redmond. Molecular cloning and expression of RPE65, a novel retinal pigment epithelium-specific microsomal protein that is post-transcriptionally regulated in vitro. *Journal of Biological Chemistry*, 1993; **268**(21), 15751-15757.

[35] SC Finnemann, VL Bonilha, AD Marmorstein & E Rodriguez-Boulan. Phagocytosis of rod outer segments by retinal pigment epithelial cells requires αvβ5 integrin for binding but not for internalization. *Proceedings of the National Academy of Sciences*, 1997; **94**(24), 12932-12937.

[36] Y Luo, Y Zhuo, M Fukuhara & LJ Rizzolo. Effects of culture conditions on heterogeneity and the apical junctional complex of the ARPE-19 cell line. *Investigative ophthalmology & visual science*, 2006; **47**(8), 3644-3655.

[37] R Kalluri & RA Weinberg. The basics of epithelial-mesenchymal transition. *The Journal of clinical investigation*, 2009; **119**(6), 1420-1428.

[38] A Ahmado, AJ Carr, AA Vugler, C Gias, JM Lawrence, LL Chen & PJ Coffey. Induction of differentiation by pyruvate and DMEM in the human retinal pigment epithelium cell line ARPE-19. *Investigative ophthalmology & visual science*, 2011; **52**(10), 7148-7159.

[39] DG Barceloux & D Barceloux. Cobalt. *Journal of Toxicology: Clinical Toxicology*, 1999; **37**(2), 201-216.

[40] S Strachan. Trace elements. *Current Anaesthesia & Critical Care*, 2010; **21**(1), 44-48.

[41] K Yamada. Cobalt: its role in health and disease. In *Interrelations between Essential Metal Ions and Human Diseases,* Springer, Dordrecht, *2013;* 295-320.

[42] L Horev-Azaria, CJ Kirkpatrick, R Korenstein, PN Marche, O Maimon, J Ponti & C Uboldi. Predictive toxicology of cobalt nanoparticles and ions: comparative in vitro study of different cellular models using methods of knowledge discovery from data. *Toxicological Sciences*, 2011; **122**(2), 489-501.

[43] D Lison, M De Boeck, V Verougstraete & M Kirsch-Volders. Update on the genotoxicity and carcinogenicity of cobalt compounds. *Occupational and environmental medicine*, 2001; **58**(10), 619-625.

[44] LO Simonsen, H Harbak & P Bennekou. Cobalt metabolism and toxicology—a brief update. *Science of the Total Environment*, 2012; **432**, 210-215.

[45] V Battaglia, A Compagnone, A Bandino, M Bragadin, CA Rossi, F Zanetti & A Toninello. Cobalt induces oxidative stress in isolated liver mitochondria responsible for permeability transition and intrinsic apoptosis in hepatocyte primary cultures. *The international journal of biochemistry & cell biology*, 2009; **41**(3), 586-594.

[46] JH Lee, SH Choi, MW Baek, MH Kim, HJ Kim, SH Kim & JY Jung. $CoCl_2$ induces apoptosis through the mitochondria-and death receptor-mediated pathway in the mouse embryonic stem cells. *Molecular and cellular biochemistry*, 2013; **379**(1-2), 133-140.

[47] A Borcar, MA Menze, M Toner & SC Hand. Metabolic preconditioning of mammalian cells: mimetic agents for hypoxia lack fidelity in promoting phosphorylation of pyruvate dehydrogenase. *Cell and tissue research*, 2013; **351**(1), 99-106.

[48] MA Goldberg, SP Dunning & HF Bunn. Regulation of the erythropoietin gene: evidence that the oxygen sensor is a heme protein. *Science*, 1988; **242**(4884), 1412-1415.

[49] VT Ho & HF Bunn. Effects of transition metals on the expression of the erythropoietin gene: further evidence that the oxygen sensor is a heme protein. *Biochemical and biophysical research communications*, 1996; **223**(1), 175-180.

[50] T Davidson, H Chen, MD Garrick, G D'angelo & M Costa. Soluble nickel interferes with cellular iron homeostasis. *Molecular and cellular biochemistry*, 2005; **279**(1-2), 157-162.

[51] TL Davidson, H Chen, DM Di Toro, G D'Angelo & M Costa. Soluble nickel inhibits HIF-prolyl-hydroxylases creating persistent hypoxic signaling in A549 cells. *Molecular Carcinogenesis: Published in cooperation with the University of Texas MD Anderson Cancer Center*, 2006; **45**(7), 479-489.

[52] Y Huang, KM Du, ZH Xue, H Yan, D Li, W Liu & GQ Chen. Cobalt chloride and low oxygen tension trigger differentiation of acute myeloid leukemic cells: possible mediation of hypoxia-inducible factor-1 α. Leukemia, 2003; **17**, 2065–2073.

[53] M Hirsila, P Koivunen, L Xu, T Seeley, KI Kivirikko & J Myllyharju. Effect of desferrioxamine and metals on the hydroxylases in the oxygen sensing pathway. *The FASEB journal*, 2005; **19**(10), 1308-1310.

[54] H Maruyama, C Dewachter, S Sakai, A Belhaj, B Rondelet, M Remmelink & L Dewachter. Bosentan reverses the hypoxia-induced downregulation of the bone morphogenetic protein signaling in pulmonary artery smooth muscle cells. Life Sci. 2016; **159**:111-115.

[55] Liu, X., Liu, Z., Gong, Q., Tian, R., & Su, G. (2016). Identification and validation of reference genes for quantitative RT-PCR analysis of retinal pigment epithelium cells under hypoxia and/or hyperglycemia. *Gene*, 2014; **580**(1), 41-46.

[56] RP Finger, R Fimmers, FG Holz & HP Scholl. Prevalence and causes of registered blindness in the largest federal state of Germany. *British journal of ophthalmology*, 2011; **95**(8), 1061-1067.

[57] S Takata, T Masuda, S Nakamura, T Kuchimaru, K Tsuruma, M Shimazawa & H Hara. The effect of triamcinolone acetonide on laser-induced choroidal neovascularization in mice using a hypoxia visualization bio-imaging probe. *Scientific reports*, 2015; **5**, 9898.

[58] Y Wang, A Sang, M Zhu, G Zhang, H Guan, M Ji & H Chen. Tissue factor induces VEGF expression via activation of the Wnt/β-catenin signaling pathway in ARPE-19 cells. *Molecular vision*, 2016; **22**, 886.

[59] J Gao, R Zhao, Y Xue, Z Niu, K Cui, F Yu, F & S Li. Role of enolase-1 in response to hypoxia in breast cancer: exploring the mechanisms of action. *Oncology reports*, 2013; **29**(4), 1322-1332.

[60] BH Jiang, F Agani, A Passaniti & GL Semenza. V-SRC induces expression of hypoxia-inducible factor 1 (HIF-1) and transcription of genes encoding vascular endothelial growth factor and enolase 1: involvement of HIF-1 in tumor progression. *Cancer research*, 1997; **57**(23), 5328-5335.

[61] N Lassen, WJ Black, T Estey & V Vasiliou. The role of corneal crystallins in the cellular defense mechanisms against oxidative stress. In *Seminars in cell & developmental biology, 2008;* **19**(2), 100-112.

[62] JV Jester, A Budge, S Fisher & J Huang. Corneal keratocytes: phenotypic and species differences in abundant protein expression and in vitro light-scattering. *Investigative ophthalmology & visual science*, 2005; **46**(7), 2369-2378.

[63] J Piatigorsky. Crystallin genes: specialization by changes in gene regulation may precede gene duplication. *Journal of structural and functional genomics*, 2003; **3**(1-4), 131-137.

[64] F Zheng, WC Jang, FK Fung, AC Lo & IY Wong. Up-regulation of ENO1 by HIF-1α in retinal pigment epithelial cells after hypoxic challenge is not involved in the regulation of VEGF secretion. *PloS one*, 2016; **11**(2), e0147961.

[65] H Xu, M Chen & JV Forrester. Para-inflammation in the aging retina. *Progress in retinal and eye research*, 2009; **28**(5), 348-368.

[66] CMG Cheung & TY Wong. Is age-related macular degeneration a manifestation of systemic disease? New prospects for early intervention and treatment. *Journal of internal medicine*, 2014; **276**(2), 140-153.

[67] A Kauppinen, JJ Paterno, J Blasiak, A Salminen & K Kaarniranta. Inflammation and its role in age-related macular degeneration. *Cellular and Molecular Life Sciences*, 2016; **73**(9), 1765-1786.

[68] E Latz, TS Xiao & A Stutz. Activation and regulation of the inflammasomes. *Nature Reviews Immunology*, 2013; **13**(6), 397-411.

[69] WA Tseng, T Thein, K Kinnunen, K Lashkari, MS Gregory, PA D'Amore & BR Ksander. NLRP3 inflammasome activation in retinal pigment epithelial cells by lysosomal destabilization: implications for age-related macular degeneration. *Investigative ophthalmology & visual science*, 2013; **54**(1), 110-120.

[70] N Kerur, Y Hirano, V Tarallo, BJ Fowler, A Bastos-Carvalho, T Yasuma & BD Gelfand. TLR-independent and P2X7-dependent signaling mediate Alu RNA-induced NLRP3 inflammasome activation in geographic atrophy. *Investigative ophthalmology & visual science*, 2013; **54**(12), 7395-7401.

[71] AG Marneros. NLRP3 inflammasome blockade inhibits VEGF-A-induced age-related macular degeneration. *Cell reports*, 2013; **4**(5), 945-958.

[72] F Doktor, P Prager, P Wiedemann, L Kohen, A Bringmann & M Hollborn. Hypoxic expression of NLRP3 and VEGF in cultured retinal pigment epithelial cells: contribution of P2Y 2 receptor signaling. *Purinergic signalling*, 2018; **14**(4), 471-484.

[73] M Shibuya. Vascular endothelial growth factor (VEGF) and its receptor (VEGFR) signaling in angiogenesis: a crucial target for anti-and pro-angiogenic therapies. Genes & cancer. 2011; **2**(12):1097-105.

[74] I Zampros, A Praidou, P Brazitikos, P Ekonomidis S Androudi. Antivascular endothelial growth factor agents for neovascular age-related macular degeneration. Journal of ophthalmology. 2011; **19,** 2012.

## ASPECT BASED SENTIMENT ANALYSIS USING MACHINE LEARNING ALGORITHMS

**Srividya Kotagiri[1] and A. Mary Sowjanya[2]**
[1]Department of CSE, Gmrit, Rajam, 532127, India
[2]Andhra University, Visakapatna, 530017, India

**ABSTRACT**

*Social media is emerging day by day on the internet. Media knowledge helps people in making decisions. Clients of Web based business were given the chance to express their feeling about the item on the web as a content as survey. Reviews are ranging from hundreds to thousands and contains various sentiments. Opinion mining is also called as sentiment analysis which involves in building a system to gather and examine opinions about the product made in reviews or tweets, comments, blog posts on the web. Here, Aspect-based opinion mining is used to extract the most interesting aspects of a product sentiment from unlabelled text data. To start with, noun phrases algorithm was utilized to get all the aspect term of a review. Secondly, the sentiment algorithm was applied on the result of the noun-phrase algorithm. Finally, using relative importance algorithm important aspects were presented to the user. The system determines the positive and negative and neutral/ aspects. The classification of sentiment polarity of aspects can be done by using Naive-Bayes and Support Vector Machine.*

## INTRODUCTION

Data mining research has successfully shaped numerous methods, tools, and algorithms for handling huge volume of data to solve real world problems. The key objectives of the data mining process are to effectively handle large scale data, mine actionable rules, patterns and gain insightful knowledge .As the internet and its technology is growing, people got the freedom of expressing their views, interests and opinions about the things they see around or use regularly in the form of reviews and feedback. Presently, a day's loads of individuals are utilizing the web and doing web based shopping and in the long run they will search for good things. Today's service providers or product providers are more interested in the reviews of their customers because they contain the opinion of the customer and/or, his/her interest about that product or service. Service providers are faced challenging issues in finding behavior or interest of their customer.Since people have different blogs, twitter, forum discussions,data analysts require more attention to get the sentiment from the reviews which were posted by the people in the comments. In order to grow up the business of the data analysts, they require special attention to extract opinion of the people about the particular entity.

Opinion Mining:

Opinion mining is extracting people's opinions from web. It mainly analyzes people's opinions, emotions, appraisals, emotions towards organizations, entity(product), topics, issues etc. It involves in building a system to collect and categorize the opinions about a product. Opinion mining is also called as sentimental analysis.

Levels of opinion mining:

There are three levels of opinion mining.

Document Level: In this approaches whole document is considers as a single entity and the analysis approaches in applied on the whole document. The result generated in document level sometimes not appropriate.

Sentence Level: In the sentence level approaches every sentence is considered as an entity and analysis approaches is applied on individual sentence then their result is summarized to provide the overall result of the document.

Aspect Level: Phrase-level opinion mining is also known as aspect based opinion mining. It performs fine grained analysis and directly looks at the opinion. The goal of this level of analysis is to discover sentiments on aspects of items. Nouns or noun phrases which are explicitly mentioned are called explicit aspects. The proposed system is based on aspect level sentimental analysis.Phrase level sentiment analysis or aspect-based sentiment analysis is the best solution to mine people's interests from online reviews. Aspects are the attributes of the service or product and we have named service or product as an entity. For example, consider a sentence "I impressed for dell customer service but it is getting motherboard problems". In this sentence, aspect terms are 'customer service' and 'motherboard'. Opinion or sentiment expressed towards those aspects is 'impressed' and 'problems'. By using our school English knowledge we can say that customer is satisfied with dell's customer service but unsatisfied with their motherboard performance.By using phrase level sentiment analysis,we can solve the problems of data analysts while making important decisions.In order to get the sentiment, we need to

make a machine to learn and this can be done by supervised learning and unsupervised learning. Supervised text classification algorithms for their famous are Naive-Bayes, Support Vector Machines. The accuracy of classification is different for these algorithms and way of classification is also different. Naive Bayes classification algorithms are the more scalable algorithm to classify documents based on the frequency of words. Naive Bayes classifiers consider more number of features for training the classifier. Naive Bayes algorithm follows Bayes theorem by assuming independence of its features. Support Vector Machines (SVM) was another classifier in the competition in this field. It is better classifier than Naive Bayes. SVM provides a unique solution. In view of the above we have developed a system that is used to classify opinion using aspect level classification to get positive, negative and neutral aspects. Then to get the sentiment of the testing data, Naive Bayes and Support Vector Machine are used.

## 2.BACKGROUND KNOWLEDGE

NurulhudaZainuddin, Ali Selamat, and Roliana Ibrahim et al Researches considered twitter sentiment analysis problem as a tweet-level sentiment classification task which is similar to document-level sentiment classification. Tweet-level sentiment classification will decide the tweet sentiment in general. The objective of this paper is aspect based sentimental analysis of twitter data. In order to do so, a hybrid approach for aspect based sentimental analysis is proposed. The hybrid approach between association rule mining, dependency parsing and Sentiwordnet is applied to solve this aspect-based sentiment analysis problem. This experimental result for twitter aspect-based sentiment analysis involves the polarity orientations for each aspect from the tweets.The objective of this paper[2] is to extend Bing Liu's aspect-based opinion mining technique to apply it to the tourism domain. Using that extension they offered an approach to for considering new alternative to discover consumer preferences about tourism products, particularly hotels and restaurents. Paper-3: Jingbo Zhu, Huizhen Wang, Muhua Zhu, Benjamin K. Tsou, Matthew Ma et al

The goal of opinion polling (customer survey) is to discover customer satisfaction on a particular product, service, or business. This is traditionally done by carefully designing some questions for customers to answer. An aspect-based opinion polling system takes as input a set of textual reviews and some predefined aspects, and identifies the polarity of each aspect from each review to produce an opinion polling. Sentiment analysis[4] is the process of extracting and analyzing the given data to determine the extent of positivity and negativity present in the expressed opinion. Every day people buy many products through online and post their reviews about the product which they have used. These reviews play a vital role in determining how far a product has been placed in consumers' psyche. In this paper the main aim is to develop an overall process of 'Aspect or Feature based Sentiment Analysis' by using a classifier called Support Vector Machine (SVM) in a novel approach.Rajalaxmi Hegde, Dr. Seema. S et al [5]Aspect based feature extraction process involves data pre-processing at the initial stage and then identify the required aspects for the feature selection, and then detect the sentiments from the sentences. Machine learning method is good because it uses supervised method for computation. The goal is to increase the efficiency and accuracy of the classification model thus improves the efficiency of system. Shwetha Rana, Archana Singh et al[6]The expanding web, social networking increases and people began to share data through various types of online networking. The expansive number of reviews makes it available for the makers to take responses of potential customers. In this paper, the main aim is to explore sentiment orientation considering the positive and negative sentiments using film user reviews. Then Two classification algorithms are used i.e. Linear SVM and Naive Bayes on the movie dataset. A model is trained to evaluate the performance. Toqir A. Rana and Yu-N Cheah et al[7] Identifying the targets of users opinions, referred as aspects, in aspect-based sentiment analysis, is the most important and crucial task. A large number of approaches have been proposed to accomplish this task. These approaches identify a huge amount of potential aspects from customer reviews. But the aspects which we get are not that much interesting and we may also get irrelevant aspects. In this paper the main aim to prune the aspects to remove irrelevant aspects. Two level aspect pruning was proposed.

Raisa Varghese and Jayasree M et al [8]A huge amount of user opinionated data are flooding in the internet now a days. The customers can review their products through social networking sites, forums, blogs etc. These user opinionated text is highly unstructured in nature and thus involves the application of various natural language processing techniques. In this paper the quantitative analysis of each aspect is done using support vector machine classifier.Kim Schouten, Onne van der Weijde, Flavius Frasincar, and Rommert Dekker[9]With the Web, word of mouth has greatly expanded. Anyone who wishes to share their experiences, can now do so electronically. Social media, like Twitter and Facebook allow for easy ways to exchange statements about products, services, and brands.

Povoda, Lukas, RadimBurget, and Malay Kishore Dutta, [10]This paper deals with sentiment analysis in text documents, especially text valence detection. The proposed solution is based on Support Vector Machines classifier. This classifier was trained with huge amount of data and complex word combinations were analysed.

**Problem Statement:**

By using document and sentence level opinion mining, users are unable to get interestingness of any entity. Whereas in aspect based opinion mining by using polarity users get most interesting aspects. The goal is to find interesting aspects based upon polarity and relative importance. Positive, negative and neutral aspects will be find based on the relative importance. Finally Naive Bayes and Support Vector Machine are used to test the accuracy.

**Proposed system:**

To develop a system that is used to classify opinion using aspect level classification to get positive, negative and neutral aspects. The aspect based opinion mining is done based upon the polarity. Most interesting aspects will be extracted based upon the relative importance.Positive ,negative and neutral aspects will be extracted. Naive Bayes and Support Vector Machine are used to get the sentiment of the test data.Noun phrases areextracted based on the chunk grammar using chunkparser. Chunk grammar used here is as follows:

***ChunkGrammar***

(r"NP:{<NN.?>+<RB><JJ>|" "<NN><RB><JJ>|"

"<JJ><NNS><RB>|"

"<RB>+<JJ><NN><RB>|"

"<RB><NN.?>+<VB.?>*<NN.?>+<RB>|"

"<IN><RB><JJ>|"

"<NN><JJ><RB>|"

"<RB><VB.?>+<JJ><NN>|"

"<RB><NN.?>+<VB.?>+<RB>|"

"<JJ><NN><RB>*|"

"<RB>|"

"<JJ><NN><RB><JJ>}")

It is not the standard but based on the dataset and itsdomain will get changed. Representation above is calledregular expression representation.The following section gives the detailed flow of the proposed word. The proposed system uses customerreviews and goes through a data preprocessing stage which deals with stop word removal, stemming, andlemmatization. Here, for each sentence get noun and other words as separate. After that, for each aspect countthe probabilities of other words. According to the sum,aspect will be categorized.

*Algorithm to find Noun Phases*

Input: POS-Tagged words

Output: a Tree with noun phrases

Method: Extract noun phrases for dataset D of sentence

Si according to the chunk grammer rule

Do: FOR EACH SENTENCE Si DO

The following section gives the detailed flow of the proposed word. The proposed system uses customer reviews and goes through a data preprocessing stage which deals with stop word removal, stemming, and lemmatization. Here, for each sentence get noun and other words as separate. After that, for each aspect count the probabilities of other words. According to the sum, aspect will be categorized.

Stop word removal:

Stopwords are common words that generally do not contribute to the meaning of a sentence, at least for the purposes of information retrieval and natural language processing. These are words such as 'the' and 'a'. Most

search engines will filter out stopwords from search queries and documents in order to save space in their index. NLTK comes with a stop words corpus that contains word lists for many languages.

Stemming:

Stemming is a technique to remove affixes from a word, ending up with the stem. For example, the stem of cooking is cook, and a good stemming algorithm knows that the "ing" suffix can be removed. Stemming is most commonly used by search engines for indexing words. Instead of storing all forms of a word, a search engine can store only the stems, greatly reducing the size of index while increasing retrieval accuracy. One of the most common stemming algorithms is the Porter stemming algorithm by Martin Porter. It is designed to remove and replace well-known suffixes of English words.

Lemmatization:

Lemmatization is very similar to stemming, but is more akin to synonym replacement. A lemma is a root word, as opposed to the root stem. So unlike stemming, you are always left with a valid word that means the same thing. However, the word you end up with can be completely different.

Algorithm for Data-Preprocess:

Input: a text file containing all the reviews

Output: sentences free from stop words, and stemmed, lemmatized words.

Method: Tokenize the given data set D into sentences S1,S2,S3,…Si again tokenize the sentence into words W1,W2,W3,..Wj

Foreach word W in a sentence, S look for the presence of it in stop word. If you found it, skip that word else include it and go for another word.

Do: FOR EACH SENTENCE in Si DO

Parts of speech tagging:

Part-of-speech tagging is the process of converting a sentence, in the form of a list of words, into a list of tuples, where each tuple is of the form (word, tag). The tag is a part-of-speech tag, and signifies whether the word is a noun, adjective, verb, and so on. Part-of-speech tagging is a necessary step before chunking. Without the part-of-speech tags, a chunker cannot know how to extract phrases from a sentence. But with part-of-speech tags, you can tell a chunker how to identify phrases based on tag patterns.

POS-Tagging is treated as the most salient part in opinion mining. It is important to identify attributes or features, opinion words from review sentence. POSTagging can be done either static (manually) or with the help of POS-Tagger tool. POS-Tagger tags all the words from reviews. NLTK's POS tag was used to tag each word in reviews. The grammar to extract noun phrases.

Noun Phrases :

Noun phrases are formed for English language and as we assumed that aspect can be found in noun phrases and formed noun grammar to accomplish this task. Algorithm for noun phases shows the algorithm to find noun phrases.

Algorithm for POS-Tagging:

Input: POS-Tagged words

Output: a Tree with noun phrases

Method: Extract noun phrases for dataset D of Sentence Si according to the chunk grammar rule

Do: FOR EACH SENTENCE Si DO

Build Word-net:

WordNet is a lexical database for the English language. In other words, it's a dictionary designed specifically for natural language processing.

Aspect Classification Algorithm(Get Probabilities) :

Algorithm for Aspect Classification

Input: noun list, other list, word probabilities

Output: Aspect classification as positive, negative and neutral

Method: get noun list NL, other list OL

For each item in OL build wordnet ON

For each item in ON look in word probabilities

If True get probability and polarity

Repeat

Sum up all probabilities is noun/ noun list

If sum >=0.7 it is positive

If sum <=0.4 it is negative

Else it is neutral Repeat

Data set is given text format. After preprocessing the above process extract the aspects which are nouns and separate those aspects into positive, negative and neutral aspects. The word probabilities used in aspect classification algorithm are taken from vendor_lexicon which was provided in NLTK sentiment corpora.

Input Dataset:

Input data set is a collection of reviews. Data set is collected from NLTK python library.It contains nearly about 800 reviews. These reviews need to be preprocessed to remove unwanted and noisy data. Preprocessing is the main step in natural language processing. It involves several steps. After preprocessing extraction of aspects will be done. By using relative importance aspects will be extracted and separated as positive, negative and neutral. In training phase we have taken a few aspects. Then based on that we have given another few aspects for testing phase. Then by applying classification algorithms like Naive Bayes Classifier and Support Vector Machine an accuracy of classification can be determined.

## RESULTS AND DISCUSSIONS

Output analysis of Naive bayes classifier:                    Performance Metrics



| Measure | Naive Bayes |
|---------|-------------|
| Precision | 0.48 |
| Recall | 0.69 |
| F1-score | 0.57 |

Output of Naive-Bayes classifier

Percentage of Accuracy: 69.13

Output analysis of Support Vector Machine:                    Performance Metrics



| Measure | SVM |
|---------|-----|
| Precision | 0.51 |
| Recall | 0.71 |
| F1-Score | 0.59 |

Output of SVM

Percentage of Accuracy:71.30

Comparison of results:
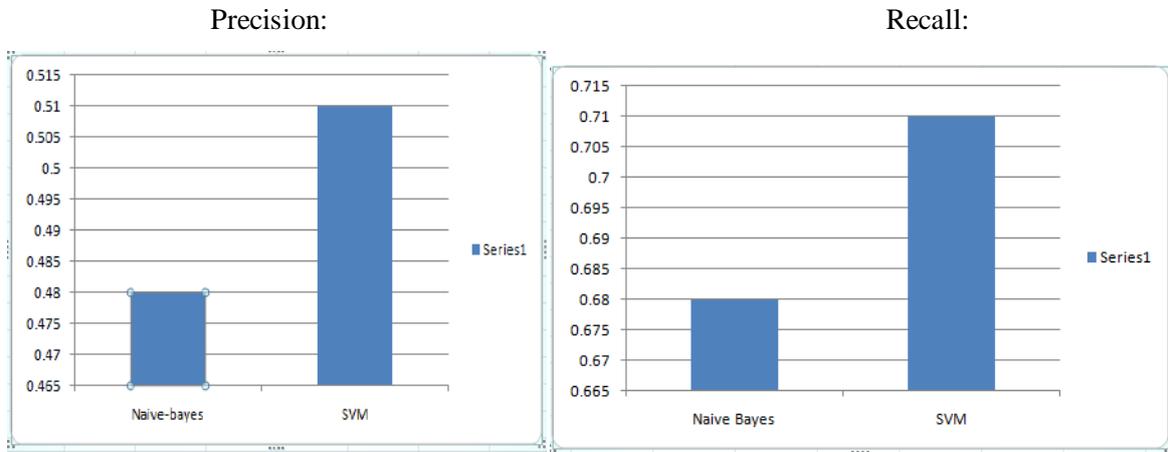
Precision:                                                                    Recall:



Precision performance                                    Recall performance

F1-Score:
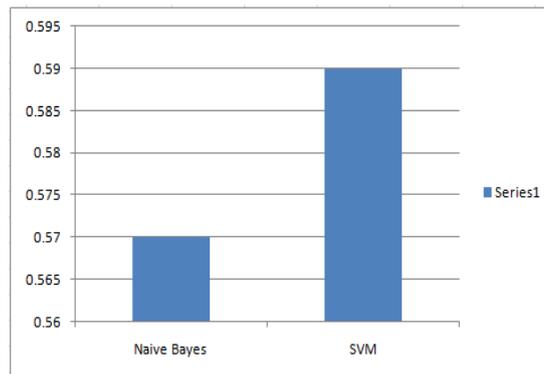


F1-Score Performance

**Analysis of results:**

| Measure | Naive Bayes | SVM |
|---|---|---|
| Accuracy | 69.13 | 71.30 |
| Precision | 0.48 | 0.51 |
| Recall | 0.68 | 0.71 |
| F1-Score | 0.57 | 0.59 |

**CONCLUSION AND FUTURE SCOPE:**
The proposed system extracts the aspects from the product reviews. The reviews are on the IPOD. These reviews contained noisy and some unwanted data. Those unwanted data is removed during preprocessing so that training the classifier will be easy.Nouns are considered as the aspect terms and extracted based on POS tagging. By using the threshold value, classification of the aspects into positive, negative and neutral is done. On the extracted aspects Naive-bayes and Support Vector Machine are applied. These classifiers are applied to find out the correct classification of aspects. Finally experimental results are presented. These experimental results shows that accuracy in analyzing the sentimental state of people on ipod, using the Support Vector Machine is high.In future, it will be proposed to work on strong positive and strong negative aspect terms .This will be implemented by using the Fuzzy concepts.  By using the Fuzzy logic,the results will be better and accurate when compared to existing methods.

**REFERENCES:**

[1] RajalaxmiHegde, Dr. Seema. S "Aspect Based Feature Extraction and Sentiment Classification of Review Data sets using Incremental Machine learning Algorithm" 3rd International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB17)

[2] Toqir A. Rana and Yu-N Cheah "Improving Aspect Extraction Using Aspect Frequency and Semantic Similarity-Based Approach for Aspect-Based Sentiment Analysis" Springer International Publishing AG 2018 P. Meesad et al. (eds.), Recent Advances in Information and Communication Technology 2017, Advances in Intelligent Systems and Computing 566.

[3] NurulhudaZainuddin, Ali Selamat, and Roliana Ibrahim "Improving Twitter aspect based sentimental analysis using hybrid approach " on 2016.

[4] D V Nagarjuna Devi, Chinta Kishore Kumar, Siriki Prasad, "A Feature Based Approach for Sentiment Analysis by Using Support Vector Machine" 2016 IEEE 6th International Conference on Advanced Computing.

[5] ShwethaRana, Archana Singh "Comparative Analysis of Sentiment Orientation Using SVM and Naive Bayes Techniques" 2016 2nd International Conference on Next Generation Computing Technologies (NGCT-2016) Dehradun, India 14-16 October 2016

[6] Povoda, Lukas, RadimBurget, and Malay Kishore Dutta, "Sentiment analysis based on Support Vector Machine and Big Data", Telecommunications and Signal Processing (TSP), 2016 39th International Conference on, IEEE, 2016.

[7] Edison Marrese-Taylor, Juan D. Velasquez, Felipe Bravo-Marquez and Yutaka Matsuo "Identifying Customer Preferences about Tourism Products using an Aspect-Based Opinion Mining Approach" 17th International Conference in Knowledge Based and Intelligent Information and Engineering Systems - KES2013

[8] Jingbo Zhu, Huizhen Wang, Muhua Zhu, Benjamin K. Tsou, Matthew Ma "Aspect-based opinion polling from customer reviews" IEEE Transactions on affective computing, Vol. 2, No.1, January-March 2011.

[9] Raisa Varghese and Jayasree M "Aspect Based Sentiment Analysis using Support Vector Machine Classifier" 2013 International Conference on Advances in Computing, Communications and Informatics (ICACCI)

[10] Kim Schouten, Onne van der Weijde, Flavius Frasincar, and Rommert Dekker "Supervised and Unsupervised Aspect Category Detection for Sentiment Analysis with Co-occurrence Data" IEEE Transactions on cybernetics.

# NANOTECHNOLOGY APPLICATIONS IN CANCER TREATMENT

**Sanjay Parethe. S[1], S.Ivo Romauld[2*], P. Vivek[3] and S.Thiruvengadam[4]**

[1-3]Department of Bioengineering, Vels Institute of Science Technology and Advanced Studies, Tamilnadu, Chennai, India

[4]Department of Biotechnology, Rajalakshmi Engineering College, Chennai, Tamil Nadu, India

## ABSTRACT

*Nanotechnology is a field of research at the crossroads of biology, chemistry, physics, engineering, and medicine. Design of multifunctional nanoparticles capable of targeting cancer cells, delivering and releasing drugs in a regulated manner, and detecting cancer cells with enormous specificity and sensitivity are just some examples of the potential application of nanotechnology to oncological diseases. In this review we discuss the recent advances of cancer nanotechnology with particular attention to nanoparticle systems that are in clinical practice or in various stages of development for cancer imaging and therapy.With a new generation of nanotech drugs, researchers are fighting cancer by approaching it as a physics problem—a problem of mass transport and fluid mechanics. They've already achieved some success, but the drugs have introduced a new series of challenges unique to the physics of nanomaterials.Recent advances have led to bioaffinity nanoparticle probes for molecular and cellular imaging, targeted nanoparticle drugs for cancer therapy, and integrated nanodevices for early cancer detection and screening. These developments raise exciting opportunities for personalized oncology in which genetic and protein biomarkers are used to diagnose and treat cancer based on the molecular profiles of individual patients.*

*Keywords: Cancer, Nanotechnology, Cancer treatment, Cancer detection, Targetting molecules*

## 1. INTRODUCTION

The overall frequency of malignancy keeps on expanding. The most well-known malignant growth treatments are restricted to chemotherapy, radiation, and medical procedure. Incessant difficulties experienced by current malignant growth treatments incorporate vague foundational conveyance of antitumor specialists, deficient medication fixations arriving at the tumor, and the limited capacity to screeoncology being an early and the most notable beneficiary to date.Malignancy nanotechnology is arising as another field of interdisciplinary exploration, cutting across the orders of science, science, designing, and medication, and is expected to prompt significant advances in malignant growth location, analysis, and treatment.What's more, malignancy is often analyzed and treated past the point of no return, when the disease cells have attacked and metastasized into different pieces of the body. At the hour of clinical show, for model, over 60% of patients with bosom, lung, colon, prostate, and ovarian malignant growth have covered up or plain metastatic settlements.Nanomaterials have an enormous surface region to volume proportion and their physicochemical properties, for example, grating and cooperation with different particles, are particular from identical materials at a bigger scope. The most common utilization of nanotechnology in medication has been in the spaces of creating novel helpful and imaging modalities that can possibly outflank the present status of the workmanship there.By applying a huge and different cluster of nanoparticles, whose plan gets from the designing, science, and medication fields, to sub-atomic imaging and designated treatment, malignancy nanotechnology guarantees answers for a few of the current snags confronting disease treatments.

## 2. CANCER DISCOVERY
### 2.1 TRADITIONAL DETECTION
Traditional discovery of the malignancy is finished by noticing the actual development/changes in the organ by X-rays or potentially CT Sweeps and is affirmed by biopsy through cell culture. Anyway the impediment of this technique is that it isn't very delicate and the discovery is conceivable as it were after considerable development of the dangerous cells. Frequently the treatment is additionally unrealistic when the disease is in a particularly progressed stage

### 2.2 NANOTECHNOLOGY DETECTION
As referenced previously, nanoparticles (NP) are of a couple of nm and the cells are of the size of not many microns. So NP can enter inside the cells furthermore, can get to the DNA particles/Qualities furthermore, there is a likelihood that the deformity in the qualities can be identified. DNA particles can be identified in their early stage. This could be conceivable in vivo or in vitro. It will be shown last that NP do show potential of malignant growth discovery in its early stage.

## 2.3 TRADITIONAL TREATMENT

One of the treatment choice is a medical procedure. That is, eliminate the harmful part. In any case, the limit is that one loses the organ and the malignant growth may show up once more. Further, the medical procedure isn't workable for a wide range of instances of the disease. Subsequent choice is radiation treatment. In this the malignant cells are scorched by radiation of explicit recurrence band and the power. The limit of this technique is that even the solid cells get singed, carcinogenic cells consuming isn't uniform and the consumed part may become dead and non useful. The third choice is chemotherapy. That is, carcinogenic cells are executed by drugs poisonous to cells or by preventing cells from taking supplements required to separate the cells or stop the system liable for division of the cell. Regularly a blend of medications is given so that medications influence every one of the three parts of the malignancy treatment. The constraint of this methodology is that treatment is destructive to solid cells, approach is gross and infrequently effective if the malignant growth is in cutting edge stage.

## 2.4 MALIGNANCY TREATMENT

As indicated above, most current anticancer specialists don't incredibly separate between harmful and ordinary cells, prompting fundamental poisonousness and antagonistic impacts. Consequently, foundational utilizations of these medications regularly cause serious results in other tissues, (for example, bone marrow concealment, cardiomyopathy, and neurotoxicity), which significantly restricts the maximal reasonable portion of the medication. Moreover, quick end also, inescapable dissemination into nontargeted organs and tissues require the administration of a medication in huge amounts, which isn't prudent and frequently confounded inferable from vague poisonousness. Nanotechnology offers a more designated approach and could in this way give huge advantages to malignant growth patients. Truth be told, the utilization of nanoparticles for drug conveyance and focusing on is likely quite possibly the most energizing and clinically significant utilizations of malignant growth nanotechnology. In this segment, we examine unique focusing on procedures for nanoscale drug conveyance frameworks.

## 3. NANOPARTICLES FOR TUMOR FOCUSING

### 3.1 Sorts of Nanoparticles as Medication Conveyance Frameworks

Nanoparticles can comprise of various materials, including polymers, metals, and ceramics. In light of their assembling strategies and materials utilized, these particles can embrace assorted shapes and sizes with unmistakable properties. Numerous sorts of nanoparticles are under different stages of improvement as medication conveyance frameworks, including liposomes and other lipid-based transporters (such as lipid emulsions and lipid-drug buildings), polymer-drug forms, polymer microspheres, micelles, and different ligand-designated items (for example, immunoconjugates).

### 3.1.1 LIPOSOMES

Liposomes structure nanoparticles with an amphiphilic unilamellar/multilamellar film of normal or engineered lipids. Lipids are portrayed by a hydrophilic head bunch and a hydrophobic tail. Liposomes structure lipid bilayers through hydrophobic cooperations and can convey hydrophilic and hydrophobic particles all the while. The hydrophobic and hydrophilic particles can be exemplified into the lipid bilayer and empty center individually. This extraordinary property permits the detailing of a solitary framework for the blend treatment to treat malignancy. Liposomes with markedly delayed dissemination and improved tumor gathering have been created by a progression of changes . Liposomes have effectively been endorsed for routine employments in medication . Doxorubicin epitomized liposome (Doxil) was quick to acquire FDA endorsement in 1995 and has powerful antineoplastic movement against a wide scope of human diseases including Kaposi's sarcoma and ovarian cancer.The surface of Doxil (100 nm) is functionalized with methoxypolyethylene glycol (MPEG, which gives a hydrophilic "covertness" covering, permitting Doxil to course in the circulation system for a drawn out timeframe .The clinical accomplishment of Doxil has prompted various new liposome definitions to be FDA endorsed, including DaunoXome (daunorubicin liposomes), DepoDur (morphine liposomes), what's more, Ambisome (amphotericin B liposomes). DaunoXome, a 45 nm liposomal definition, has been demonstrated to be dynamic against Kaposi's sarcoma and different tumors . Regardless of the clinical accomplishment of liposomes, these nanocarriers are restricted by imperfect soundness and medication discharge profiles in vivo. Along these lines, endeavors have been centered around the advancement of stable and pH-delicate liposomes that can empty the medication in an acidic climate

### 3.1.2 DENDRIMERS

The dendrimers are nanocarriers that have a round polymer center with consistently divided branches. As the dendritic macromolecule measurement expands, the inclination to shift towards a round structure increases.There are generally two different ways to orchestrate dendrimers, a disparate strategy wherein the

dendrimers can become outward from the focal core, and an assembly technique, where the dendrimers become internal from the edges and end up in the focal nucleus. Different atoms including polyacrylamide, polyglycerol-succinic corrosive, polylysine, polyglycerin, poly, 2bis (hydroxymethyl) propionic corrosive, and melamine are usually used to shape dendrimers. These dendritic macromolecules display diverse synthetic constructions and properties, like alkalinity, hydrogen bond limit and charge, which can be controlled by developing dendritic macromolecules or changing the gatherings on the outside of dendritic macromolecules. All in all, the dendritic medication forms are shaped by the covalent restricting of antitumor medications to dendritic fringe gatherings. Hence, a few medication particles can join to each dendritic atom and the arrival of these restorative particles is controlled to a limited extent by the idea of the connection. The physicochemical and organic properties of the polymer including the size, charge, multi-ligand gatherings, lipid bilayer collaborations, cytotoxicity, disguise, plasma maintenance time, natural appropriation, and filtration of dendritic macromolecules, have made dendrimers potential nanoscale transporters. A few examinations have additionally shown that malignant growth cells with a high articulation of folate receptors could shape foils from dendritic atoms bound to folate. An additional benefit of dendrimers is their capacity to tie to DNA as seen with the DNA-polyamides grouping DNA-poly(amidoamine) (DNAPAMAM), making them exceptionally compelling at murdering disease cells that express the folate receptor

### 3.1.3 POLYMERIC NANOPARTICLE

Polymer based conveyance frameworks show extraordinary guarantee for biomedical applications because of their high biocompatibility and adaptability wherein their constructions can be changed to design multifunctional nanoparticles with wanted shape, size, inside and outer morphology just as surface alterations. During the arrangement phase of nanoparticles, polymers can be used through separation from their normal sources, for example, chitosan that is created from chitin or they can be incorporated in the ideal design, for example, poly-lactic-co-glycolic corrosive (PLGA). PLGA, arginine, chitosan, human serum egg whites, alginate, and hyaluronic corrosive have been broadly utilized in preclinical investigations for drug conveyance. Polymer based nanoparticles shows incredible guarantee in preclinical examinations. For instance, chitosan nanoparticles are quite possibly the most mainstream polymeric conveyance framework that is broadly utilized specifically quality conveyance. Chitosan nanoparticles fill in as an alluring contender for little meddling RNA (siRNA) conveyance due its positive charge. Electrostatic connections between adversely charged siRNA and emphatically charged chitosan make a protected transporter for siRNA in the blood flow. Kim and colleagues, broke down the restorative impacts of src and fgr hindrance utilizing siRNA consolidated chitosan nanoparticles in orthotopic models of ovarian disease. Double hushing of src and fgr with chitosan nanoparticles in vivo, prompted a critical decrease in tumor development . For clinical examinations, egg whites bound paclitaxel (abraxane) is the main polymeric plan that is supported by FDA for the therapy of metastatic bosom malignancy and it is as of late endorsed for the therapy of cellular breakdown in the lungs. Abraxane abused the capacity of egg whites to tie to 60-kDa glycoprotein (gp60) receptor (albondin). After this receptor-ligand association, egg whites gp60 complex triggers caveolin-1 intervened take-up of protein bound plasma particles. Then again, egg whites likewise ties to osteonectin (discharged protein corrosive wealthy in cysteine [SPARC]) because of a grouping homology with gp60. SPARC is profoundly communicated specifically neoplasms (bosom, prostate, and cellular breakdown in the lungs) and adds to intratumor gathering of all egg whites bound medications . Also, Livatag is a poly (isohexyl cyanoacrylate) nanoparticle plan stacked with doxorubicin and supported for the treatment of multidrug-safe protein-overexpressing hepatocellular carcinoma.

### 3.1.4 NANOSHELLS

Polymeric nanoshells (20 to 60 nm) of diblock copolymers can collect into a center/shell structure. These nanoshells can be made without help from anyone else get together of oppositely charged polymers framing a flimsy multi-facet structure. The trait of nanoshells is characterized by the layer-by-layer gathering of nanoparticles, permitting a high medication stacking proficiency. In this manner, the medication discharge rate is constrained by the properties of the polymers and the dissemination coefficient through the polymeric layer. Moreover, the outside of the nanoshells can be without any problem functionalized for focusing on applications. pH-delicate doxorubicin embodied nanoshells have been combined using amphiphilic tercopolymerpoly(N-iso-propylacrylamideco-N,Ndimethylacrylamide-co-10-undecenoic corrosive) that can trigger intracellular medication discharge at pH 6.6. Metallic nanoshells (20 nm) are described by a dielectric center covered with a flimsy metallic shell to improve their biocompatible the mid-infrared. Gold nanoshells have been created for in vivo photothermal treatment utilizing close to infrared light . Additionally, thermally touchy polymeric hydrogels and optically dynamic nanoshells have been created with the end goal of photothermally modulated drug conveyance. Nanoshell particles with an attractive center (carbonyl iron) and a biodegradable poly(butylcyanoacrylate) (PBCA) shell have additionally been created for controlled delivery of 5-fluorouracil .

The mix of attractive nanoshells what's more, a medication typified biodegradable polymer considers molecule focusing to explicit destinations of the body in light of an remotely applied attractive field.

## 4. DESIGNATED MALIGNANT GROWTH TREATMENT

As indicated above, most current anticancer specialists don't incredibly separate between malignant and typical cells, prompting foundational poisonousness and unfriendly impacts. Consequently, foundational utilizations of these medications frequently cause serious results in other tissues, (for example, bone marrow concealment, cardiomyopathy, and neurotoxicity), which incredibly restricts the maximal passable portion of the medication. Likewise, fast end what's more, inescapable dissemination into nontargeted organs and tissues require the administration of a medication in huge amounts, which isn't practical and regularly convoluted inferable from vague poisonousness. Nanotechnology offers a more designated approach and could consequently give huge advantages to disease patients. Indeed, the utilization of nanoparticles for drug conveyance and focusing on is reasonable quite possibly the most energizing and clinically significant uses of malignant growth nanotechnology. In this segment, we examine extraordinary focusing on techniques for nanoscale drug conveyance frameworks.

## 4.1 ACTIVE TARGETING

Different receptors on the tumor cell surface have been concentrated as possible locales toaccomplish specific conveyance. Nanoparticle surface can be altered by an assortment of formation sciences to append explicit receptor ligands. Nanoparticles perceive and tie to their objectives with ensuing take-up through receptor interceded endocytosis. When disguised, the medication or payload is delivered in the cytoplasm or core. Such receptor ligands might be peptides, nutrients, antibodies, sugars and other substance structures. For example, the overexpression of transferrin and folate in specific tumors have been misused to convey nanoparticles formed with these receptor's ligands . Another model is the $\alpha v \beta 3$ integrin, which is overexpressed in a wide scope of tumors and angiogenic tumor-related endothelium, and is to a great extent missing in ordinary tissues. Han and associates have as of late revealed that the organization of chitosan nanoparticles formed with cyclic Arg-Gly-Asp (RGD) prompted expanded tumor conveyance and improved enemy of tumor action in ovarian malignancy models. An assortment of focusing on specialists like monoclonal antibodies (mAbs) and nucleic acids (aptamers) are additionally used to upgrade tumoral take-up of nanoparticles. Utilizing mAbs for focusing in disease treatment was first depicted by Milstein in 1981. From that point forward, counter acting agent based focusing on has made a huge movement as a plausible system in disease treatment.

Clinically supported and broadly utilized mAbs incorporate rituximab (Rituxan) for the therapy of nonHodgkin's lymphoma, trastuzumab (Herceptin) for bosom disease therapy, bevacizumab as an angiogenesis inhibitor in colorectal malignancy. Since 1997, 12 mAb-based treatment have been endorsed and an enormous number of immunizer based system is in progress for preclinical or clinical preliminaries. Formation of an immune response straightforwardly to a helpful specialist has been additionally investigated. Mylotarg was the main supported definition with this respect in center.

Calicheamicin is a chemotherapeutic specialist and it was formed with the CD33 immunizer. Zevalin and Bexxar are radio-immunoconjugates figured by utilizing CD20 neutralizer and supported for the treatment of non-Hodgkin's lymphoma.As of late, nucleic corrosive aptamers have acquired prompt consideration after the in vitro choice of useful nucleic acids (named SELEX) that was found in 1990. Aptamers are single abandoned oligonucleotides that can regulate sub-atomic focuses with high explicitness and proclivity through their three-dimensional constructions. Aptamers show huge benefits like the specialized chance in choice and synthetic change, particularity to focus on some random atom, its prosperous bio-action in vivo, the low creation costs, the straightforwardness in amalgamation and capacity for the promoting. There are presently a few aptamers that are in clinical preliminaries . For example, Pegaptanib was supported by FDA and utilized as a VEGF-explicit aptamer that ties to VEGF and squares the association with its receptor (VEGFR) subsequently hindering its action. Additionally, aptamers appear to be appealing to adjust the outside of nanoparticles for the plan of designated drug conveyance frameworks.

## 4.2 PASSIVE TARGETTING

Quick vascularization in quickly developing harmful tissues is known to result in cracked, damaged engineering and hindered lymphatic waste. This construction permits an EPR impact , bringing about the collection of nanoparticles at the tumor site . For a particularly uninvolved focusing on component to work, the size and surface properties of medication conveyance nanoparticles should be controlled to stay away from uptake by the reticuloendothelial framework (RES) . To expand course times furthermore, focusing on capacity, the ideal size ought to be under 100 nm in breadth and the surface ought to be hydrophilic to bypass freedom by macrophages. A hydrophilic surface of the nanoparticles shields against plasma protein adsorption also, can be

accomplished through hydrophilic polymer coatings like Stake, poloxamines, poloxamers, polysaccharides, or using extended or block amphiphilic copolymers . The covalent linkage of amphiphilic copolymers (polylactic corrosive, polycaprolactone, polycyanonacrylate synthetically coupled to Fix) is by and large liked, as it keeps away from accumulation and ligand desorption when in touch with blood parts.An alternative passive targeting strategy is to utilize the unique tumor environment in a scheme called tumor-activated prodrug therapy. The drug is conjugated to a tumor-specific molecule and remains inactive until it reaches the target . Overexpression of the matrix metalloproteinase (MMP) MMP-2 in melanoma has been shown in a number of preclinical as well as clinical investigations. Mansour et al.reported a watersoluble maleimide derivative of doxorubicin (DOX) incorporating an MMP-2-specific peptide sequence (Gly-Pro-Leu-Gly-Ile-Ala-Gly-Gln) that rapidly and selectively binds to the cysteine-34 position of circulating albumin.The albumin-DOX conjugate is efficiently and specifically cleaved by MMP-2, releasing a DOX tetrapeptide (Ile-Ala-Gly-Gln-DOX) and subsequently DOX. pH and redox potential have been also explored as drug release triggers at the tumor site . Another passive targeting method is the direct local delivery of anticancer agents to tumors. This approach has the obvious advantage of excluding the drug from the systemic circulation. However, administration can be highly invasive, as it involves injections or surgical procedures. For some tumors, such as lung cancers,that are difficult to access, the technique is nearly impossible to use.

## 4.3 POLYMERIC MICELLES
Polymeric nanoparticles (PNPs) are the inventions that relate to a solid micelle with a particle size range of 10-1000 nm. PNPs are collectively known as polymer nanoparticle, nanospheres, nanocapsules or polymer micelles and they were the first polymers reported for drug delivery systems. PNPs serve as drug carriers for hydrophobic drugs and are widely used for drug discovery. The PNPs constructed from amphiphilic polymers with a hydrophilic and hydrophobic block can perform rapid selfassembly because of the hydrophobic interactions in an aqueous solution. The PNPs can capture the hydrophobic drugs because of a covalent bond or the interaction via a hydrophobic core. Thus, to carry the hydrophilic charged molecules, such as proteins, peptides, and nucleic acids, these blocks are switched to allow interactions in the core and neutralize the charge.The advantages of the higher thermodynamic stability and the smaller volume make the PNPs a suitable drug carrier with good endothelial cell permeability while avoiding kidney rejection. The hydrophobic macromolecules and drugs can be transferred to the center of the PNPs, hence, the injection of PNPs suspension after being separated in an aqueous solution could achieve therapeutic effect. Importantly, by oral or parenteral administration, drugs can reach the target cells in different ways, potentially provide alternative ways to lower cytotoxicity in healthy tissues compared to the cancer cells. However, the major challenges in the use of PNPs for cancer nanomedicine still exist in how to effectively deliver the drugs to the target site with limited side effects or drug resistance. Recently, the PNPs have been used widely in the nanotechnology-based cancer drug design due to their excellent potential benefits for patient care. For example, adriamycin conjugated nanomaterial was used to treat several types of cancers where it achieved therapeutic effects to a decent degree. However, it also presented with many side-effects, such as toxicity and heart problems, thereby limiting its use. Such problems are overcome by Doxil (a liposomal form of doxorubicin), which is less associated with cardiotoxicity in patients, and hence may provide a safer nanomaterial synthetic approach for researchers in the future.

## 4.5 PEPTIDES
Examination utilizing antibodies for focusing on applications has prompted a superior comprehension of basic components influencing focusing on. Peptides and counter acting agent pieces have been developed to defeat a portion of the inadequacies of antibodies, and a few instances of these ligands are currently under clinical turn of events. It is presently all around acknowledged that the binding proclivity, solidness, and the size of the ligand play a basic part for effective focusing on. Peptides are little, engineered particles that can be fabricated in huge quantities with astounding quality control. Peptides are more steady than antibodies and probably not going to be immunogenic. The discovery of new peptide focusing on areas has been successful because of the advancement of peptide library screening techniques (e.g., phage show; 1011 various peptides) . Show advancements are amazing assets to disconnect novel ligands for helpful and demonstrative applications. A quarter century prior, Scott and Smith announced the first peptide phage library .Combinatorial peptide libraries are characterized by an enormous pool of irregular arrangements or in view of a spine arrangement with arbitrary transformations. Huge libraries of direct or obliged peptides are currently accessible. When all is said in done, round balanced out or multivalent peptides show higher restricting fondness due to enhanced inflexibility and cooperation with cell layer antigens. Much of the time, short peptides are chosen after fondness screening of the library on an objective protein, entirety cell, ex vivo tissues or live creatures and even people . Countless high fondness peptides (Kd in uM–nM range) with potential for focusing on application have been

disengaged against an assortment of cell surface antigens . Peptides that contain RGD (ArgGly-Asp) areas can specially tie cells in tumor microvasculature that express the (V) 3 integrin . This methodology has been utilized tentatively to convey chemotherapy and radioactive particles specifically to tumors . Besides, cyclic RGD peptide (EMD 121974 or Cilengitide) is presently under stage II clinical evaluation for the therapy of a few tumors including androgen free prostate malignancy and intermittent Glioblastoma , RGD successions additionally act as cement atoms and can vaguely tie tissues that likewise express its integrin supplement. Integrin receptors are likewise communicated on the cell layer of macrophages  and it is shown that RGD bioconjugates total in spleen and liver tissues because of macrophage freedom . Ex-vivo determination of designated peptide on biopsy examples have been created and displayed to effectively confine strong peptide ligands. In vivo phage library determination was spearheaded by Arap et al. to additionally advance the selection boundaries. The revelation of intense peptide sequences relies upon the plan of the choice conventions what's more, it is perceived that it is basic for the segregation of most promising particles. A definitive conditions ought to be as close as conceivable to the human physiological climate further, tumor structure. Subsequently, the in-vivo phage is intended to select peptides that tight spot tumor vasculatures and to permit differentiation between normal vascular cell receptors and explicit tissues' receptor-restricting peptides. Conceivable limitations of utilizing creature models that may not totally address the human vasculature profile have prompted the choice of peptide libraries straightforwardly on patients. This approach has effectively been accounted for different diseases. Peptide arrangement restricting to human interleukin (IL-11) receptor on prostate diseases was described. Notwithstanding, the survival time was just reached out by 20 days. The turn of events of determination conventions, moral rules, and nanotechnologies will prompt the clinical interpretation of new imaging and helpful advancements. Other peptide-based focusing on innovations have been fostered that give a few new stages to producing target explicitness. Utilizing the A-area of different local human receptors as a stage for adjustment, singlechain proteins that can tie to different districts of target particles utilizing different spaces have been created and named ardentness multimers or avimers. In a proof of idea study, an avimer explicit for IL-6 (an intense stage fiery arbiter) was exhibited to be non-immunogenic in mice, just as an inhibitor of IL-6 capacity in vivo. All the more for the most part, this features the capability of this class of ligand to estrange proteins, which may at last discover application in malignancy treatment. Useful, single-domain hefty chain antibodies, otherwise called nanobodies, have been raised against disease targets, which either antagonize receptor work or convey a compound for prodrug initiation , both for remedial advantage. However another significant system utilizing phage show technology utilized a  buildup - helical area of staphylococcal protein An as a stage to foster polypeptide focusing on ligands named affibodies . Affibodies against an assortment of disease related targets have been created and are currently industrially accessible, including: EGFR, HER2, and transferrin.

## 4.6  QUANTAM DOT NANOPARTICLE

Semiconductor quantum dots (QDs) are nanometer-scale, light-emitting particles with unique optical and electronic properties such as size-tunable light emission, improved signal brightness, enhanced stability of the fluorescent signal, and the ability to simultaneously excite multiple fluorescent colors. These properties are most promising for improving the sensitivity of molecular imaging and quantitative cellular analysis by 1 to 2 orders of magnitude. Nie et al first reported that it is feasible to simultaneously target and image prostate tumors in living animal models using bioconjugated, prostate membrane antigen-targeted QDs.This new class of QD conjugate contains an amphiphilic triblock copolymer layer for in vivo protection and multiple PEG molecules for improved biocompatibility and circulation, making it highly stable and able to produce bright signals. Another advantage is that QD probes emitting at different wavelengths can be used together for imaging and tracking multiple tumor markers simultaneously, potentially increasing the specificity and sensitivity of cancer detection. Recently, QDs producing NIRF signals have been developed.NIRF light penetrates much more deeply into tissues compared with visible fluorescence and allows for the detection of signals inside animals, as compared with visible fluorescent signals, which can only pass through several millimeters in the tissues . A major advantage of NIRF QDs is that their emission is well beyond the spectral range of the fluorescence signal produced by blood and tissues (autofluorescence), resulting in imaging with a high signal-to-background ratio. Detection of QD NIRF signals in sentinel lymph nodes within large animals in real time has been demonstrated.Therefore, QDs are excellent optical imaging nanoprobes for evaluating the specificity of tumor targeting ligands in vitro in tumor cells and in vivo in animal tumor models. Sensitive real-time detection of tissue distribution of targeted QDs is also possible using the NIRF optical imaging system after systemic delivery. However, since cadmium is the main component of most QDs,there is some concern over their potential toxicity, making the feasibility of using these QDs for future clinical application still undetermined

## 5. FUTURE DIRECTIONS

Nanotechnology has become an enabling technology for personalized oncology in which cancer detection, diagnosis, and therapy are tailored to each individual's tumor molecular profile, and also for predictive oncology in which genetic/molecular markers are used to predict disease development, progression, and clinical outcomes. In recognition of its potential impact in cancer research, the U.S. National Cancer Institute (NCI) has recently funded eight national Centers of Cancer Nanotechnology Excellence (CCNE) (http://nano.cancer.gov). Looking into the future, there are a number of research themes or directions that are particularly promising but require concerted effort for success. The first direction is the design and development of nanoparticles with monofunctions, dual functions, three functions, or multiple functions.Along with the prospects that nanotechnology holds for medical innovation comes the caveat that this is uncharted scientific territory and may have potential risks and hazards.There is evidence that certain nanoscale particles can have detrimental effects on living organisms. Carbon nanoparticles,for instance, have been shown to induce lipid peroxidation inthe brain cells of fish and pulmonary inflammation in rats.As our knowledge of cancer biology becomes more complete, it is increasingly important for clinicians, biologists and engineers to discuss ideas for diagnostics and treatments of cancer. Developing nanoparticle therapies that are aimed in the right directions with the right therapies will improve the outcome for patients with cancer.

## 6. REFERENCES:

[1] Ferrari M. Cancer nanotechnology: Opportunities and challenges.Nat Rev Cancer 2005;5:161–71.

[2] Farokhzad OC, Langer R. Nanomedicine: Developing smarter therapeutic and diagnostic modalities. Adv Drug Deliv Rev 2006;58:1456 –9.

[3] Whitesides GM. The "right" size in nanobiotechnology. Nat Biotechnol 2003;21:1161–5.

[4] LaVan DA, McGuire T, Langer R. Small-scale systems for in vivo drug delivery. Nat Biotechnol 2003;21:1184 –91.

[5] Farokhzad OC, Karp JM, Langer R. Nanoparticle-aptamer bioconjugates for cancer targeting. Expert Opin Drug Deliv 2006;3:311–24.

[6] Bae Y, Jang WD, Nishiyama N, et al. Multifunctional polymeric micelles with folate-mediated cancer cell targeting and pH-triggered drug releasing properties for active intracellular drug delivery. Mol Biosyst 2005;1:242–50.

[7] Nasongkla N, Bey E, Ren J, et al. Multifunctional polymeric micelles as cancer-targeted, MRIultrasensitive drug delivery systems. Nano Lett 2006;6:2427–30.

[8] Larina IV, Evers BM, Ashitkov TV, et al. Enhancement of drug delivery in tumors by using interaction of nanoparticles with ultrasound radiation. Technol Cancer Res Treat 2005;4:217–26.

[9] Torchilin VP. Recent advances with liposomes as pharmaceutical carriers. Nat Rev Drug Discov 2005;4:145– 60.

[10] Bangham AD, Standish MM, Watkins JC. Diffusion of univalent ions across the lamellae of swollen phospholipids. J Mol Biol 1965; 13:238 –52.

[11] Green MR, Manikhas GM, Orlov S, et al. Abraxane, a novel Cremophor-free, albumin-bound particle form of paclitaxel for the treatment of advanced non-small-cell lung cancer. Ann Oncol 2006;17:1263– 8.

[12] Ellerhorst JA, Bedikian A, Ring S, et al. Phase II trial of Doxil for patients with metastatic melanoma refractory to frontline therapy. Oncol Rep 1999;6:1097–9.

[13] Fassas A, Anagnostopoulos A. The use of liposomal daunorubicin (DaunoXome) in acute myeloid leukemia. Leuk Lymphoma 2005;46:795– 802.

[14] Wang YX, Hussain SM, Krestin G. Superparamagnetic iron oxide contrast agents: Physicochemical characteristics and applications in MR imaging. Eur Radiol 2001;11:2319 –31.

[15] Jain RK. Delivery of molecular and cellular medicine to solid tumors. Adv Drug Deliv Rev 2001;46:149 – 68.

[16] Yuan F, Dellian M, Fukumura D, et al. Vascular permeability in a human tumor xenograft: Molecular size dependence and cutoff size.Cancer Res 1995;55:3752– 6.

[17] Kong G, Braun RD, Dewhirst M. Hyperthermia enables tumorspecific nanoparticle delivery: Effect of particle size. Cancer Res 2000;60:4440 –5.

[18] Jain RK. Transport of molecules in the tumor interstitium: A review. Cancer Res 1987;47:3039 –51.

[19] Maeda H, Wu J, Sawa T, et al. Tumor vascular permeability and the EPR effect in macromolecular therapeutics: A review. J Control Release 2000;65:271– 84.

[20] Kirpotin DB, Drummond DC, Shao Y, et al. Antibody targeting of long-circulating lipidic nanoparticles does not increase tumor localization but does increase internalization in animal models. CancerRes 2006;66:6732– 40.

[21] Farokhzad OC, Jon S, Khademhosseini A, et al. Nanoparticleaptamer bioconjugates: A new approach for targeting prostate cancer cells. Cancer Res 2004;64:7668 –72.

[22] Farokhzad OC, Cheng J, Teply BA, et al. Targeted nanoparticleaptamer bioconjugates for cancer chemotherapy in vivo. Proc Natl Acad Sci USA 2006;103:6315–20.

[23] Chiu SJ, Ueno NT, Lee RJ. Tumor-targeted gene delivery via antiHER2 antibody (trastuzumab, Herceptin) conjugated poly ethylenimine. J Control Release 2004;97:357– 69.

[24] Cheng J, Teply BA, Sherifi I, et al. Formulation of functionalized PLGA-PEG nanoparticles for in vivo targeted drug delivery. Biomaterials 2007;28:869 –76.

[25] Bagalkot V, Farokhzad OC, Langer R, et al. An aptamer-doxorubicin physical conjugate as a novel targeted drug-delivery platform. Angew Chem Int Ed Engl 2006;45:8149 –52.

[26] Arencibia JM, Schally AV, Krupa M, et al. Targeting of doxorubicin to ES-2 human ovarian cancers in nude mice by linking to an analog of luteinizing hormone-releasing hormone improves its effectiveness. Int J Oncol 2001;19:571–7.

[27] Guzman LA, Labhasetwar V, Song C, et al. Local intraluminal infusion of biodegradable polymeric nanoparticles. A novel approach for prolonged drug delivery after balloon angioplasty. Circulation 1996;94:1441– 8.

[28] Bourlais CL, Acar L, Zia H, et al. Ophthalmic drug delivery systems—recent advances. Prog Retin Eye Res 1998;17:33–58.

[29] Eerikainen H, Kauppinen EI. Preparation of polymeric nanoparticles containing corticosteroid by a novel aerosol flow reactor method. IntJ Pharmacol 2003;263:69 – 83.

[30] Holland TA, Mikos AG. Biodegradable polymeric scaffolds. Improvements in bone tissue engineering through controlled drug delivery. Adv Biochem Eng Biotechnol 2006;102:161– 85.

[31] Schroder U, Sabel BA. Nanoparticles, a drug carrier system to pass the blood-brain barrier, permit central analgesic effects of i.v. dalargin injections. Brain Res 1996;710:121– 4.

[32] Moghimi SM. Recent developments in polymeric nanoparticle engineering and their applications in experimental and clinical oncology. Anticancer Agents Med Chem 2006;6:553– 61. Yatvin MB, Kreutz W, Horwitz BA, Shinitzky M. pH-sensitive liposomes: possible clinical implications. Science 1980;210:1253–1255.

[33] Kong G, Anyarambhatla G, Petros WP, et al. Efficacy of liposomes and hyperthermia in a human tumor xenograft model: importance of triggered drug release. Cancer Res 2000;60:6950–6957.

[34] Stohrer M, Boucher Y, Stangassinger M, Jain RK. Oncotic pressure in solid tumors is elevated. Cancer Res 2000;60:4251–4255.

[35] Omelyanenko V, Gentry C, Kopeckova P,Kopecek J. HPMA copolymer-anticancer drugOV-TL16 antibody conjugates. II. Processing in epithelial ovarian carcinoma cells in vitro. Int J Cancer 1998;75:600–608.

[36] Omelyanenko V, Kopeckova P, Gentry C, et al. HPMA copolymer-anticancer drug-OV-TL16 antibody conjugates. 1. influence of the method of synthesis on the binding affinity to OVCAR-3 ovarian carcinoma cells in vitro. J Drug Target 1996;3:357–373.

[37] Ulbrich K, Etrych T, Chytil P, et al. Antibodytargeted polymer-doxorubicin conjugates with pHcontrolled activation. J Drug Target 2004;12:477–489.

[38] Wachters FM, Groen HJ, Maring JG, et al. A phase I study with MAG-camptothecin intravenously administered weekly for 3 weeks in a 4-week cycle in adult patients with solid tumours.Br J Cancer 2004;90:2261–2267.

[39] Goren D, Horowitz AT, Zalipsky S, et al. Targeting of stealth liposomes to erbB-2 (Her/2) receptor: in vitro and in vivo studies. Br J Cancer 1996;74:1749–1756.

[40] Guillemard V, Uri Saragovi H. Prodrug chemotherapeutics bypass p-glycoprotein resistance and kill tumors in vivo with high efficacy and target-dependent selectivity. Oncogene 2004;23: 3613–3621.

[41] Guillemard V, Saragovi HU. Novel approaches for targeted cancer therapy. Curr Cancer Drug Targets 2004;4:313–326.

[42] Pechar M, Ulbrich K, Subr V, et al. Poly(ethylene glycol) multiblock copolymer as a carrier of anticancer drug doxorubicin. Bioconjug Chem 2000;11:131–139.

[43] Lu ZR, Gao SQ, Kopeckova P, Kopecek J. Modification of cyclosporin A and conjugation of its derivative to HPMA copolymers. Bioconjug Chem 2001;12:129–133.

[44] James ND, Coker RJ, Tomlinson D, et al. Liposomal doxorubicin(Doxil): An effective new treatment for Kaposi's sarcoma in AIDS. Clin Oncol (R Coll Radiol) 1994;6:294 – 6.

[45] Gibbs DD, Pyle L, Allen M, et al. A phase I dose-finding study of a combination of pegylated liposomal doxorubicin (Doxil), carboplatin and paclitaxel in ovarian cancer. Br J Cancer 2002;86:1379 – 84.

[46] Gabizon A, Shmeeda H, Barenholz Y. Pharmacokinetics of pegylated liposomal Doxorubicin: Review of animal and human studies.Clin Pharmacokinet 2003;42:419 –36.

[47] Sadava D, Coleman A, Kane SE. Liposomal daunorubicin overcomes drug resistance human breast, ovarian, and lung carcinoma cells. J Liposome Res 2002;12:301–9.

[48] Reddy JA, Low PS. Enhanced folate receptor mediated gene therapy using a novel pH-sensitive lipid formulation. J Control Release 2000;64:27–37.

[49] Slepushkin VA, Simoes S, Dazin P, et al. Sterically stabilized pH-sensitive liposomes. Intracellular delivery of aqueous contents and prolonged circulation in vivo. J Biol Chem 1997;272:2382– 8.

[50] Turk MJ, Reddy JA, Chmielewski JA, et al. Characterization of a novel pH-sensitive peptide that enhances drug release from folatetargeted liposomes at endosomal pH. Biochim Biophys Acta 2002;1559:56 – 68.

# THE FUZZY-LOGIC ALGORITHM FOR PREDICTION OF LITHOSPHERE POLLUTION WITH PETROCHEMICAL SLUDGE

**Ph.D. S.V. Ostakh**

Assistant Professor, National University of Oil and Gas, Gubkin University, Leninsky Prospekt, 65, Building 1 119991, Moscow (Russia)

**ABSTRACT**.

*Multi-scenario forecasting of pollution migration processes is carried out on the basis of information obtained at the stage of pre-project analysis. It includes analysis of survey results and forecast of the movement of polluted effluents in soils.*

*The proposed algorithm takes into account the semantics of each specific analytical problem being solved for the process-structural computerized analysis of various scenarios for the release of petrochemical sludge into the environment and the transition from the resulting fuzzy set to the only clear ecological zoning of oil-contaminated lands.*

*The purpose of this work is to develop an algorithm for multi-scenario forecasting and situational modeling using fuzzy logic of lithosphere pollution by petrochemical sludge.*

*Key words and phrases: algorithm, forecasting, method, petrochemical sludge, pollution*

## INTRODUCTION

The impact of industrial enterprises of the petrochemical industry on the environment is associated with permanent or temporary penetration of components of oily waste as a result of: losses during their transportation and unloading, filtration of pollutants into soil layers and groundwater, secondary dusting and evaporation of light organic compounds, and, as a result, alienation significant territories.

Predicting the dynamics of petrochemical hazards and the consequences of emergency and emergency situations is feasible using subject-oriented cartographic material based on an assessment of the boundaries and probability of an event, taking into account adverse hydrometeorological conditions, time of year, day, terrain, environmental features and the nature of the use of territories.

The specificity of predicting the consequences of the impact of petrochemical sludge on the lithosphere is that in the overwhelming majority of cases one has to deal with probabilistic and random components of the negative impact, which brings the quality of forecasts closer to the level of hypotheses. In addition, when forecasting, one has to deal with intuitive and formalized methods. The impossibility of a complete mathematical formalization of the predictive model is an extremely difficult methodological problem.

Multi-scenario forecasting of pollution migration processes is carried out on the basis of information obtained at the stage of pre-project analysis. It includes analysis of survey results and forecast of the movement of polluted effluents in soils.

Multi-scenario forecasting of the movement of areal and deep pollution depends on many factors: the properties of pollutants, the type and characteristics of the rocks through which the flows pass, the general characteristics of the climate and terrain (temperature, humidity, proximity to water bodies, seismic activity, etc.).

Multivariate analysis and multi-scenario forecasting allow taking into account the above factors using modern methods of analytical mechanics, mathematical scenario analysis and decision theory. At the same time, multifactorial dependences of surface runoff and underground hydromechanics are used, as well as existing ideas about the dynamics of technogenic flows and the vulnerability of natural-anthropogenic complexes. They have a different nature and dimension. In solving such weakly formalized problems, the theory of fuzzy sets is an effective forecasting tool.

The purpose of this work is to develop an algorithm for multi-scenario forecasting and situational modeling using fuzzy logic of lithosphere pollution by petrochemical sludge.

## MATERIALS AND METHODS

In general, the process of using fuzzy logic methods in solving the tasks of complex interpretation consists of three main parts: obtaining input signals, which are transformed into fuzzy sets of systematized data with various purposes using the blur operator ("fuzzyfire") and membership functions; using a set of rules (most

often logical operators with embedded mathematical formulas) to determine the sequence of actions, purpose and method of data processing; restoration of clarity (defuzzification).

Defuzzification is directly a method of determining output data in a familiar form for further processing and presentation.

The defuzzification method should be chosen taking into account the semantics of each specific applied problem being solved and the transition from the resulting fuzzy set to a single clear value.

The process of data aggregation within selected sets, which depends mainly on the initial types of information and the selected categories for the set of rules, is the main step in processing the information received (Arai B., Das G., Gunopulos D., Kalogeraki V., 2006). It can be performed in a fully automated mode in real time, taking into account real computational costs, with the initial determination of the main parameters of the system functioning and the availability of only a priori information about the ranges of their expertly important values.

The most dangerous consequence of this kind of pollution is the penetration of pollutants into deep geological layers and their further vertical and horizontal migration, which increases the total area and volume of pollution. Such pollution is unpredictable, the processes and characteristics of its movement are difficult to predict.

The implementation of a fuzzy-logical algorithm (Figure 1) for predicting pollution of the lithosphere with petrochemical sludge also involves the use of a set of methods for system analysis and mathematical modeling:

the method of physical and geographical analogies in combination with remote sensing of the Earth (Díaz Varela, R. A., P. Ramil Rego, S. Calvo Iglesias, and C. Muñoz Sobrino, 2008);

method of expert assessments for assessing impacts that are not directly measurable (Morgan, R.K. Environmental impact assessment, 2012);

"list method" and "matrix method" to identify significant impacts and the nature of secondary pollution (Klopper, R., Lubbe, S., & Rugbeer, H., 2007);

the method of cause-and-effect relationships for the analysis of indirect impacts (Barrow, C.J.,1997);

calculation method for determining projected emissions, discharges and volumes of production waste generation.

In the considered system of environmental monitoring and forecasting, it is necessary to single out "regular observations - measurement of pollution levels - a model of environmental dynamics - pollutant migration".

Analysis of the data obtained in the course of a complex of engineering surveys, as well as pre-project analysis, makes it possible to draw up maps of the studied areas with the characteristics of individual sections and the most vulnerable areas in relation to technogenic polluted flows.

To aggregate the characteristics in order to build vulnerability maps of natural and anthropogenic complexes, the following existing approaches to fuzzy data systematization were used:

weighted geometric assessment (the method is based on the method of aggregating a multi-criteria assessment into a single-criteria form using a ratio):

$$h_{A_0} = h_1^{w_1} \cdot h_2^{w_2} \cdots h_n^{w_n} \qquad (1)$$

weighted arithmetic estimate based on the ratio:

$$h_{A_1} = \sum_{i=1}^{n}(w_i \cdot h_i) \qquad (2)$$

set intersection method (assigning the minimum value from the totality of all parameters):

$$h_{A_2} = \min_{i = 1 \ldots n} (h_i). \qquad (3)$$

In the given ratios, $h_i$ is the score according to the $i$-th criterion, $w_i$ is the coefficient of significance of the $i$-th criterion.

The results obtained using the above methods, with the possibility of summing unequal "weights" of indicator elements proportional to their membership functions, are considered as: the result of using a weighted geometric estimate.

The next step provides for multi-scenario forecasting of the movement of areal and situational modeling of deep pollution. It depends on the following main factors: the properties of pollutants, the type and characteristics of the rocks through which the flows pass, the general characteristics of the climate and terrain (temperature, humidity, proximity to water bodies, seismic activity, etc.).

The complexity of the dependence of the situation of the development of events on technological, hydrogeological, landscape-geochemical, meteorological, and chemical groups of factors (S.V. Ostakh, M.P. Papini, P. Ciampi, N.Yu. Olkhovikova, 2019) and, at the same time, the need to involve hardware and software systems integrated into the environmental monitoring system to build model ideas about the dynamics of pollution and migration of oil products in the natural environment, as a form of implementation of the initial stage of the task, argued the need to use graph theory.

Figure 2 shows the system digraph $\vec{G}\ (V, R)$, where $V$ are the scenarios, $R$ are the groups of factors influencing $v_i$ for the transition to $v_j$.

$\vec{G}$ is the development digraph of the analyzed events.

The marker method of scoring scenario evaluation was used to visualize the degree of danger $\{v_i,\ v_{i+1}, .. v_{j-1}, v_j\}$ and situational modeling.

It is supposed to select the level of detail required by the user in the analysis and mathematical situational cartographic modeling.

In any case, situational modeling begins with some expert (exogenous in relation to the object) description, which synthesizes the initial expertly significant information about the course of the phenomenon under study.

The implemented sequence of analysis of the initial data obtained in the course of a complex of engineering surveys, as well as pre-project analysis, makes it possible to map the studied zones with the characteristics of individual sections and the most vulnerable territories in relation to the results of establishing structural and dominant signs of lithosphere pollution by petrochemical sludge.
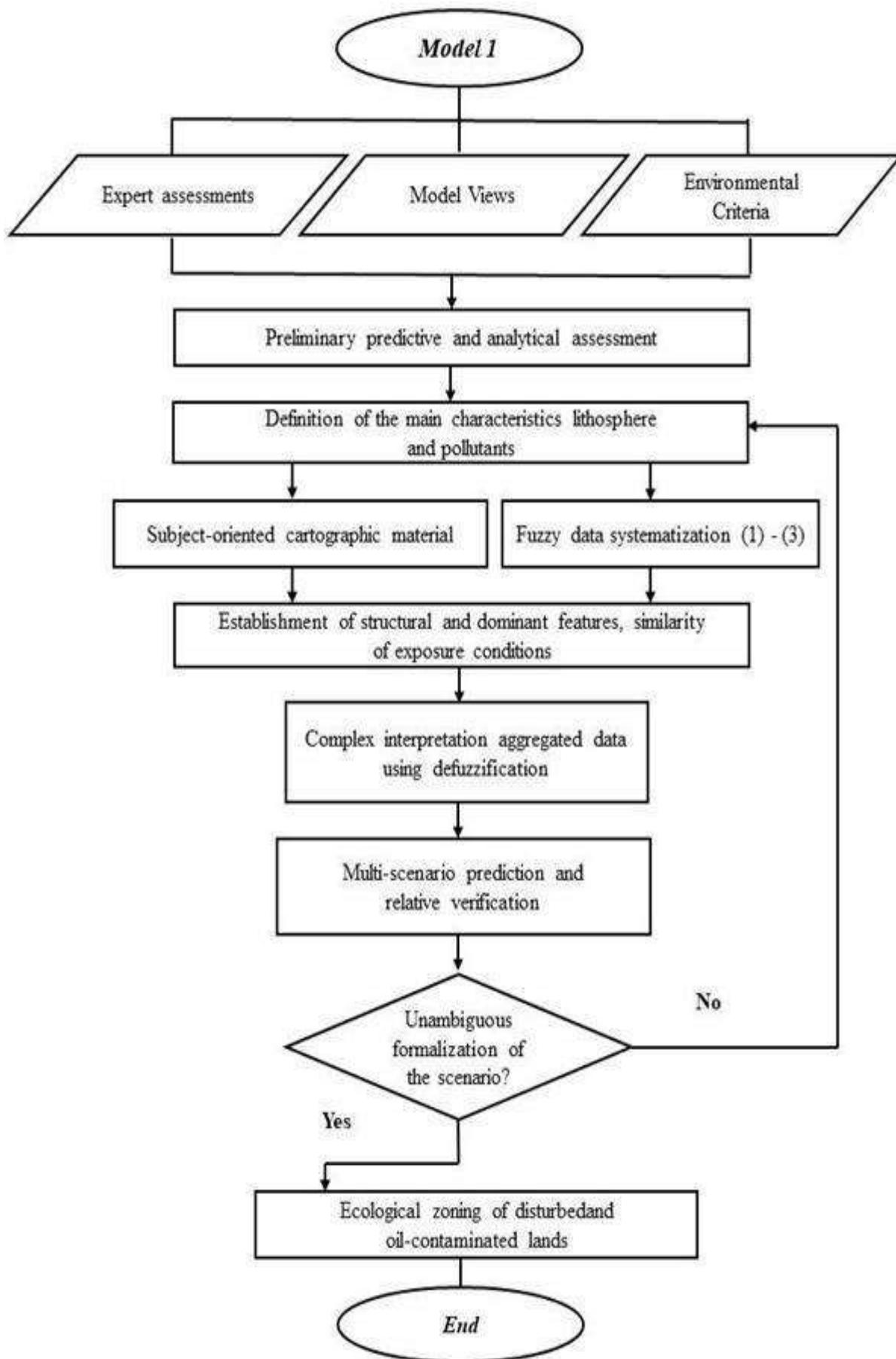
**Figure 1**. The block diagram of the proposed algorithm
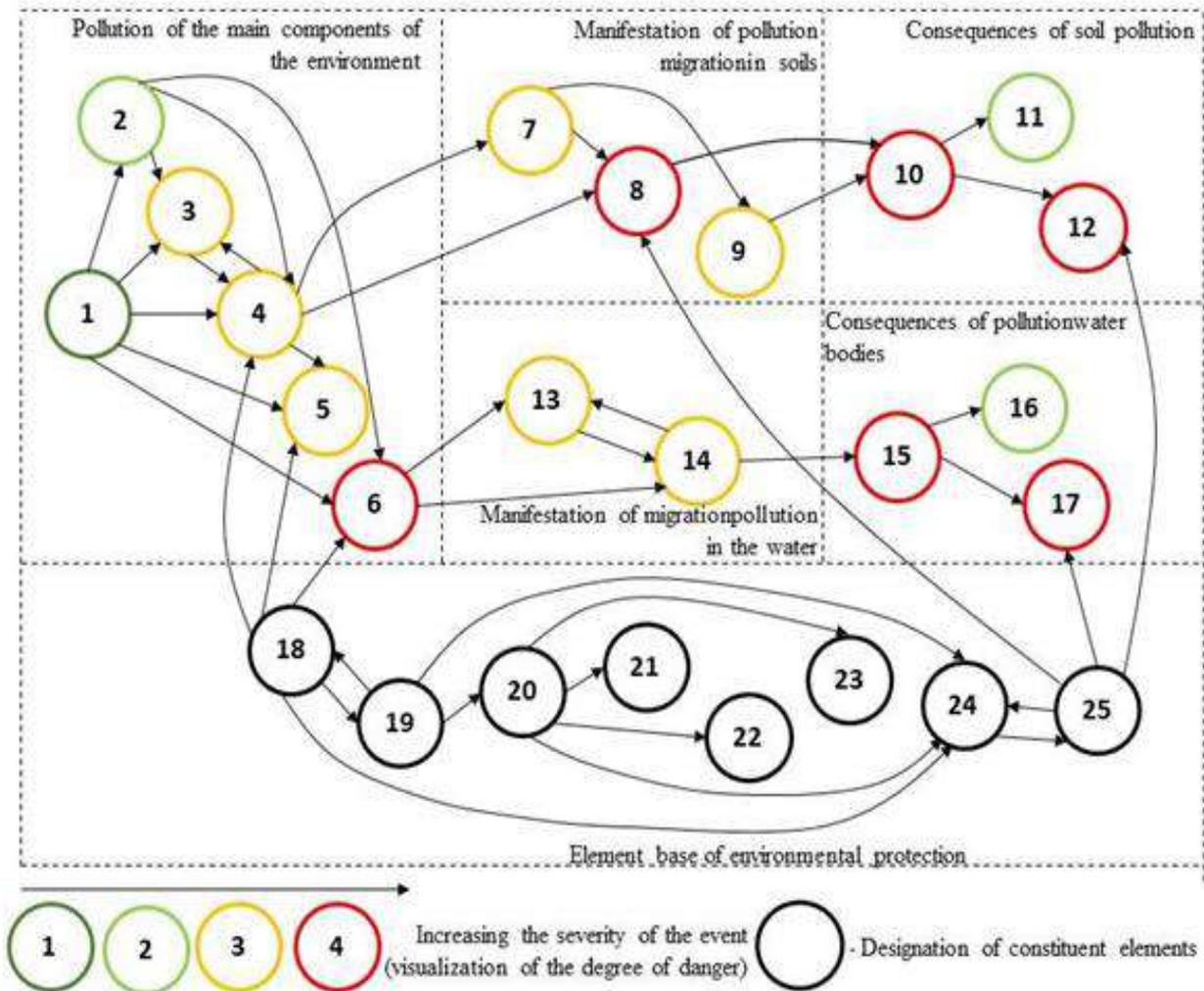
**Figure 2**. The enlarged graph of forecasting pollution of the environment by petrochemical sludge: (1. Natural-anthropogenic complex; 2. Oil spill and petrochemical liquid waste; 3. Air pollution with vapors of petroleum products, products and their derivatives 4. Pollution of the day surface 5. Pollution of deep layers soil 6. Pollution of a water body 7. Migration of oil products into the aeration zone 8. Ingress of pollution into groundwater 9. Erosion of the pollution front 10. The appearance of soil and water pollution is not taken into account 11. Adaptation of soil biocenosis 12. Violation of the functions of soil biogeocenosis up to complete destruction 13. The appearance of a film on the surface of the water 14. The appearance of oil products and their derivatives in the coastal zone 15. The appearance of pollution in the water body is ignored 16. Adaptation of the aquatic biocenosis 17. Violation of the functions of aquatic biogeocenoses up to their complete cessation;18 19. Collection and localization of pollution 20. Identification of pollution and their consequences th; 21. Artificial geochemical barrier; 22. Environmental barrier (with filler); 23. Environmental impenetrable barrier; 24. Environmental impact monitoring; 25. Development and implementation of a complex of rehabilitation measures)

## RESULTS

Analysis of the data obtained in the course of a complex of engineering surveys, as well as pre-project analysis, makes it possible to compile maps of the studied areas with the characteristics of individual areas and the most vulnerable areas in relation to the results of establishing structural and dominant signs of lithosphere pollution by petrochemical sludge.

An effective forecasting tool is the theory of fuzzy sets with the adaptation of the defuzzification method when aggregating the output data within the selected sets in the required form to present maps of the studied areas with the characteristics of individual areas and the most vulnerable areas in relation to technogenic polluted flows.

An example of the implementation of multi-scenario forecasting using the proposed methodological approach and an expertly significant level of detail is shown in Figure 3.
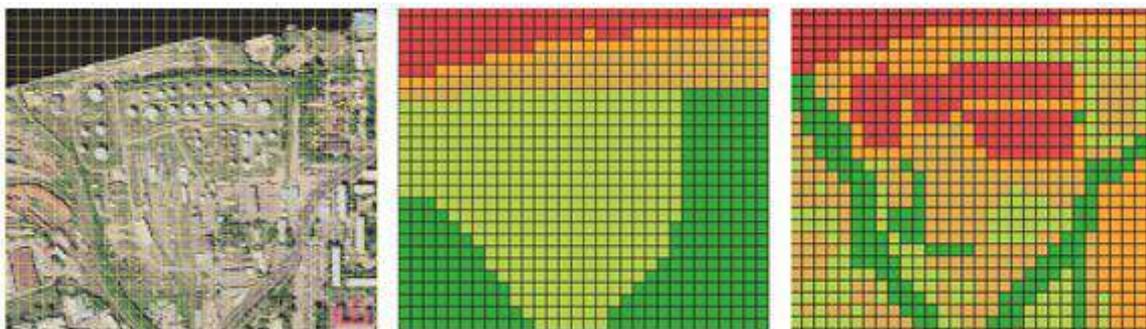
**Figure 3**. The example of the implementation of multi-scenario forecasting (natural-anthropogenic complex (left); manifestation of pollution migration in soils (center); consequences of soil pollution (on right)

## CONCLUSIONS

The effectiveness of the integration of environmental safety systems largely depends on the scientific substantiation of its theoretical and methodological foundations, criteria for evaluating various factors and indicators of changes and violations based on predicting the consequences of environmental pollution during man-made accidents.

An effective tool for process-structural computerized analysis of various scenarios for the release of petrochemical sludge into the environment is the theory of fuzzy sets with the adaptation of the defuzzification method when aggregating the output data within the selected sets in the required form to present maps of the studied zones with characteristics of individual areas and the most vulnerable areas.

The proposed algorithm takes into account the semantics of each specific analytical problem being solved for the process-structural computerized analysis of various scenarios for the release of petrochemical sludge into the environment and the transition from the resulting fuzzy set to the only clear ecological zoning of oil-contaminated lands. It is provided for when conducting one-time and regular observations with the systematic use (combination) of modeling methods, remote and other methods of operational data acquisition.

The regular and systematic conduct of the considered studies makes it possible to predict the dynamics of the deposition and spread of oil pollution.

## REFERENCES

1. Díaz Varela, R. A., P. Ramil Rego, S. Calvo Iglesias, and C. Muñoz Sobrino, 2008, Automatic habitat classification methods based on satellite images: A practical assessment in the NW Iberia coastal mountains. Environmental Monitoring and Assessment, 144, 229-250.

2. Morgan, R.K. Environmental impact assessment, 2012, The state of the art. Impact Assess. Proj. Apprais., 30, 5–14.

3. Klopper, R., Lubbe, S., & Rugbeer, H., 2007, The matrix method of literature review. Alternation, 14(1), 1-17.

4. Barrow, C.J.,1997, Environmental and Social Impact Assessment. London: Arnold. p. 310.

5. Arai B., Das G., Gunopulos D., Kalogeraki V., 2006, Approximating aggregation queries in peer-to-peer networks. In: Proceedings of the 22nd international conference on data engineering, p. 42.

6. Ostakh S.V., Papini M.P., Ciampi P., Olkhovikova N.Yu., 2019, Integration of methods of geophysical and ecological forecasting of the consequences of deep environmental pollution during the operation of petrochemical industry facilities, Protection of the environment in the oil and gas complex, 2 (287), 5-11. – DOI 10.33285/2411-7013-2019-2(287)-5-11.

## STATISTICAL INTERPRETATION OF HEAVY METAL DISTRIBUTION IN MAGDALLA AREA OF TAPI ESTUARY, SURAT

[1]Dr. Ranjana Bengani and [2]Prof. Dr. Mohini Gadhia
[2]Former HOD, Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat, Gujarat, India

**ABSTRACT**

*The speedy industrialization and unregularized anthropogenic activities have severely threatened the natural environment. Among the different types of pollutants dispersed in water bodies, heavy metals are one among of the major pollutants that could pose a serious threat because of their toxicity, extended persistence, bioaccumulation and biomagnification characteristics. During the present investigation Mercury (Hg), Cadmium (Cd), Lead (Pb), and Zinc (Zn) were assessed in the water, sediment, and fish (Boleophthalmus dussumieri) from Magdalla area of Tapi estuary in order to monitor the status of the estuary with reference to these metals. The assessment of heavy metals was done using Atomic Absorption Spectrophotometer (AAS). Heavy metals were distributed in the order Pb>Zn>Cd> Hg in water whereas the order was Zn>Pb>Cd> Hg in sediment and fish. The distribution of heavy metals mercury, cadmium, lead and zinc in three levels were in order sediment>fish>water from the sampling site. The investigation showed elevating level of heavy metals in environment. Thus, a serious interpretation and steps are required to control industrial and manmade pollution which has depreciated the estuary. Mann-Whitney test revealed statistically significant difference in the average value of only mercury in water and sediment whereas significant differences in the average concentration of mercury, lead and zinc was found in the fish between two years. Kruskal-Wallis test showed a strong significant difference in the distribution of heavy metals in water, sediment and fish(p<0.05).The study showed increased concentration of heavy metals in the sediment which can be harmful for the aquatic ecosystem. A continuous monitoring and serious remedial measures are required to control industrial as well as anthropogenic pollution in the estuary.*

*Keywords: heavy metals, water, sediment, fish, bioaccumulation*

## INTRODUCTION

Environmental pollution and degradation of water quality with wide range of pollutant is a worldwide problem and among them heavy metals hold its place to the most important pollutants. The advancement of industries has led to increased emission of pollutants into aquatic ecosystems as these bodies receives effluents discharged from industrialized and highly populated settlements. Metals tend to accumulate in water and pass up through the successive food chain. It is important to determine the level of heavy metals in environment and possible hazardous impact on aquatic ecosystem.

Due to the industrial and economic growth, the production of a variety of compounds and chemicals followed by increased consumption had cause serious problems and risks for the environment and man himself. Wastes from municipal, industrial, and agricultural sources enters the water bodies that brings in physical, chemical and biological changes in the water. One of the most crucial properties of these metals, which differentiate them from other toxic pollutants, is that they are not easily biodegradable in the environment (Nasrabadi, 2015)

Estuaries are the most productive aquatic ecosystem that are under serious threat due to urbanization and industrialization. Estuaries are characterized with high biological productivity, providing habitat to immense number of organisms. These productive ecosystems are constantly under stress from various pollutants such as metals, persistent organic compounds, pesticides and hydrocarbons. Monitoring and assessment of the water pollution in water bodies has become a very critical area of study because of direct influences of water pollution on the aquatic life and the human beings (Manoj et al., 2012). Heavy metals though they occur naturally, are increasing in the environment as a result of anthropogenic activities such as burning of fossils fuels, agricultural practices, mining and various other industries (Dickinson et al, 2019). Heavy metals are natural constituents of the environment, but the increase in their concentrations has been reported extensively in many coastal environments. In the recent past, a great volume of scientific literature has been reviewed concerning the sources, fate and transport, toxicity, mode of action and bioaccumulation of metals in food chain organisms in the coastal realms (Tao et.al, 2012). Both natural and anthropogenic activities are responsible for the abundance of heavy metals in the environment (Khan et al., 2008). Effluents from mining, electroplating, metallurgy, machinery, automobile, refinery, combustion of coal/fuel oil, agriculture and domestic are discharging metals into coastal waters (Burakov et al, 2018). Water bodies and sediments suffer impacts from many of these sources and can carry pollutants to other sites. Sediments which usually act as reservoir of these pollutants, interact directly with the environment, thus can serve as an important indicator of the effects caused by

pollution and human activities (Sodrzeieski et al, 2019). Metals tend to adsorb from water columns onto surfaces of particles and they are settled into the sediment. Metals can be accumulated in the tissues of marine organisms from the water, sediment, suspended particulate materials. Several studies have demonstrated metal contamination in seawater, sediments and bioaccumulation in coastal and estuarine ecosystems of India (Surana et al, 2019; Dickinson et al, 2019; Burakov et al, 2018; Surana et. al, 2015; Dhanakumar et al, 2015 and Gupta et al, 2009). The increasing pollution by heavy metals have a significant adverse health effect for invertebrates, fish, and humans (Martin et al., 2015). Bioaccumulation is the indication of bioavailability and it could be a biomarker of metal pollution. Bio-indicator organisms are able to bio-accumulate metals from contaminated ambient environments (Duarte et al, 2020).

Heavy metals are always present in waters from disintegration and due to run-off from anthropogenic sources (Laar et al,2011). Within the water body fish are also a major sink for heavy metals. They ingest and amasses heavy metals through bio-magnifications (Abdel et al,2015). A comprehensive study of metal contamination during different period around India revealed that estuaries are affected by pollutants (Chakraborty et al, 2014). According to Li et al, 2019, heavy metals viz. Cu, Cr, Cd, Pb and Ni are increasing globally in the inland and coastal waters especially regions of developing countries like India. Thus, it is vital to explore the status of heavy metal pollution in estuarine samples. The present study was undertaken to assess the concentration and distribution of heavy metal in water, sediment and fish from Tapi estuary in Magdalla area.

## MATERIALS AND METHODS:
The sampling site is situated in the south of Gujarat about 15 km from Surat city at $21^o\ 08'47.13''$ N and $72^o\ 45'\ 7.81''$ E



**Heavy Metals Analysis**:
Water, sediment and fish samples were collected every month in the morning during low tide from June 2011 to May 2013 from Tapi estuary near in Magdalla area.

Four heavy metals viz. mercury, cadmium, lead and zinc were estimated in water, sediment and fish with the aid of Atomic Absorbance Spectrophotometer (AAS).

**Water analysis**
Acid preserved water sample (100 ml) was taken in a beaker and 10 ml of nitric acid was added. It was then brought to a slow boil and evaporated on a hot plate to the lowest volume possible (about 10 to 20 ml) before precipitation occurred. Heating was continued with the addition of concentrated nitric acid till digestion was completed indicating a light-coloured clear solution. Care was taken not to let sample get dried during the digestion. Beaker wall was washed with distilled water and volume was made up to 100 ml by adding distilled water. The sample was then filtered and the filtrate was collected for AAS analysis.

**Sediment analysis**
Sediment was dried in an oven at $55^0$c for 48 hours and fine powder was made by grinding 0.5 gm of powdered sediment which was weighed in a Teflon beaker containing little distilled water. Ten ml of concentrated acids was added in the order of hydrofluoric acid (HF), perchloric acid, nitric acid and hydrochloric acid. The acid was added in a sequence only after allowing each content to dryness by evaporating on a hot plate in a fume hood. Finally, 0.1 N HCL was added to dissolve the contents and the volume was made to 25 ml. The solution was filtered and collected for AAS analysis for heavy metals.

**Fish analysis**
Tissue samples collected from the fish (*Boleophthalmus dussumieri*) were oven dried at $80^0$C for 24 hours and fine powder was made by grinding. One gm of the sample was taken and 10 ml of concentrated nitric acid was added at $60^0$c for 30 minutes. Subsequently, 1 ml of 30 % hydrogen peroxide was added to further oxidize any

recalcitrant lipid materials in the sample. The digested tissues were further diluted to 50 ml with deionized water and filtered. The filtrate was the analysed for heavy metals using AAS.

**RESULT AND DISCUSSION:**

The average value of heavy metals distributed in water was found in order Pb>Zn>Cd> Hg in both the sampling years (2011-12 and 2012-13). The dispersal of average value of heavy metals in sediment and fish was in order Zn>Pb>Cd> Hg in both the sampling years (2011-12 and 2012-13).

Mercury, cadmium, lead and zinc concentration in three levels was found in increasing order, highest in sediment and lowest in water samples (Fig.1,2, &3).

**Fig.1,2 and 3 illustrates concentration and distribution of heavy metals in water, sediment and fish**
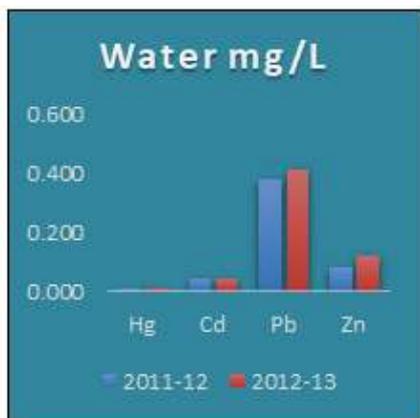


Fig.1
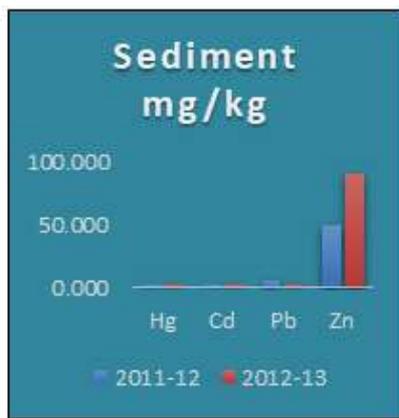


Fig.2
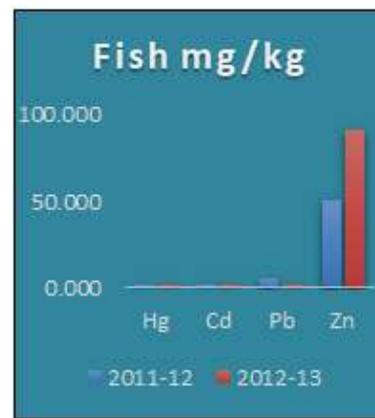


Fig. 3

The Mann-Whitney test between two sampling years showed significant difference in the average

values of mercury in water, sediment and fish ($p < 0.05$). Cadmium showed no significant difference between two studied years. Lead and Zinc showed significant differences in their average concentration in fish ($P<0.05$) at the significance level of 95%. (Table 1)

**Table 1:** Mann-Whitney test to reveal statistically significant difference in the average value of heavy metals concentration in water, sediment and fish between sampling years

| Levels | | Mercury | Cadmium | Lead | Zinc | |
|---|---|---|---|---|---|---|
| Water | Asymp. Sig. (2-tailed) | 0.042 | 0.862 | 0.791 | 0.861 | |
| Sediment | | 0.006 | 0.977 | 0.225 | 0.248 | |
| Fish | | 0.024 | 0.671 | 0.017 | 0.004 | |

The statistical analysis between three levels (water, sediment and fish) showed strong significant difference in the distribution of average values of mercury, cadmium, lead and zinc between three levels ($p < 0.05$) at the significance level of 95% (Table 2)

**Table 2.** Kruskal Wallis Test with grouping variables level (water, sediment and fish)

| Sn. | Metal | Asymp. Sig.(2-tailed) |
|---|---|---|
| 1 | Mercury | 0.00 |
| 2 | Cadmium | 0.00 |
| 3 | Lead | 0.00 |
| 4 | Zinc | 0.00 |

The post Hoc test revealed strong significant difference in the concentration of heavy metals between water and sediment as well as sediment and fish. Distribution of metals in water and fish was statistically significant for Zinc only showing no significant difference between other metals (Table 3).

**Table 3.** Post hoc test between different level (water, sediment and fish)

| Levels | | Mercury | Cadmium | Lead | Zinc |
|---|---|---|---|---|---|
| Water &Sediment | Asymp. Sig. (2-tailed) | 0.00 | 0.00 | 0.00 | 0.00 |
| Water &Fish | | 0.080 | 0.289 | 0.561 | 0.00 |
| Sediment &Fish | | 0.009 | 0.00 | 0.00 | 0.00 |

Mercury, lead and cadmium have been reported to be most injurious for aquatic life (Rasheed, 2001). The present investigation revealed that the mean concentration of mercury, cadmium, lead and zinc in water were higher than the permissible limits recommended by USEPA (1986). This might be attributed to the unregularized and untreated raw sewage, agricultural and industrial wastewater into the studied water body. Similar observations were revealed during the research carried out in different water bodies by Gupta et al (2009); Bhuiyanet al (2011), Kumar et al (2012) Abdel and Mahmoud (2015); to Li et al, 2019; Bengani and Gadhia (2021).

According to Vardi and Chenji (2020), fish and sediments are the best bio-indicator recognised for the assessment of heavy metals in the natural aquatic ecosystem. The study conducted by Wang and Guo also revealed that the heavy metals which are released into the aquatic habitats are quickly absorbed by the plankton and get absorbed by the suspended particles that ultimately settle down and become part of the bed sediments (Wang and Guo 2000). Heavy metals present in sediments are mobilized in the aquatic components due to significant changes in physico-chemical characteristics of water (Kelderman et al., 2000). The chemicals discharged into the aquatic bodies are ultimately adsorbed by the sediments that would sink and becomes source of pollution. The investigation during the present research work revealed that the average concentration of the studied heavy metals in the sediment was above the threshold effect sediment quality guidelines for metals (MacDonald et al., 2000). The concentrations of heavy metals in sediment increase as the amount of organic material increases. The high level of Cd and Pb in sediments could be attributed to the industrial and agricultural discharge as well as from spill of leaded petrol from fishing boats (Hardman et al., 1994). The results of the present study showed polluted nature of the sediment from various industrial and anthropogenic activities.

The study findings exhibited that the heavy metals concentrations in fish muscle was closely associated with metal content of sediments and followed the same pattern of distribution. The post hoc test also supported the findings where significant difference was strong between the concentration in water samples and sediments samples. A notable association between heavy metals concentrations in aquatic organisms and sediments were also observed by Ibrahim and Naggar (2006). The muscle tissue of fish (*B. dussumieri*) collected from the studied area showed that all the studied heavy metals far exceeded their concentration those given standard by the national and international agencies (USEPA, 1986 and FAO/WHO, 2011) The elevated concentration in fish may pose health risk to consumer (Lee et al., 2007 and Reza and Singh, 2010). The health issues may be due to high concentration, persistence, bioaccumulation, and biomagnification of heavy metals in the aquatic environment from the consumption of fish species from contaminated water source over some time (Andreji et al, 2005; El-Moselhy et al. 2014; Zhao et al. 2012). Highest concentration of Zinc in muscle tissue followed by other heavy metals could be explained by the fact that zinc is one of the essential elements in the bodies of living organisms and has an important role in different physiological processes. According to Vardi and Chenji, 2020 Zinc, an essential metal, is regulated by many organisms because it does not bio magnify in the aquatic organism. This is because many aquatic animals absorb Zn majorly from water and sediments but not in the food they consume. In the present study also significant difference in the concentration of Zinc was found between concentration in water and fish. This order of concentration might be attributed to the different uptake, metabolism and detoxification of metals in fish (Ibrahim and Naggar, 2006). Similar observation was also recorded by Huang (2003) in common benthic fishes (Zn > Cu > Cd = Pb). Similarly, Bahnasawy et al., (2009) found that the average concentrations of the metals in fish tissues from Lake Manzala, Egypt exhibited order of Zn>Cu>Pb>Cd. These findings corroborate and validate the results obtained in the present study.

## CONCLUSION
Several industries are found discharging their effluent to the aquatic environments causing serious concerns on the water quality of Tapi estuary. The findings suggested that heavy metal concentrations in all the abiotic and biotic level were exceeding regulatory limits which may harm the functioning of the aquatic environment posing serious threat to human being. More so, the increased level in sediment if not reduced, may lead to health hazards. The present findings also confirmed that mudskipper *(B. dussumieri)*, an edible fish could significantly bioaccumulate heavy metals in long period and affect the species consuming these fish. However, continuous monitoring of the water, sediment and fish in the estuary is required by the monitoring and regulatory bodies to account the concentrations of heavy metals in the estuary.

## REFERENCES:

- Abdel-Mohsien H. S. and Mahmoud M. A. M. (2015). Accumulation of some heavy metals in *Oreochromis niloticus* from the Nile in Egypt: potential hazards to fish and consumers, ‖ J. Environ. Prot. (Irvine,. Calif)., 6,(09), p. 1003

- Andreji, J., Stranai, I. Massanyi, P. and Valent, M. (2005) Concentration of selected metals in muscle of various fish species. Journal of Environmental Science and Health 40, 1-14.

- Bahnasawy. M., Khidr, A. and Dheina, N. (2009). Seasonal Variations of Heavy Metals Concentrations in Mullet, *Mugil cephalus* and *Liza ramada* (Mugilidae) from Lake Manzala, Egypt. J. App. Sci. Res., 5(7), 845-852.

- Bhuiyan, M.A.H., Islamc, M.A., Dampared, S. B., Parvezb, L. and Suzukia, S. (2010). Evaluation of hazardous metal pollution in irrigation and drinking water systems in the vicinity of a coal mine area of northwestern Bangladesh. Journal of Hazardous Materials, vol. 179, 1065–1077.

- Burakov A. E. Galunin E. V, BurakovaI. V., Kucherova A. E, Agarwal. S., Tkachev A. G., Gupta. V. K. (2018). Ecotoxicology and environmental safety adsorption of heavy metals on conventional and nanostructured materials for wastewater treatment purposes: a review Ecotoxicol. Environ. Saf., 702- 712

- Chakraborty. P, Ramteke. D., Chakraborty. S., Nagender Nath B(2014). Changes in metal contamination levels in estuarine sediments around India - an assessment Mar. Pollut. Bull. 15; 78 (1-2), 15-25.

- Dhanakumar. S., Solaraj. G., Mohanraj. R. (2015). Heavy metal partitioning in sediments and bio accumulation in commercial fish species of three major reservoirs of river Cauvery delta region, India Ecotoxicol. Environ. Saf. ,145-151

- Dickinson, A. W., Power, A., Hansen, M. G., Brandt, K. K., Piliposian, G., Appleby, P., et al. (2019). Heavy metal pollution and co-selection for antibiotic resistance: a microbial palaeontology approach. Environ. Int. 132:105117.

- Duarte G. S. C., Lehun A. L., Leite L. A. R., Consolin-Filho N., Bellay. S., Takemoto. R. M (2020). Acanthocephalans parasites of two Characiformes fishes as bioindicators of cadmium contamination in two neotropical rivers in Brazil, Sci. Total Environ.,738:140339

- El-Moselhy, K. M., Othman, A. I., El-Azem, H. A., & ElMetwally, M. E. A. (2014). Bioaccumulation of heavy metals in some tissues of fish in the Red Sea, Egypt. Egyptian Journal of Basic and Applied Sciences, 1(2)

- FAO/WHO (2011). Joint FAO/WHO food standards programme codex committee on contaminants in foods. Fifth session.

- Gupta, D.K. Rai, R.S. Pandey, B. Sharma (2009). Analysis of some heavy metals in the riverine water, sediments and fish from river Ganges at Allahabad Environ. Monit. Assess., 157, p. 449

- Hardman, D.J., Mceldowney, S. and Watte, S. (1994). Pollution, ecology and biotreatment. Longman Scientific, Technical, England.

- Huang, W. (2003). Heavy metal concentrations in the common benthic fishes caught from the coastal waters of Eastern Taiwan. J. of Food and Drug Analysis, 2 (4), 324-330

- Ibrahim, N.A and El-Naggar, G.O. (2006). Assessment of heavy metals levels in water, sediment and fish at cage fish culture at Damietta Branch of the river Nile. J. Egypt. Acad. Environ. Develop, 7 (1), 93- 1114

- Kelderman, P., Drossaert, W.M.E. and Zhang, M. (2000). Pollution assessment of the canal sediments in the city of Delft (The Netherlands). Water Research, 34 (3), 936-944.

- Khan, R., Israili, S.H., Mohan, A. (2005): Heavy metal pollution assessment in surface water bodies and its suitability for irrigation around the Neyveli lignite mines and associated industrial complex, Tamil Nadu, India. – Mine Water and Environment 24: 155-161

- Khan. S., Cao. Q., Zheng. Y. M., Huang. Y. Z., Zhu. Y. G. (2008). Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China

- Kumar, B., Sajwan, K.S., Mukherjee, D.P. (2012). Distribution of Heavy Metals in Valuable Coastal Fishes from North East Coast of India. Turkish Journal of Fisheries and Aquatic Sciences, 12,81-88.

- Laar. C., Fianko J. R., Akiti T. T., Osae S., and Brimah A. K. (2011). Determination of heavy metals in the black-chin tilapia from the Sakumo Lagoon, Ghana, ‖ Res. J. Environ. Earth Sci.,3,(1), pp. 8–13

- Lee, C. L.; Li, X. D.; Zhang, G.; Li, J.; Ding, A. J.; Wang, T. (2007). Heavy metals and Pb isotopic composition of aerosols in urban and suburban areas of Hong Kong and Guangzhou, South China Evidence of the long-range transport of air contaminants. Environ. Pollut., 41 ( 2),432-447.

- Li. Y., Zhou. Q., Ren. B., Luo. J., Yuan. J., Ding. X., Bian. Yao. H., X. (2019). Trends and health risks of dissolved heavy metal pollution in Global River and Lake Water from 1970 t0 2017 P.D. Voogt (Ed.), Reviews of Environmental Contamination and Toxicology, Springer, Cham pp. 22-28

- MacDonald, D.D., Ingersoll, C.G. and Berger, T.A. (2000). Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Env. Contam Toxicol., 39, 20–31.

- Manoj, K., Kumar, P. and Chaudhury, S. (2012). Study of Heavy Metal Contamination of the River Water through index Analysis Approach and Environmetrics Bull. Environ. Pharmacol. Life Sci.; 1, (10), 07 – 15

- Martin. J. A. R., Arana. C. D., Ramos-Miras. J. J., Gil. C., Boluda. R. (2015). Impact of 70 years urban growth associated with heavy metal pollution, Environ Pollut., 196 (2015), 156-163

- Nasrabadi, T. (2015). An Index Approach to Metallic Pollution in River Waters. Int. J. Environ. Res., 9, (1), 385-394

- Panday, J., Shubhashish, K. Richa, P. (2010): Heavy metal contamination of Ganga River at Varanasi in relation to atmospheric deposition. - Tropical Ecology 51: 365-373.

- Rasheed, M.N. (2001). Monitoring of environmental heavy metals in fish from Nasser Lake. Env. Int., 27, 27 – 33.

- Reza, R.; Singh, G., (2010). Assessment of heavy metal contamination and its indexing approach for river water. Int. J. Environ. Sci. Tech., 7(4), 785-792.

- Sodrzeieski P. A., Andrade. L. C. de, Tiecher T., and Camargo F. A. de, (2019). Physico-chemical variability and heavy metal pollution of surface sediment in a non-channeled section of Dilúvio Stream (Southern Brazil) and the influence of channeled section in sediment pollution, Rev. Ambient. Água,14(1)

- Surana. R, Gadhia. M and Ansari. E. (2015). Accumulation of lead in the muscle of brackish water fish (Boleopthalmus dussumieri), J. App. Nat. Sci 7 (2), 662 – 665

- Surana. R, Gadhia. M and Ansari. E. 2019.Assessment of heavy metal contamination in estuarine sediment, Gujarat, India, Int. J. Res. Analyt. Rev. ,6(1),104-109

- USEPA. (1986). Quality Criteria for Water. Office of Water Regulation and Standards, Washington DC, USEPA 40015-86-001, 256

- Vardi, V., & Chenji, V. (2020). Bioaccumulation of heavy metals in edible marine fish from coastal areas of Nellore, Andhra Pradesh, India. GSC Biological and Pharmaceutical Sciences, 10(01), 18–24.

- Wang, W.X., and Guo, I.D. (2000). Bioavailability of colloid-bound Cd, Cr, and Zn to marine plankton. Mar. Ecol. Prog. Ser., 202, 41– 49.

- Zhao, S., Feng, C., Quan, W., Chen, X., Niu, J., & Shen, Z. (2012). Role of living environments in the accumulation characteristics of heavy metals in fishes and crabs in the Yangtze River Estuary, China. Marine Pollution Bulletin, 64, 1163–1167

## USERSPACE IMPLEMENTATION OF PROTOCOL INDEPENDENT TRANSPORT API

**[1]Sangram Keshari Nayak, [2]Sarojananda Mishra and [3]Manoranjan Dash**

[1,2]Department of Computer Science and Engineering, Indira Gandhi Institute of Technology
Sarang, India

[3]Faculty of Management Sciences, Siksha O Anusandhan University, Bhubaneswar, India

## ABSTRACT

*One of the general purpose reliable transport protocol is Stream Control Transmission Protocol (SCTP). SCTP has a number of additional capabilities over TCP and UDP. Although TCP and UDP are widely used in networking environment, use of SCTP can not be ignored. Now a days SCTP is supported by all operating systems and applications. But difficulty lies in implementation of newly developed APIs, which can be troublesome in some operating systems. We have taken protocol independent API [1] as our basis for protocol implementation. In this paper we have studied available APIs and their implementations. We have chosen protocol independent API preferably and implemented in userspace. The proposal is very clear and we showed performance benefit of userspace implementation as compared to kernel implementations.*

*Index Terms—TCP, UDP, SCTP, multi-streaming, multi-homing, HOL*

## I. INTRODUCTION

Now a days due to exponential growth of Internet, more reliable and secure services are required by people. Over time people also has changed their service to IP based networks. Majority of internet users use TCP [2] as reliable transfer protocol, but it is not as reliable as when used in IP telephony networks. to overcome this deficiencies, SCTP [3] is another protocol came into existence, which was originally designed for telephony networks. But as the popularity and reliability is observed over general networking environment, it was adopted as an emerging transport protocol for use over internet and standardized. SCTP also provide higher data integrity by 32 bit checksum over 16 bit checksum for TCP [4]. SCTP has some innovative features as multi-streaming which avoids head-of-line (HOL) blocking within messages. SCTP can have more than one connections at a time which helps in fault tolerance mechanism. This is possible by switching to alternate path during network failure. Efforts have been made to support multi-streaming in TCP and UDP [5], [6]. Also efforts have been made for standardizing TCP to add multi path support [7] and stronger 32 bit checksum [8].

Since SCTP is having more features and services, Linux SCTP stack [9] has been included from kernel version 2.4 onwards. Consequently *sctplib* was released which also provides support to SCTP but unable to provide all the features [10]. Although *sctplib* was implemented in userspace, the popularity was far from expectation.

Many developments were made with respect to userspace stack. Several attempts were made using it user level [11]. Similar proposal was made by Siemon [12]. Although many attempts were made for TCP implementations [13], [14], [15], [16] in userspace, these failed to show similar performance metrics with kernel implementations.

So main intention of this work is to implement a socket API which is protocol independent and run in userspace. Further performance is projected and compared with generic implementations.

## II. RELATED WORKS

Main problem of new protocol is the deployment issues. Many scientists [17] have worked in the area of protocol development which will have additional features and services. In the next section we study on protocol implementations in user level and by virtualization.

### A. Alpine

Application Level Protocol Infrastructure (Alpine) [17] is networking tool designed by developers to achieve virtualization, where kernel level hardware routines were available to userspace by simulation. Resources are allocated without changing kernel. Virtualization is done in a manner not to affect kernel hardware and routines. Also it does not access hardware interfaces directly and hence does not violate the security policy of hardware. Resources are available through hardware simulation.

### B. Structured Streams

Structured stream [18] supports a hereditary structure, which allows different child streams for a single stream. It supports independent data streams to transact parallel. Here the author [18] emphasizes the use of streams for large and long transactions.

## III. CURRENT TRANSPORT APIS

This section describes currently available APIs. We study on convenience of protocol implementation with different APIs.

### A. Winsock

After development of Berkeley socket, Microsoft developed a socket like interface for Windows operating system called *WinSock*. This API corresponds use of similar API and aimed at easy migration of programs in Windows operating system.

### B. XTI API

Another API related to TCP/IP stack was developed, called Transport Layer Interface (TLI), but later renamed as X/Open Transport Interface (XTI) [19] after standardization by OpenGroup. XTI provides an independent API which can handle multiple communications at transport layer. Due to some distribution issue it has not became an emerging API for protocols.

### C. Socket API

Socket API, called Berkeley sockets is a standard API to access the network uniformly. The socket API does not only provide access to functionality of the transport layer, but also allows the direct use of the IP layer. The socket API consists of two standard procedures. There is one for the so-called "server" and there is another one for the "client". The server provides a service by listening to a specific port and the client requests the offered service from the server by connecting to it. There are several differences in the send/receive procedures for each supported transport protocol.

### D. Protocol Independent Socket API

A new API is developed [1] which decouples the protocol by the application. This has many benefits, where there is a independence to choose the particular protocol. This encourages the OS developers as well as application developers to develop applications independent to the particular deployment of protocol. The API is presented in [20]. In this paper our main objective is to implement this protocol independent API in userspace.

## IV. SCTP USERSPACE STACK

We try to create an SCTP stack on Linux. A library called *sctplib* [21] is available in Linux, but it lacks throughput and latency. Different kernel versions available for Linux which can be used for SCTP stack design. One of the favourable choice is FreeBSD, which has its own kernel implementation. Although Java SDK supports SCTP, but it utilizes the existing underlying kernel implementation [22]. There are three types of kernel implementation. One is use of SCTP stack by utilizing Berkeley sockets API. Here the transport protocol implementation forms a valid SCTP packet and passes to the IP layer. Then it performs routing table lookups for outward bound packets. Inward bound packets are demultiplexed to appropriate tuple and eventually to that application's socket. Inside kernel, SCTP interacts with NIC controller by the device driver. In kernel space design, host processor takes the responsibility of parsing of protocol and makes buffer copies and also does the context switch between userspace and kernel space. In this design, additional copies are avoided between networking layers. So here context switch overhead is avoided because all operations are done in userspace. Therefore major challenge lies to find out ways to reduce these overhead. In recent times multi core and virtualization technology makes easier to provide kernel bypass and more generic support for NIC.

Moving the transport layer to the userspace encompasses some merits over kernel space as it more portable as compared to sctplib implementation also. This also allows to run SCTP on small devices like cellular devices and mobile devices. Here user level stack development becomes more easier for SCTP. Here userspace is described to show how the code works on kernel [23]. There are two types of protocol interaction are given as Lower Layer Protocol (LLP) and Upper Layer protocol (ULP) interaction.

### A. Lower Layer Protocol

Originally SCTP was specified over IP but here SCTP stack interacts with LLP, where implementation done with the layer below it. So userspace stack is able to access SCTP protocol data units (PDUs) over IP. Therefore LLP interactions occur using IP socket that filters all SCTP traffic.

LLP Outbound: LLP Outbound interactions occur through the entire stack, thereby it passes the SCTP PDU downward. Therefore when the application sends data destined for other SCTP applications remotely, an Outbound interaction occurs. Then protocol generates LLP outbound interactions and passes required control information. This is required when the protocol specification sends a SACK for acknowledgment of receipt. But in userspace stack, sendmsg() call used with generic socket for SCTP and kernel IP layer is used for routing and interfacing with the NIC.

LLP Inbound: LLP Inbound interaction occurs when packets arrive and progress into SCTP stack. Simultaneously SCTP PDU enters SCTP stack by sctp_input().

**TABLE I USERSPACE SOCKET FUNCTIONS**

| Function | |
|---|---|
| userspace_socket | Returns a userspace socket. |
| userspace_bind | Binds port and address |
| userspace _isten | Enables server-side capabilities |
| userspace _accept | Blocks until it returns a new socket |
| userspace _connect | Connects to a remote socket |
| userspace _sctp_sendmsg | Sends data on a userspace socket |
| userspace_sctp _recvmsg | Receives data from a userspace socket. |
| sctp_setopt | Allows the setting of socket options |

It was registered as a callback from initialization of SCTP stack. But in userspace SCTP implementation no such callback is registered. The main difference is that in userspace implementations, LI interactions cross the boundary where as in kernel level implementation, LLP boundary is internal. Here the calls to recv() makes the purpose of crossing the kernel space and a wake up occurs to traverse this kernel space boundary. Finally it issues a notification to block recv() call that an SCTP PDU has arrived and been placed in the lower-layer socket buffer.

## B.   Upper Layer Protocol
At the upper layer, kernel code in userspace stack is based on Berkeley socket implementations. Many socket related functions and structures are widely used in SCTP stack. These socket structures were exposed to userspace. So socket related functions are listed in table I which enumerates the structures and functions with userspace as prefix.

## C.   SCTP Implementation
SCTP implementation requires many other modules to be implemented. These are discussed in the following sections.

1)   *Memory Allocation:* Inside kernel, PDUs are passed between different layers without excessive number of copies. Internal structure represents a reference count and pointer to the PDU's memory. This is done through its object caching strategy that is used when allocation and deallocation of memory of the same type or size is happening frequently.

2)   *Timers:* There are a number of timers with respect to any protocol for reliable transmission. The transport layer keeps track of the time, which is essential for response to queries. For example during connection establishment, an INIT packet is sent and if INIT-ACK is not received before timeout, then INIT is again resent. Sine timeout occurs in milliseconds, the overhead is minimal. So even when the timer thread awakes, it typically has very little to do.

## V.   TEST SCENARIO
We implemented the userspace version for protocol independent socket API. Here we describe and compare our userspace SCTP stack with the same for kernel space in single network interface. We showed initial throughput using single homed bandwidth test over Gigabit Ethernet. Our test are conducted between two Intel® Core™ i3-4005U CPU @ 1.70GHz × 4, 64 bit machines with 4GB memory. Both machines run Linux kernel of version 4.15. Figure 2 shows initial throughput results for API which is similar to Berkeley sockets.
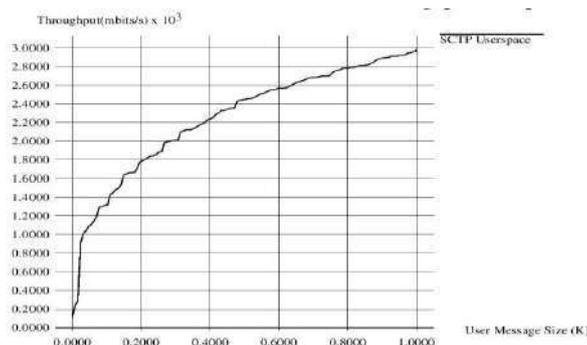


**Fig. 1.** Userspace Implementation

## VI. RESULTS AND DISCUSSION

We begin with our implementation for protocol independent API [20] and tested our throughput for userspace implementation as shown in figure 1. It shows userspace stack generally outperforms the kernel implementation on Linux. For small message sizes upto nearly 40K, the desired results are at par with kernel implementation, but for larger message sizes, userspace stack were better than generic socket types.
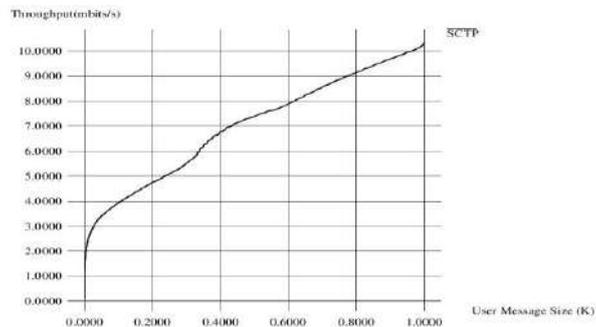


**Fig. 2.** Kernel Implementation

## VII. CONCLUSION

We have showed the tuned userspace implementation of SCTP, which enables SCTP additional features on other platforms. Our results show different API will have different metrics, but kernel space implementation is sometimes error prone and requires solid knowledge of OS to build. With this we showed we can use any API with respect to userspace implementation with little programming effort.

## REFERENCES

[1] S. Jorer, "A Protocol-Independent Internet Transport API", 2010. http://home.ifi.uio.no/michawe/teaching/dipls/stefan joerer.pdf

[2] J. Postel. Transmission Control Protocol. RFC 793 (Standard), September 1981. Updated by RFCs 1122, 3168

[3] R. Stewart, Q. Xie, K. Morneault, C. Sharp, H. Schwarzbauer, T. Taylor, I. Rytina, M. Kalla, L. Zhang, and V. Paxson. Stream Control Transmission Protocol. RFC 2960(Proposed Standard), October 2000. URL http://www.ietf.org/rfc/rfc2960.txt.

[4] J. Stone and C. Partridge, "When the CRC and TCP checksum disagree," in SIGCOMM, 2000, pp. 309–319. [Online]. Available: citeseer.ist.psu.edu/stone00when.html

[5] Google, "SPDY project website," 2010, http://dev.chromium.org/spdy.

[6] B. Ford, "Structured streams: a new transport abstraction," SIGCOMM Comput. Commun. Rev., vol. 37, no. 4, pp. 361–372, 2007.

[7] IETF, "Multipath TCP (mptcp) Charter," 2011, available at http://datatracker.ietf.org/wg/mptcp/charter/

[8] A. Biswas, "Support for Stronger Error Detection Codes in TCP for Jumbo Frames, draft-ietf-tcpm-anumita-tcp-stronger-checksum-00 (work in progress)," IETF, May 2010.

[9] "Linux Kernel Stream Control Transmission Protocol (lksctp) project," available at http://lksctp.sourceforge.net/.

[10] M. Tuxen and T. Dreibholz, "The sctplib Userspace SCTP Implemen-¨ tation," 2009, available at http://www.sctp.de/sctp-download.html.

[11] V. Jacobson and B. Felderman, "Network channels," Available from http://lwn.net/Articles/169961/, January 2006

[12] D. L. Siemon, "The IP Per Process Model: Bringing End-to-end Network Connectivity to Applications," Master's thesis, University of Western Ontario, London, Ontario, Canada, 2007.

[13] "Solarflare Communication (Ethernet Accelerator)," Available at http://www.solarflare.com.

[14] A. Kantee, "Environmental Independence: BSD Kernel TCP/IP in Userspace," in Proceedings of AsiaBSDCon 2009, 2009.

[15] D. Ely, S. Savage, and D. Wetherall, "Alpine: a user-level infrastructure for network protocol development," in USITS'01: Proceedings of the 3rd conference on USENIX Symposium on Internet Technologies and Systems. Berkeley, CA, USA: USENIX Association, 2001, pp. 15–15.

[16] P. Pradhan, S. Kandula, W. Xu, A. Shaikh, and E. Nahum, "Daytona: A User-Level TCP Stack," Available from http://nms.csail.mit.edu/ kandula/data/daytona.pdf.

[17] D. Ely, S. Savage, and D. Wetherall, Alpine: A User-level Infrastructure For Network Protocol Development," in: Proc. 3rd USENIX Symposium on Internet Technologies and Systems (March 2001) pp. 171–183.

[18] Bryan Ford. Structured streams: a new transport abstraction. In Proceedings of the 2007 conference on Applications, technologies, architectures, and protocols for computer communications, SIGCOMM '07, pages 361–372, New York, NY, USA, 2007. ACM. [36] D.C. Schmidt.

[19] R. Stewart, K. Poon, M. Tuexen, V. Yasevich, and P. Lei. Sockets API Extensions for Stream Control Transmission Protocol (SCTP).InternetDraft (work in progress), July 2010. http://tools.ietf.org/html/draft-ietftsvwg-sctpsocket-23.

[20] Sangram Keshari Nayak, Sarojananda Mishra, Manoranjan Dash. Performance Analysis of SCTP for Multiple Parallel Streams Volume-8 Issue-4, November 2019. International Journal of Recent Technology and Engineering. ISSN:2277-3878(Online), A SCOPUS Journal. URL: https://www.ijrte.org/wp-content/uploads/papers/v8i4/D9773118419.pdf

[21] M. Tuxen and T. Dreibholz, "The sctplib Userspace SCTP Implemen-¨ tation," 2009, available at http://www.sctp.de/sctp-download.html.

[22] Chris Hegarty, "SCTP in Java," available at http://openjdk.java.net/projects/sctp/

[23] B. Penoff, A. Wagner, M. Tuxen and I. Rungeler, "Portable and Performant Userspace SCTP Stack," 2012 21st International Conference on Computer Communications and Networks (ICCCN), 2012, pp. 1-9, doi: 10.1109/ICCCN.2012.6289222.

## EFFICACY OF BRIEF INTERNET BASED PROGRAM TO BOOST EMOTIONAL INTELLIGENCE AMONG ADOLESCENT

**Manisha Sonone[1], Vaishnavi Shiwarkar[2], Dhanshree Selukar[3] and Ankit Selokar[4], Prof. Jaya Pranoykumar Gawai[5]**

[1-4] B.BSc Nursing, Smt. Radhikabai Meghe Memorial College of Nursing, Datta Meghe Institute of Medical Sciences (Deemed to be University), Sawangi Meghe, Wardha, Maharshtra, India

[5] Department of Mental Health Nursing, Smt. Radhikabai Meghe Memorial College of Nursing, Datta Meghe Institute of Medical Sciences (Deemed to be University), Sawangi Meghe, Wardha, Maharshtra, India

**ABSTRACT**

*Background: Emotional intelligence is a matter of great interest in cognitive research for a long time. It is defined by WHO as a person's capacity to control ones self and others' feelings, differentiate between them, and Using knowledge to support one's activities, thinking, and understanding. Objectives: 1.To assess the efficacy of brief internet-based program to boost emotional intelligence of adolescent at pre-test. 2.To assess the efficacy*

*of brief internet based program to boost emotional intelligence among adolescent at posttest. 3. To evaluate the efficacy of brief internet based program to boost emotional intelligence among adolescent between pre-test and post-test. 4. To associate the emotional intelligence among adolescent with their demographic variables at posttest. Materials and Methods: The interventional method was used in this investigation. Purposive sampling technique was utilized. In this study 100 adolescents as samples were used and used structured questionnaire as a tool. Results: Findings of the study, In the pre-test findings of the present study shows that 17% of Adolescents scored poorly on knowledge tests, 36% had average, 28% had good, 16% had very good and Only 3% of teenagers had an excellent degree of knowledge. The pretest had a minimum knowledge score of 0 and a maximum knowledge score of 21. In the pretest, the mean knowledge score became 8.89±4.60. In the pretest, the average percentile score for knowledge was 40.40±20.92. In the posttest the current study's findings shows that 9% of adolescents had very good and 91 percent of teenagers scored excellent in terms of knowledge. The posttest possessed a minimum level of knowledge score of 16 and a maximum knowledge score of 22. Mean knowledge score in posttest was 20.77±1.71 and mean percentage of knowledge score in post test was 97.40 ±7.77. Adolescents' post-test knowledge score is statistically linked to their religion, family type, and educational level.*

*Keywords: Keywords: Emotional Intelligence, Adolescents, Brief internet based program.*

## 1. INTRODUCTION:

When a person feels the right emotion in the right situation and expresses it in the right amount, he is known to be emotionally intelligent. Today, there are 1.2 billion adolescents everywhere. Teen is a formative period in which young people discover who they are and purpose in their lives, with feelings and self-esteem performing key roles. Goleman (1998) claims that the current generation is more emotionally disturbed than previous generations; they are more sad and lonely; they are more angry and restless; they are more impatient and violent; and they are more upset. [1]

Those whose age is in between the child and an adult are known as adolescents. This is a key stage in a child or adolescent when he must decide who he wants to be in the future. Also, during this stage of adolescence, they are emotionally separated from their parents, and certain adjustments must be made in order to face the challenges that will occur throughout the period of transition. At the same time, more personal ideas are established in the individual. It is up to them, however, to assess whether the values are good or bad. Though we all understand, not all teenagers are successful in determining the best path to take as they enter into a new phase of their lives, and others are terribly misguided by the forces around them.

Furthermore, this is the period when an adolescent seeks a clear and unique purpose in his own community (Christie &Viner, 2005), although it is frequently occupied by an uncertain phase between childhood and adulthood. According to some specialists, the difficulties of adolescence are frequently overestimated because, for the majority of teens, this phase of maturation is more likely to be smooth and calm, with less issues. But, a rising number of specialists identify adolescence as a hard and difficult phase followed by stressful processes caused by particular behavioral changes .Adolescents are characterized as noisy, irresponsible, distracted, and aggressive. This seems to be based on the fact that they experience a lot of hormonal changes, making it hard for them to decide what to do. This challenge may be handled if and only if the elders play an important part in

guiding the younger generation based on their own experiences, so that they do not become caught in the bad side of the world (Kagu, 2000).[2]

EI became an important psychological concept early in the 1990s, when it was regarded as a collection of skills that were usually equal to general intelligence. Emotional intelligence, according to Salovey and Mayer (1990), is "the ability to notice one's own and others' moods and emotions, to discriminate between them, and to utilize this information to direct one's thoughts and actions. They stated that people with high EI scores had emotional capabilities and skills related to recognizing and controlling emotions in themselves and others. "Like a result of this, it really was claimed that persons with High EI may be able to identify and adjust specific feelings in oneself while in others to achieve a range of positive affect or emotional states. [3]

## 1.1 Background Of The Study:

Emotional intelligence is a subject that has long been discussed in cognitive science. Emotional intelligence has got a lot of interest recently in study, particularly in psychology studies. Salovey and Mayer were the pioneers in introducing the concept of emotional intelligence. WHO defines it as a capacity of a person to regulate his or her own emotions and also the thoughts of others, discriminate between them, and use resources to facilitate one's behavior, thinking, and learning. Mayer, Caruso, and Salovey are well-known for their important involvement to the growth of emotional intelligence. After that, in 1995, the idea of emotional intelligence was born, with Daniel Goleman's work playing an important role. Emotional intelligence, according to Goleman, is a variety of abilities or capacities that include the opportunity to empower oneself as well as persevere in the face of hardship, the able to handle with obligation and sadness, the capacity to keep one's imagination in check, and the responsibility to maintain one's sufferings from getting involved with one's ability to reason, express sympathy, and be positive. Goleman's approach is said to be a subscription vehicle of emotional intelligence that presents a collection of leadership competencies organized into five categories: Self-awareness, interpersonal skills, self-regulation, motivation, and empathy. Bar-On is another well-known scientist in the field of emotional intelligence. He describes emotional intelligence as effects of pre talents, talents, and skills that impact one's capacity to achieve in the face of difficulties and expectations from outside sources. [4]

## 1.2 Need Of The Study:

Emotional intelligence may assist in living a happy and fulfilled life by providing a framework for applying norms of intelligence to emotional responses as well as acknowledging that these feelings may be intellectually consistent or inconsistent with certain emotional ideas. Emotional intelligence (EI) is extremely important and should not be ignored. The first step toward realising your full potential is to understand and regulate your emotions. Emotional maturity is essential for achieving achievement in both personal and professional endeavours, whether it is connecting with others and improving social interaction, achieving success in the job or in social interactions, coping with challenges and increasing motivation, or honing decision-making abilities.[5]

We have conducted the above research study "Efficacy of brief internet based program to boost emotional intelligence among adolescent." Due to covid-19 pandemic adolescent's intellectual ability, cognitive skills, emotional intelligence got disturbed because school was closed for long times and impact of lockdown also. So it was very necessary to boost emotional intelligence among adolescent.

## 1.3 Objectives of the study:

1. To assess the efficacy of brief internet-based program to boost emotional intelligence of adolescent at pre-test.

2. To assess the efficacy of brief internet based program to boost emotional ntelligence among adolescent at post-test.

3. To evaluate the efficacy of brief internet based program to boost emotional intelligence among adolescent between pre-test and post-test.

4. To associate the emotional intelligence among adolescent with their demographic variables at posttest.

## 1.4 Hypotheses:

**H1:** There may be significant difference in efficacy of internet based program to boost emotional intelligence among adolescence between the pre and posttest.

**H0:** There may be no significant difference inefficacy of brief internet based program to boost emotional intelligence among adolescence between the pre and posttest.

## 2. MATERIALS AND METHODS:

This study took an interventional strategy, and the research design was an experimental design with no control group. Sampling technique was Purposive sampling technique. Selected area for sampling was Rural and Urban area from wardha district. Adolescents made up the sample population. Sampling size was 100 samples. Tool used for the present study was structured questionnaire.

### 2.1 Variables

**Independent variable:** Brief internet based program to boost emotional intelligence.

**Dependent Variable:** Knowledge of Adolescent Regarding Emotional Intelligence

**Demographic Variables:** Age, gender, Educational level, Residence Religion, Type of family, Socio-economic status of family per annum, Educational level of father, Educational level of Mother, Occupation of father and occupation of Mother.

### 2.2 Sampling Criteria
**Inclusion criteria:**

1. The study participant's age was 13 – 19 years.

2. The study participants who were not having any psychological disorders.

3. The study Participants who were willing to give consent.

4. The study participants who were able to read and write.

**Exclusion criteria:**

▪ Adolescent with mental retardation.

### 2.3 Description of tool
Structured questionnaire:

It is divided into the categories listed below:

**Section A:** includes of demographic variables such as age of the adolescent, gender, level

Of education, residence, religion, type of family**,** socio economic status of family per

Annum, educational level of father, educational level of mother, occupation of father and

Mother.

**Section B**: consists of 8 questions on knowledge of emotional intelligence

**Section C**: consists of 5 questions on boosting of emotional intelligence

**Section D**: consists of 9 questions on brief internet based program on emotional

Intelligence

**SCORING:**
- If answer is correct score 1 was given

- If answer is wrong score 0 was given

- The score was graded from poor to excellent.

## 3. RESULTS

Data obtained from 100 samples who were adolescent from selected areas. The current research was conducted up to assess the efficacy of brief internet based program to boost emotional intelligence among adolescent. The objectives of the study are used to guide the analysis and interpretation. The data analysis is divided into four phases: **Section A:** Adolescent distribution in relation to demographic variables. **Section B:** Assessment of level of pretest and posttest efficacy of brief internet based program to boost emotional intelligence of adolescent. **Section C:** Assessment of efficacy of brief internet based program to boost emotional intelligence among adolescent between pretest and post test. **Section D:** Association of posttest emotional intelligence among adolescent with their selected demographic variables. For data collection, a structured questionnaire was designed to gain knowledge. Inferential and descriptive statistics were used in the analysis.

### 3.1 Major Findings of the Study

### 3.1.1  SECTION-A  :  Distributions of samples according to their demographic characteristics:

- According to the statistics, there were 37 % adolescent boys in the 13-15 year age range, there were 39% in the age group of 15-17 years and in the age group of 17-19 years there were 24% adolescent.

- 38% of adolescents were males and 62% of them were females.

- 57% of adolescents were educated up to secondary, 42% up to higher secondary and 1% up to under graduation.

- 51% of adolescents were from urban area and 49% of them were from rural area.

- 65% of adolescents were Hindus, 33% were Buddhist and each 1% of them were Christian and Muslim.

- 41% of adolescents were from nuclear families, 40% were from joint families, 5% were from single parent family, 10% were from extended families, 3% were from separate families and only 1% of them were from divorced family.

- 31% of adolescents were having monthly family income of 25000-50000 Rs, 29% had between 51000-75000 Rs, 28% had between 76000-100000 Rs and Only 12% of them had a family income of more than Rs 1 lakh per month.

- 2% fathers of adolescents were illiterate, 35% of them had completed primary school., 44% up to secondary school, 14% up to the upper secondary level, undergraduates made about 3% of the total and 2% of adolescent fathers had a bachelor's degree or higher.

- 2% mothers of adolescents were illiterate, only 44% of them had completed primary school, 33 up to secondary school, 18% up to higher secondary and 3% mothers of -adolescents were undergraduate.

- 18% fathers of adolescents were farmer, 42% were self-employed, 24% of them were private servant, 9% of them were government servant and 7% of them were doing other profession.

- 69% mothers of adolescents were homemaker, 7% were farmer, 5% were self employed, 12% were private servant, 4% of them were government servant and only 3% mothers of adolescents were labourer.

### 3.1.2  SECTION B

- **Assessment of level of Pretest knowledge regarding brief internet based program to boost emotional intelligence among adolescent.**
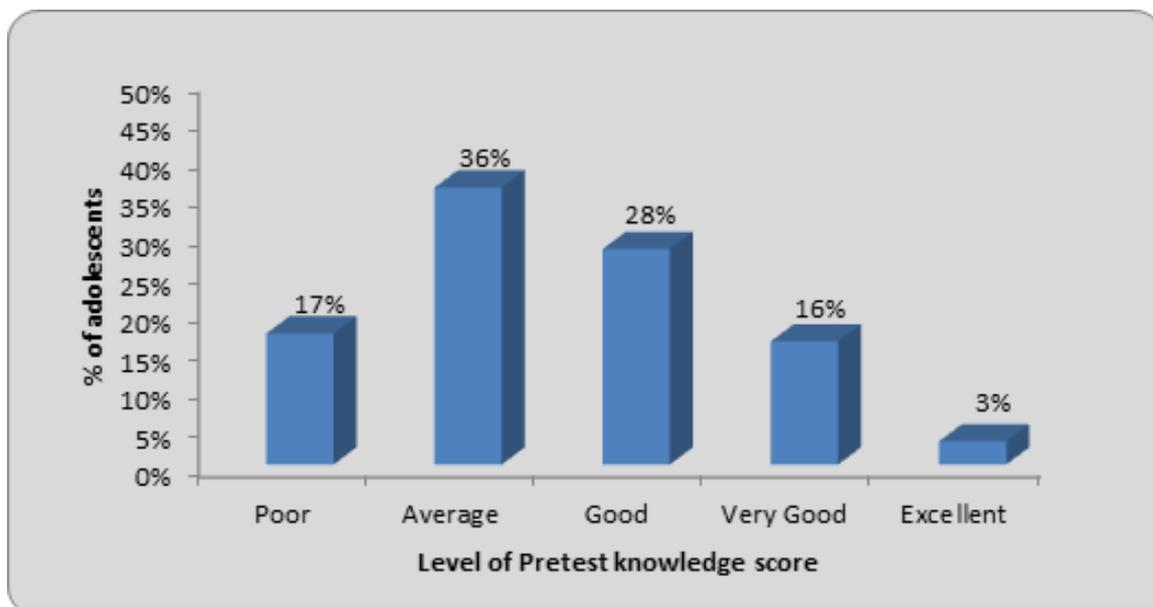


**Fig.1. Assessment with pre-test knowledge score**

According to the results of the current study's pre-test, 17 percent of teenagers shown a poor level of knowledge score, 36% had average, 28% had good, 16% had very good and 3% of adolescents possessed excellent score for knowledge level. Minimum knowledge score in pretest was 0 and maximum knowledge score in pretest was 21. In the pretest, the mean knowledge score was 8.89±4.60 and the mean percentage of knowledge score was 40.40±20.92.

**Assessment of level of Posttest knowledge regarding brief internet based program to boost emotional intelligence among adolescent.**
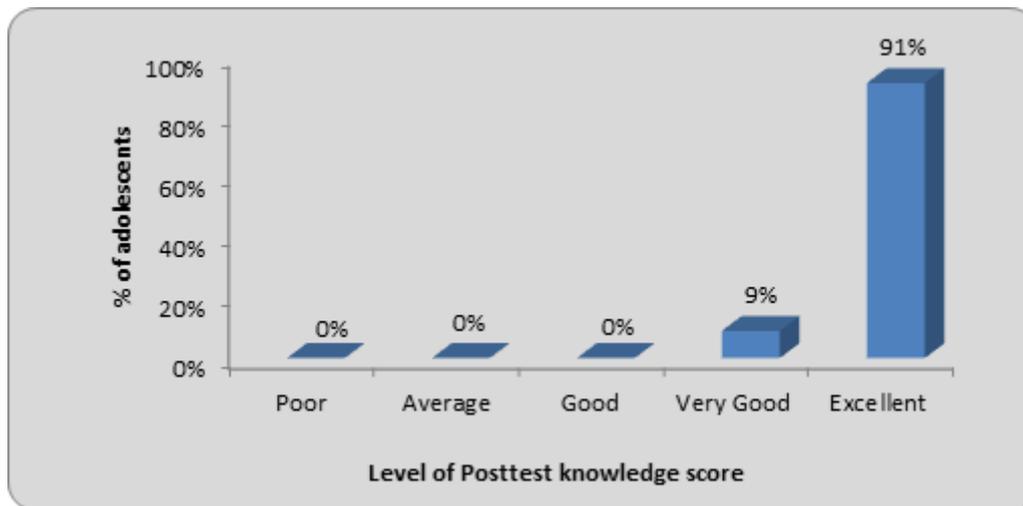


**Fig.2. Assessment with post test knowledge**

In the posttest findings of the present study shows that 9% of adolescents had very good and 91 percent of teenagers scored excellent in terms of knowledge score. The posttest possessed a minimum level of knowledge score of 16 and a maximum knowledge score of 22. In the posttest, the mean knowledge score was $20.77\pm1.71$ and the average knowledge percentage score used to be $97.40\pm7.77$.

### 3.1.3 SECTION- C: Evaluation of efficacy of brief internet based program to boost emotional intelligence among adolescent between pretest and post test.

The current study compares adolescents knowledge score before and after completing a brief internet-based programme. The student's paired "t" test is employed at a significance level of 5% to compare the mean, standard deviation, and mean difference values. For n=100-1, or 99 degrees of freedom, the calculated value was 1.98. The computed 't' value, 25.01, is significantly greater than the tabulated value for total knowledge score of brief internet-based program at a statistically acceptable level of significance of 5%. As a result, it is statistically deduced that the brief internet based program to boost emotional intelligence among adolescent was effective. Thus the H1 is accepted.

### 3.1.4 : SECTION –D Association of level of posttest knowledge score regarding emotional intelligence among adolescent in relation to demographic variables

**1) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to age**

In related to emotional intelligence, the study's findings demonstrate an association between knowledge score and adolescent age. The computed 'F,' i.e. 1.21 at a 5% level of significance, was substantially greater than the tabulated 'F,' which was 3.07(DF=2,97). 'p'=0.30 was also estimated, which was substantially higher than the allowed level of significance, i.e. 'p'=0.05. In conclusion, the age in years of a teenager has no meaningful statistical link with their posttest knowledge score.

**2) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to gender.**

The present statistics of the study show the association of knowledge score with gender of adolescents regarding emotional intelligence. The computed 't' value was 0.44 at the 5% level of significance., whereas the tabulated 't' value was 1.98 (DF=98). Second, the calculated 'p'=0.65 the recognised was so much greater than significance level of 'p'=0.05. As an outcome, Gender of adolescent has been proven to have no statistically significant link with posttest knowledge score.

**3) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to education.**

In terms of emotional intelligence, the current findings of the study demonstrate a link between knowledge score and educational level of adolescents. The computed 'F' value was 3.66 at the 5% level of significance, but the calculated 'F' value was 3.07 (DF=2, 97). Furthermore, the computed 'p'=0.029 was so lower than the accepted

level of significance, i.e. 'p'=0.05.As a result, the educational level of adolescents is statistically related to their posttest knowledge score.

**4) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to residence**

The study's findings reveal a link between an adolescent's emotional intelligence knowledge score and their residence area. The computed 't' value was 0.08 at the 5% level of significance., whereas the tabulated 't' value was 1.98(DF=98). Additionally, the estimated 'p'=0.93 was significantly higher than the recognised threshold of significance of 'p'=0.05. As a result, a teenager's housing location is statistically unrelated to their posttest knowledge score.

**5) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to religion.**

The study's findings reveal an association between an adolescent's emotional intelligence and their religion. At the 5% level of significance, the calculated 'F' value was 3.20, whereas the tabulated 'F' value was 2.68(DF=3, 96). Additionally, the estimated 'p'=0.027 was so lower than the recognised level of significance, which is 'p'=0.05. 2. Finally, there is a statistically significant link between teenage religion and posttest knowledge scores.

**6) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to type of family.**

In terms of emotional intelligence, the study's findings reveal a link between knowledge score and the type of family that teenagers come from. The computed 'F' value was 3.16 at a 5% level of significance, but the tabulated 'F' value was 2.29 (DF=5, 94). The computed 'F' value was 3.16 at a 5% level of significance, but the tabulated 'F' value was 2.29 (DF=5, 94). As a consequence, a teenager's family type was discovered to be statistically related to their posttest knowledge score.

**7) Association of posttest knowledge score regarding emotional intelligence among adolescent in relation to Family income (Rs).**

. In terms of emotional intelligence, the data show a link between adolescents' knowledge score and their annual family income. Furthermore, the estimated 'p'=0.13 was significantly greater than the accepted threshold of significance, i.e. 'p'=0.0. Additionally, the estimated 'p'=0.22 was significantly higher than the recognised significance level of 'p'=0.05. As a consequence, it is determined that an adolescent's annual family income has no statistically significant relationship with their posttest knowledge score.

**8) Association of posttest knowledge score regarding emotional intelligence among Adolescent in relation to Father's Education.**

This findings shows the association of knowledge score with father's education of adolescents regarding emotional intelligence. The computed 'F' value was 1.74 at the 5% level of significance, but the computed 'F' value was 2.29 (DF=5, 94). Secondly, the estimated 'p'=0.13 was significantly greater than the accepted significance level of 'p'=0.05. As an outcome, it is determined that an adolescent's father's education has no statistically significant relationship with their posttest knowledge score.

**9) Association of posttest knowledge score regarding emotional intelligence adolescent in relation to Mother's Education**

This findings shows the association of knowledge score with mother's education of adolescents regarding emotional intelligence. The computed 'F' value was 0.53 at the 5% level of significance, but the computed 'F' value was 2.45 (DF=4, 95). In addition, the estimated 'p'=0.70 was much greater than the accepted significance level of 'p'=0.05. As a consequence, the education of an adolescent's mother has no statistically meaningful link with the adolescent's posttest knowledge score.

**10) Association of posttest knowledge score regarding emotional intelligence among Adolescent in relation to Father's Occupation.**

In terms of emotional intelligence, this research demonstrates an association between adolescents' knowledge score and their father's work. At the 5% level of significance, the calculated 'F' value was 0.99, whereas the tabulated 'F' value was 2.45 (DF=4, 95). Moreover, the calculated 'p'=0.41 was significantly higher than the identified level of significance of 'p'=0.05. As a result, it is determined that an adolescent's father's work is statistically unrelated to their posttest knowledge score.

**11) Association of posttest knowledge score regarding emotional intelligence among Adolescent in relation to Mother's Occupation.**

This findings shows the association of knowledge score with mother's occupation of adolescents regarding emotional intelligence. The computed 'F' value was 2.18 at the 5% significance level, but the computed 'F' value was 2.29 (DF=5, 94). Additionally, the estimated significance level of 'p'=0.062 was substantially higher than the recognised significance level of 'p'=0.05. According to the findings, mother's occupation of adolescent has no statistically significant link with their posttest knowledge score.

## 4. DISCUSSION

The current study's findings were compared to the study's stated aims and the findings of previous research in this area, as well as the references listed below. The present research study statement was efficacy of brief internet based program to boost emotional intelligence among adolescents. On the basis of the selection criteria, the non-probability purposive sampling approach was used in this study. After pretest brief internet based program was implemented on emotional intelligence among adolescents by using visual aids i.e. PowerPoint presentation. The duration of the teaching program was 45 minutes and after 7th days posttest was taken. Overall program was found to be very effective in terms of boosting emotional intelligence and adolescents were communicated and clarified their doubts regarding emotional intelligence.

One of the researchers reported on the Impact of an Emotional Intelligence Training Program on First-Year University Students' Social and Academic Adjustment. In this study, the subjects performed ten days of emotional intelligence training lasting an hour to an hour and a half, whereas the control group received just pre-post questionnaires. The training approach was shown to be successful in considerably boosting the degree of emotional intelligence, but not in improving social and academic adjustment. [6]

In the present study it was found that, before conducting brief internet based program in terms of boosting emotional intelligence,17% of adolescents had poor level of knowledge , 36% had average, 28% had good, 16% had very good and 3% of adolescents had excellent level of knowledge. The pretest had a knowledge score range of 0 to 21, with a minimum of 0 and a maximum of 21. In the pretest, the mean knowledge score was 8.89±4.60 , and the mean percentage of knowledge score was 40.40±20.92.

But after 1 week brief internet based program i.e. structured teaching program given to adolescents on emotional intelligence. It revealed that 9% of adolescents had very good and91% of teenagers had an excellent level of knowledge. The posttest had a knowledge score range of 16 to 22, with a minimum of 16 and a maximum of 22. In the posttest, the mean knowledge score was 20.77+1.71, and the mean percentage of knowledge score was 97.40+7.77.

The Impact of an Emotional Intelligence Training Program on First-Year University Students' Social and Academic Adjustment was documented by the researcher. According to the findings of this survey, the majority of Jordanian university students are teenagers. Many challenges confront students in their late adolescence and throughout the transition period to campus, including physical, social, intellectual, and emotional adjustment. Managing emotions, gaining autonomy, and forming interpersonal relationships are important challenges for kids at this period. This study created an emotional intelligence training program, and students willingly agreed to engage for ten days. They were assigned to one of two groups at random, the experimental group, and were given nine sessions over the course of ten days. Otherwise, the control group received no therapy. The training program administrations were carried out by six trainers. The training curriculum consisted of a series of lectures, discussions, demonstrations, and experimental approaches such as role-playing.

Descriptive statistics revealed substantial differences in the dependent variables, emotional stability, psychological adjustment, and academic adjustment, between the experimental group and control group. The experimental and control groups exhibited greater emotional intelligence, social adjustment, and academic adjustment ratings than the control group. The ANCOVA results demonstrated that there was a difference in emotional intelligence between the experimental and control groups, but not in behavioural or educational adjustment levels. [6]

In a research study researcher has reported that there is a need to construct an emotional intelligence (EI) programme for teenagers and evaluate its impact on variables related to avoidance of violence. The sample was composed of 148 adolescents ranging in age from 13 to 16 years. An experimental design was used in this investigation, which included repeated pretest–posttest measures as well as control groups, before the experiment, four evaluation tools were employed to measure the variables, during, and after the programmer, as well as during the follow-up phase. Twenty one-hour sessions made up the programme. ANCOVAs were used to compare the results of the pretest and posttest., the training substantially improved: (1) Emotional Intelligence (attention, precision, emotional growth); (2) strategies for convincing intellectual social interaction; (3) internal control of anger; and (4) the ability to think critically about bad feelings. [7]

According to one of the researchers' study reports, 132 samples are included in this investigation. The purpose of this study was to see how teenagers might improve their emotion detection skills by using microexpression training. A quasi-experimental control group pretest-posttest design was utilised in this work, which is a type of quasi-experimental method. This design includes a treatment (training) and a control (no training) group to demonstrate the training's effect (i.e., the intervention group should improve in contrast to the control group). The pretest mean (M = 5.61) increased to the posttest mean (M = 9.83), t (83) = 14.52, p = 0.001, Cohen's d = 3.19.As a result, it was determined that the microexpression training enhanced the participants' capacity to recognize emotions. In the control group, there was no significant difference between the pretest and posttest averages. As a result, the little change between pretest and posttest means was purely coincidental. General, the results indicated that the novel microexpression training for teenagers greatly improved their capacity to recognize microexpressions, but it had no effect on their overall emotional intelligence or social skill. Girls were also revealed to have a stronger capacity to perceive microexpressions both before and after the instruction.

In the present study association was found between posttest knowledge score with educational level of adolescents. It was found due to maximum adolescents were taking well education. In this study, there was also a link discovered between posttest knowledge score  and type of family and religion. It was discovered because the people from the different religion are aware about the importance of education in today's generation and they are giving best children. They are helping them to grow. It was found that most of the family type was nuclear. Due to this family can afford the best education to their children and also can give best facilities which are helpful for education. And this all will help to increase the knowledge of adolescents about emotional intelligence and also it will be helpful for boosting of emotional intelligence among adolescents.

According to above study findings it supports the present study. The study findings was interpreted that, boosting of emotional intelligence among adolescents is very important. It will help the adolescents in proper decision making. It will also help to improve cognitive skills in adolescents.

## 5. CONCLUSION:

The study aimed to evaluate the efficacy of brief internet based program for boosting of emotional intelligence among adolescents. Certain goals were established to aid the researchers in arriving at the desired results. Each step has been given a specific amount of time. At the start of the study, the investigators offered their hypothetical perspectives. The study was completed by breaking down the subject into five chapters, after which the researchers delved into their results. The result of the this study shows that, 9% of adolescents had very well and 91 percent of teenagers scored excellent in terms of knowledge. The posttest had a minimum knowledge score of 16 and a maximum knowledge score of 22. The "s" test was utilised to measure the efficacy of a brief internet-based programme, and the "t" value was computed; the post test score was significantly higher than the pretest score at the 0.05 level. So, it was found that brief internet based program for boosting of emotional intelligence among adolescents was effective.

## 6. RECOMMENDATIONS

Based upon the findings of this investigation the following recommendations for additional research might be made:

➢ A study to evaluate the efficacy of brief internet based program for boosting of emotional intelligence among adolescents.

➢ Replication of the study can be conducted with maximum samples size at different settings to validate and generalize the result.

➢ Similar type of study could be conducted regarding knowledge of emotional intelligence. among adolescents.

➢ The similar studies can be conducted with an experimental research approach having a Control.

➢ A comparative study can be conducted on assessing the effectiveness of brief internet based program in schools and junior college.

➢ A study to assess the knowledge of emotional intelligence among adolescents.

## CONSENT AND ETHICAL APPROVAL

The authors will collect and keep participant permission and ethical approval in accordance with the worldwide standard or university standard guideline.

## COMPETING INTEREST

Authors have declared that no competing interests exist.

## REFERENCES

1. Tajpreet, K. and Maheshwari, S.K., 2015. Relationship of emotional intelligence with self-esteem among adolescents. Indian Journal of Psychiatric Nursing, 10(1), p.18.

2. Ravikumar, R., Rajoura, O.P., Sharma, R. and Bhatia, M.S., 2017. A study of emotional intelligence among postgraduate medical students in Delhi. Cureus, 9(1).

3. Hasanzadeh, R. and Shahmohamadi, F., 2011. Study of emotional intelligence and learning strategies. Procedia-Social and Behavioral Sciences, 29, pp.1824-1829.

4. Suleman, Q., Hussain, I., Syed, M.A., Parveen, R., Lodhi, I.S. and Mahmood, Z., 2019. Association between emotional intelligence and academic success among undergraduates: a cross-sectional study in KUST, Pakistan. PloS one, 14(7), p.e0219468.

5. Clancy, C., 2014. The importance of emotional intelligence. Nursing Management (2014+), 21(8), p.15.

6. Jdaitawi, T., Taamneh, A., Gharaibeh, N. and Rababah, M., 2011. The effectiveness of emotional intelligence training program on social and academic adjustment among first year university students. International Journal of Business and Social Science, 2(24).

7. Garaigordobil, M. and Peña-Sarrionandia, A., 2015. Effects of an emotional intelligence program in variables related to the prevention of violence. Frontiers in psychology, 6, p.743.

## A COMPREHENSIVE STUDY FOR IMPROVING THE FACTS LOCATION USING OPTIMIZATION TECHNIQUES

**Vibhuti and Shehzer Farid Vachkoo**

Sri Sai College of Engineering and Technology, Badhani, Pathankot, India

**ABSTRACT**

*The demand for electricity has risen dramatically in recent decades. However, increasing power generation and transmission capacity is not being pushed to meet this rising demand. As a result, power plants are operating at maximum capacity to meet the increased demand for electricity. As a result, power systems are only slightly protected and are vulnerable to voltage instability, which has resulted in the failure of many large networks and generation of losses and harmonics. Implementing a flexible alternating current transmission system (FACTS) can be a good way to improve the transmission network's reliability and power capacity. The FACTS controller has been given a thorough examination in order to improve its stability and power flow capability. FACTS devices require a significant upfront cost. As a result, FACTS location, type, and rating are critical and should be optimised for optimal network placement. Different optimization approaches such are explored and compared in this study for determining the best location, kind, and rating of devices. In the event of a traffic jam, the bus system IEEE 30 fact on the best spot to wait. Losses on various loads have increased as a result of the congestion. The proposed study demonstrates how changing the position of FACTS in an IEEE 30 bus reduces power loss, stabilises the voltage in the bus bar, and determines the optimal location of FACTS for maximum efficiency.*

*KEYWARD: - FATCS devices, Voltage stability, Power system stability, Losses*

## INTRODUCTION

Greater demands have been exerted on the transmission network in recent decades, and all these expectations will continue to increase as the quantity of nonutility sources grows and competitiveness between firms grows. Higher transmission requirements, a lack of long-term planning, and the necessity supply open access to producing businesses and customers have all contributed to a decrease in supplied quality and protection [1]. The ability to manage current via a line at a reasonable cost opens up a lot of possibilities for expanding the capabilities of current lines with wider conductors and using one of the FACTS Controllers to allow equivalent power to flow via such lines under normal and contingency conditions. Increased transmission line capacity can occasionally result in voltage instability leading to a shortage of reactive power provided at the load centres [2]. This seems to be caused to the transmission network's higher reactive power usage and the load's characteristics. Voltage, frequency, and network interruption are the most common causes of power quality difficulties in a power distribution system. Figure 1 shows the power quality issue in power system. It could have any issue, but it does have an impact on the output power. Voltage variations in the network are the most common consequence of bad power quality.
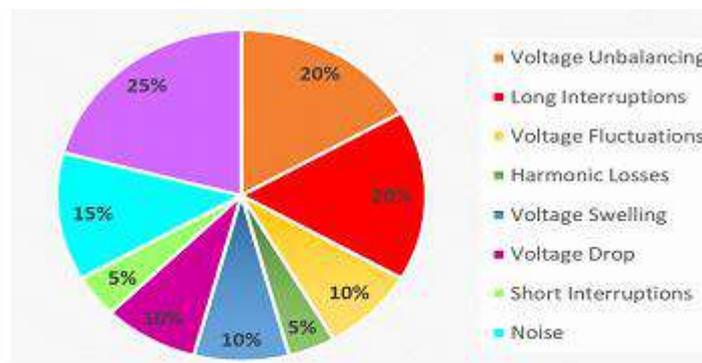


Figure 1: Power quality issues in power system [1]

FACTS technology is termed from the idea of combining the power electronics devices with some static elements, which would control the voltage and the power flow in the power system [3-5]. FACTS refer to multiple power electronics-based devices like the TCSC, STATCOM, UPFC, UPQC, and IPFC etc. The improved interest in FACTS devices is because of the latest development in the technology of power electronics [6]. But FACTS devices are always preferred predicated on their overall efficiency.

The FACTS controllers can be classified as:

(a) Series connected controllers,

(b) Shunt connected controllers,

(c) Combined series-shunt,

(d) Combined series-series controllers.

The series controllers help in controlling the line-based power flow while shunt controllers can control the bus-based voltage to which they are associated [4]. The FACTS devices used in electric power system consists of the following.

**Figure 2 shows the different FACTS devices play various roles in improving the stability of power system during disturbances [7].**
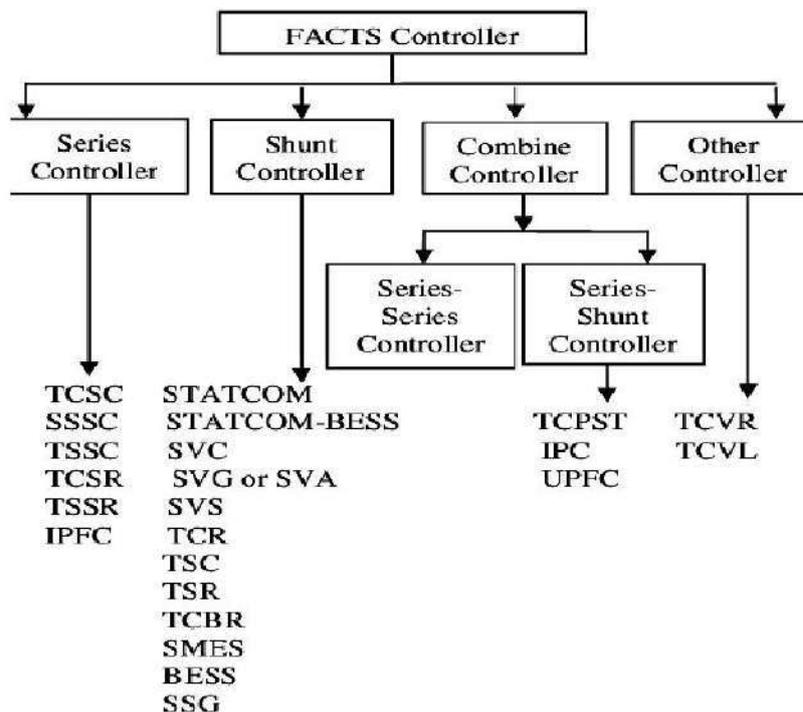


**Figure 2: Types of facts controllers [2]**

This paper discusses about the role of flexible alternating current transmission system in power system with categories of these devices [8].

## ROLE OF FACTS DEVICES

FACTS technology is termed from the idea of combining the power electronics devices with some static elements, which would control the voltage and the power flow in the 15-power system [9-12]. FACTS refer to multiple power electronics-based devices like the TCSC, STATCOM, UPFC, UPQC, and IPFC etc. The benefits of the FACTS devices are as follows. Electric power systems along with some stationary equipment offering controllability of power circulation and volts are referred to as Flexible AC Transmission Systems (FACTS) controllers. FACTS will not make reference to any kind of single ga FACTS et but a bunch of controllers such as for example SVC, UPFC, STATCOM, TCSC, TCPST, etc. Nevertheless, their primary function is usually to regulate electric power by manipulating the parameters such as for example impedance of transmission line, voltage angles and terminal voltage perspectives [13]. The improved interest in FACTS devices is because of the latest development in the technology of power electronics [14]. But FACTS devices are always preferred predicated on their overall efficiency. Table 1 shows the FACTS devices used in electric power system.

**Table 1 FACTS devices used in electric power system**

| Type | Operation Problem | Corrective Action | Facts Controllers |
|---|---|---|---|
| Thermal Limits | Transmission circuit overloaded | Reduced over-load | TCAC, SSSC, UPFC |
| | Tripping of parallel circuits | Limit circuit loading | TCSC, SSSC, UPFC |

| Loop flows | Power flow direction reversal | Adjust phase angle | SSSC, UPFC |
|---|---|---|---|
| | Parallel line load sharing | Adjust series reactance | SSSC, UPFC, TCSC |
| | Post-fault power flow sharing | Rearrange network | TCSC, SSSC, UPFC |
| Voltage Limit | High voltage at low load | Absorb reactive power | STATCOM, SVC, TCR |
| | Low voltage at heavy load | Supply reactive power | STATCOM, SVC |

## Genetic Algorithm

Genetic algorithms are an example of an optimization algorithm in that they are used to identify the best solution (s) to a computational issue by maximising or minimising a function. Genetic algorithms are a subset of the evolutionary calculus field of study since they simulate biological reproduction and natural selection in order to find "more suitable" solutions. Many of the genetic algorithm's processes are random as they evolve, but this optimization strategy allows you to regulate the level of randomization [15-18]. These algorithms are far more powerful and efficient than random and exhaustive search algorithms, but they require more information about the problem. Figure 3 shows the flow chart of genetic algorithm.
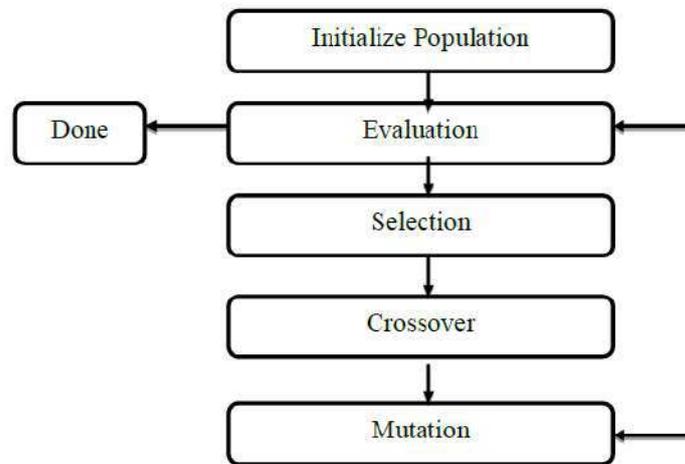


**Figure 3: Flow chart of genetic algorithm**

In a variety of applications, genetic algorithms are used. Automatic programming and machine learning are two important examples. Modelling phenomena in economics, ecology, the human immune system, population genetics, and social systems is also a good fit for them.

## Biogeography

Biogeography-based optimization (BBO) is an evolutionary algorithm (EA) that improves candidate solutions stochastically and repeatedly in relation to a given measure of quality, or fitness function. BBO is classified as a metaheuristic since it has various variations and does not make any assumptions about the situation, allowing it to be used to a wide range of challenges. BBO is commonly used to optimise multidimensional real-valued functions, but it doesn't employ the function's gradient, therefore it doesn't require the function to be differentiable, as traditional optimization methods like gradient descent and quasi-newton methods do [19]. As a result, BBO can be applied to non-continuous functions. BBO optimises a problem by keeping a population of candidate solutions and combining existing ones according to a simple formula to create new candidate solutions. The objective function is thus viewed as a black box that just gives a measure of quality for a candidate solution, and the gradient of the function is not required [20].

## Results of simulation

The proposed method improves the total or average loss. According to the analysis, when load increases, losses increase due to line congestion, which causes voltage to become unstable, and the amount of the loss decreases. As a result, lower the loss by reducing congestion by placing data in the most effective location. The proposed method optimises the location using both global and local optimization techniques. Table 2 present the losses in 30 bus system of facts replacement. Figure 3 Graphical representation of losses on 30 bus by GA and BBO.

**Table 2: Losses in 30 bus system of facts placement**

| Load | GA (Loss) | BBO (Loss) |
|---|---|---|
| 100 | 22.34 | 21.343 |
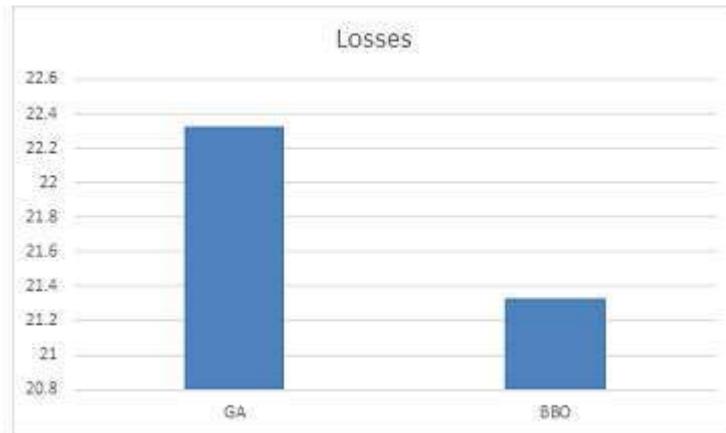
Figure 4: Graphical representation of losses on 30-bus by GA and BBO

Table 3 shows an analysis of voltage improvement following the arrangement of facts using various optimization techniques. In the analysis, set the load to 100%. On average, voltage improves in the suggested method on all buses. In this experiment, a 30-bus system was used. The proposed method employs a hybrid PSO-GA to enhance fact placement and voltage. Figure 5 shows the comparison of voltage in genetic algorithm and biogeography-based optimization which shows the superior results of BBO.

**Table 3: Line wise voltage in load 100**

| Bus Number | GA | BBO |
|---|---|---|
| 1 | 1.2 | 1.08 |
| 2 | 1.08 | 1.06 |
| 3 | 1.07 | 1.05 |
| 4 | 1.05 | 1.01 |
| 5 | 1.03 | 0.98 |
| 6 | 0.96 | 0.94 |
| 7 | 0.95 | 0.93 |
| 8 | 0.93 | 0.91 |
| 9 | 0.91 | 0.89 |
| 10 | 0.90 | 0.87 |
| 11 | 0.87 | 0.84 |
| 12 | 0.84 | 0.80 |
| 13 | 0.81 | 0.78 |
| 14 | 0.77 | 0.76 |
| 15 | 0.76 | 0.75 |
| 16 | 0.75 | 0.75 |
| 17 | 0.74 | 0.77 |
| 18 | 0.78 | 0.79 |
| 19 | 0.7 | 0.81 |
| 20 | 0.81 | 0.80 |
| 21 | 0.83 | 0.79 |
| 22 | 0.78 | 0.76 |
| 23 | 0.77 | 0.76 |
| 24 | 0.75 | 0.76 |
| 25 | 0.76 | 0.79 |
| 26 | 0.7 | 0.80 |
| 27 | 0.82 | 0.81 |
| 28 | 0.81 | 0.80 |
| 29 | 0.80 | 0.79 |
| 30 | 0.7 | 0.79 |
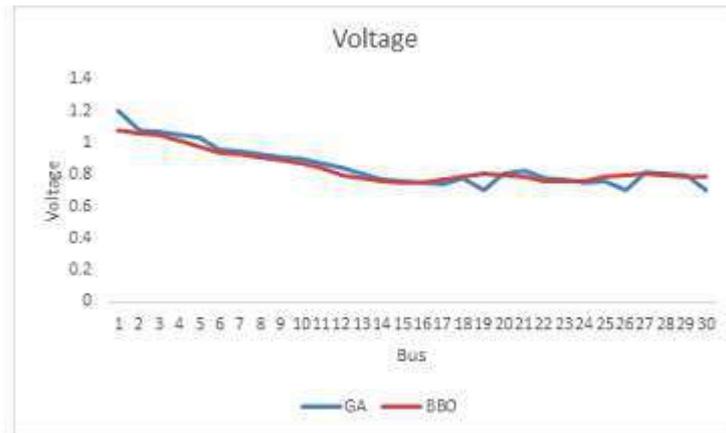
Figure 5: Comparison of voltage

## CONCLUSION

FACTS have the potential to significantly improve the static and dynamic performance of power systems. FACTS devices require a significant upfront cost. As a result, FACTS location, type, and rating are critical and should be optimised for optimal network placement. Two optimization approaches, Genetic Algorithm and Biogeography Optimization, are discussed in this study. are examined and compared for the best device location, type, and rating. Losses on various loads have increased as a result of the congestion. In fact, proper placement reduces traffic congestion and losses. This research examines three alternative strategies for reducing cumulative or average loss, including genetic algorithm (GA) and biogeography optimization (BBO). According to the analysis, when load increases, losses increase due to line congestion, which causes voltage to become unstable, and the amount of the loss decreases. As a result, lower the loss by reducing congestion by placing data in the most effective location. The proposed method optimises the location using both global and local optimization techniques.

## REFERENCES

[1] https://www.google.co.in/search?q=FACTS+devices&sxsrf=AOaemvIlungYuMdOpJfwDcgb4WiIcihlEA:1639977212901&source=lnms&tbm=isch&sa=X&ved=2ahUKEwiNs9uZz_H0AhXyzjgGHWsEBdAQ_AUoAXoECAgQAw&biw=1707&bih=828&dpr=1.13#imgrc=Ev-6ZwjmFRW0aM&imgdii=cagjBb8x2P80YM

[2] Quantifying harmonic distortion: Options for calculating THD - On the Grid - Archives - TI E2E support forums

[3] A. Masood, Q. Hasan and A. Mahmood, "Flexible AC transmission system controllers: a review", *Int. Multi-Topic ICT Conf.*, pp. 393-403, 2015.

[4] M. Saha, J. Izykowski and E. Rosolowski, "Fault location on power networks", *Springer-Verlag*, pp. 32, 2009.

[5] A. Acha, C. Esquivel, H. Prez and C. Camacho, "FACTS: modelling and simulation in power networks", *Wiley*, pp. 3-6, 2004.

[6] Vibhuti, Deepika Bhalla, and Genius Walia. "Transient Finite Element Method for Computing and Analyzing the Effect of Harmonics on Hysteresis and Eddy Current Loss of Distribution Transformer." *International Journal of Performability Engineering* 17.5: 451.

[7] CIGRE Task Force 14–27, "Unified power flow controller", CIGRE Technical Brochure, 1998.

[8] H. Gandoman et al., "Review of FACTS technologies and applications for power quality in smart grids with renewable energy systems", *Renew. Sustain. Energy Rev.*, vol. 82, pp. 502-514, 2018.

[9] A. Siddiqui, M. Khan and F. Iqbal, "Determination of optimal location of TCSC and STATCOM for congestion management in deregulated power system", *Int. J. Syst. Assur. Eng. Manage.*, vol. 8, pp. 110-7, 2017.

[10] N. Hingorani and L. Gyugyi, "Understanding FACTS: concepts and technology of flexible AC transmission systems", *Wiley-IEEE Press*, pp. 165-172, 1999.

[11] K. Padiyar, "FACTS controllers in power transmission and distribution", New Age International, pp. 207-212, 2008.

[12] J. Izykowski et al., "Fault location on double circuit series-compensated lines using two-end unsynchronized measurements", *IEEE Trans. Power Delivery,* vol. 26, pp. 2072-80, 2011.

[13] N. Kang, J. Chen and Y. Liao, "A fault location algorithm for series-compensated double-circuit transmission lines using the distributed parameter line model", *IEEE Trans. Power Delivery*, vol. 30, pp. 360-367, 2015.

[14] A. Junior, S. Santo and D. Rojas, "Fault location in series-compensated transmission lines-based on heuristic method", *Electr. Power Syst. Res.*, vol. 140, pp. 950-7, 2016.

[15] T. Bains and M. DadashZadeh, "Supplementary impedance-based fault location algorithm for series-compensated lines", *IEEE Trans. Power Delivery,* vol. 31, pp. 334-42, 2016.

[16] M. Sahani, and P. Dash, "Fault location estimation for series-compensated double-circuit transmission line using EWT and weighted RVFLN", *Eng. Appl. Artif. Intell.*, vol. 88, Article NO. 103336, 2020.

[17] Z. Moravej, M. Khederzadeh and M. Pazoki, "New combined method for fault detection, classification, and location in series-compensated transmission line", *Electr. Power Compon. Syst.*, vol. 40, pp. 1050-71, 2012.

[18] C. Yu et al., "A new PMU-based fault location algorithm for series compensated lines", *IEEE Trans. Power Delivery*, vol. 17, pp. 33-46, 2002.

[19] A. Sadeh and A. Adinehzadeh, "Accurate fault location algorithm for transmission line in the presence of series connected FACTS devices", *Int. J. Electr. Power Energy Syst.*, vol. 32, pp. 323-328, 2010.

[20] M. Ahsaee and J. Sadeh, "A novel fault location algorithm for long transmission lines compensated by series FACTS devices", *IEEE Trans. Power Delivery*, vol. 26, pp. 2299-08, 2011.

## PREPARATION OF RED SANDAL PTEROCARPUS SANTALINUS ETHANOLIC EXTRACT AND ITS ANTI-INFLAMMATORY AND ANTI-DIABETIC ACTIVITY

**[1]Pratheebha C, [2]Dr. R. Priyadharshini, [3]Dr. S. Rajeshkumar, [4]Dr. Palati Sinduja, and [5]Dr. R. Priyadharshini**

[1]Graduate and [2,4,5]Assistant Professor, Department of Pathology,  Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai-77, Tamil Nadu, India

[3]Associate Professor, Nanobiomedicine Lab, Department of Pharmacology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai-77, Tamil Nadu, India

**ABSTRACT**

*Introduction : Pterocarpus santalinus, with the common names red sanders, red saunders, red sandalwood, Rakt Chandan, and saundersfoot is a species of Pterocarpus endemic to the southern Eastern Ghats mountain range of South India. Pterocarpus santalinus is used in traditional herbal medicine as an antipyretic, anti-inflammatory, anthelmintic, tonic,hemorrhage, dysentery, aphrodisiac, anti-hyperglycaemic and diaphoretic.*

*Aim: To evaluate the antiinflammatory and anti diabetic property of Pterocarpus santalinus.*

*Methodology: The anti-inflammatory activity for Solanum torvum gel was tested by the following convention proposed by Muzushima and Kabayashi with specific alterations. Spearman correlation analysis was done with SPSS.*

*Result: Pterocarpus santalinus exhibited positive correlation with maximum anti-inflammatory at 50 µl concentration and maximum anti diabetic activity at 20 µl and 50 µl concentration. The obtained data were analysed using spearman correlation analysis andthe non parametric correlation was statistically significant at p value< 0.05.*

*Conclusion : From the present study it can be concluded that Pterocarpus santalinus have a good anti-inflammatory at high concentration and anti diabetic at low concentration. This is a relatively novel concept but has good potential in the pharmaceutical industry.*

*Keywords: diaphoretic, anthelmintic, tonic, pharmaceutical industry, innovative technique,green synthesis, eco friendly.*

**INTRODUCTION**

Diabetes mellitus is a endocrinal multifactorial disorder resulting in hyperglycemia with defective insulin secretion and action (1). Occurrence of side effects with prolonged oral hypoglycaemic drugs and other therapeutic drugs leads to the discovery of plant based drugs with less cost and relatively low adverse effects (2). Overexpression of Fertunin and sirtuin genes affects the homeostasis of glucose metabolism and insulin secretion leading to elevated reactive oxygen species in tissues. Plant based ethanolic extract of *Pterocarpus santalinus* lowers blood glucose level and shows significant effect in the underlying mechanism of Diabetes mellitus (3,4). Heartwood extract catalyses alpha glucosidase to polysaccharides andmonosaccharides. Cups of red sandalwood used as traditional method to treat  diabetes mellitus helping in carbohydrate metabolism (5).

Classical signs of inflammation are rubor, dolor, tumor, color along with abnormalities in structure affecting the quality of normal life. Non-steroidal anti-inflammatory drugs interact with proinflammatory mediators like cytokines, TNF - alpha, Interleukins relieves pain and inflammation(6). Prolonged NSAIDS leads to increased risk in gastric irritation and systemic effects. Plant based formulations of ethanolic extract of *Pterocarpus santalinus* helps as alternative formulation for treating Inflammatory condition (7,8). Extract of *Pterocarpus santalinus* reveals alkaloids, flavonoids, sterols, phenols, tannins, glucosides, lignans with increased medicinal activities and less adverse reactions. Lignins of *Pterocarpus santalinus* help in inhibition of TNF- alpha production and increased T-cell production (5).

*Pterocarpus santalinus* flavonoids helps in stimulation of beta cells to secrete insulin, decreased hyperglycaemia, proteolysis and increased scavenging of free radicals. Aqueous extract from *Pterocarpus santalinus* suppresses inflammatory enzymes resulting in decreased insulin resistance and oxidative stress (3)(9). Developing countries with chronic inflammatoryconditions like arthritis, synovial hyperplasia leading to joint deformity use NSAIDS with decreased response and increased adverse effects(10). Numerous studies showed significant results on topical application of *Pterocarpus santalinus* gel resulting with analgesic and anti-inflammatory and helps as safe topical NSAIDS. Topical application of red sandalwood extract paste helps reduce inflammation, ulcers, headache, bleeding, eruptions of  skin oedema. Reactive oxygen species result in

cellular damage in inflammatory lesions. Phenol and flavonoids have a powerful role against prostaglandins and cyclo-oxygenase inhibition and relieving inflammation(11). Sarinin and calocedin from *Pterocarpus santalinus* increase T cell production, inhibit Tumour necrosis factor alpha production, cyclic AMP phosphodiesterase also regulate Nuclear factor KB expression (12).

*Pterocarpus santalinus* is a natural bioactive orbicular shaped red sandalwood of the Fabaceae family Arunakumara (13). *Pterocarpus santalinus* species is distributed along tropical regions like India,China, Srilanka etc.,(5). *Pterocarpus santalinus* is a brown residue rich in phenol, fatty acids, resin, lignin and cellulose with increased elastic and tensile strength (14). The Ethanolic extract of *Pterocarpus santalinus* acts as anti-anti-inflammatory, anti-cytotoxic, anti-cariogenic, anti-diabetic and antioxidant agent. The use of traditional medicinal plants is reported resulting in good maintenance of health. It is used widely in advanced research in Nanomedicine and genetic engineering because of its multimodal use (3). *Pterocarpus santalinus* is a flower and fruit producing plant by self pollination, vulnerable to dry conditions. Wood bark with ghee, oil and honey used in defective vision. Wood bark is also given orally for reducing vomiting, hallucination, dysentery, helminthic infection, and wound healing. Also the leaf of *Pterocarpus santalinus* has activity towards E.coli, staphylococcus, Bacillus Proteus, faecalis, aerogenes, vulgaris etc.,(15) The present study was designed to investigate anti-inflammatory and anti-diabetic activity of the ethanolicextract of *Pterocarpus santalinus.*Our team has extensive knowledge and research experiencethat has translate into high quality publications (16).(17–30) ,(31–35).

In this present investigation we have prepared the plant extract of *Pterocarpus santalinus* and to evaluate the anti inflammatory and anti diabetic property.

## MATERIALS AND METHOD
### Preparation of plant extract
An in vitro study with 5.003 g of *Pterocarpus santalinus* was measured in a weighing machine. 45 ml of Ethanol was added to the *Pterocarpus santalinus* and was kept in thestirrer and shaker overnight. Then 10 µl, 20 µl, 30 µl, 40 µl, 50 µl of *Pterocarpus santalinus* ethanol extract was taken in the 5 separate beakers. Then it was boiled for 75°C for 10 minute and filtered.

### Reagent and Chemicals :
### Anti inflammatory :
0.45 mL of Bovine serum albumin (1% aqueous solution)

0.05 mL of *Pterocarpus santalinus* of various fixation (10µL,20µL,30µL,40µL,50µL)1N hydrochloric acid

Positive control : Diclofenac Sodium

Negative control : DMSO : Dimethyl sulfoxide.

### Anti diabetic :
100 µl of alpha amylase solution (1 % w/v )

Different concentration of nanoparticle ( 10µl , 20µl , 30µl , 40µl , 50µl )100 µl of 96 mM ( 3,5- dinitrosalicylic acid solution ) DNSA reagent Positive control : Sodium phosphate.

Negative control : DMSO : dimethyl sulfoxide.

### Anti-inflammatory activity Albumin degeneration assay
The anti-inflammatory activity for *Pterocarpus santalinus* was tested by the following convention proposed by Muzushima and Kabayashi with specific alterations (Pratik Das et al.,2019). 0.05 mL of *Pterocarpus santalinus* of various fixation (10µL,20µL,30µL,40µL,50µL) was added to 0.45 mL bovine serum albumin(1% aqueous solution) and the pH of the mixture was acclimated to 6.3 utilizing a modest quantity of 1N hydrochloric acid. These samples were incubated at room temperature for 20 min and then heated at 55 °C in a water bath for 30 min. The samples were cooled and the absorbance was estimated spectrophotometrically at 660 nm. Diclofenac Sodium was used as the standard. DMSO is utilized as a control.

Percentage of protein denaturation was determined utilizing following equation,

% inhibition= Absorbance of control- Absorbance of sample×100

Absorbance of control Colour change was recorded before and after incubation.

### Anti-diabetic activity
### Alpha amylase inhibition assay

The amount of maltose liberated during the experiment was analysed by Alpha amylase inhibition method. The method reported by Bhutkar and Bhise has been followed (36). Different concentration of nanoparticle ( 10µl , 20µl , 30µl , 40µl , 50µl ) was pre - incubated with 100 µl of alpha amylase solution (1 % w/v ) was further added to it and the mixture was incubated at room temperature for 10 minutes 100 µl of 96 mM ( 3,5-dinitrosalicylic acid solution ) DNSA reagent was mixed to stop the reaction and the solution was heated in a water bath for 5 minutes. Where there is equal quantity of enzyme extract was replaced there control was maintained of sodium phosphate buffer maintained at a pH value of 6.9. Reading was measured at 540 nm wavelength. The experiment was % of inhibition was calculated using the formula -

% inhibition = C - T * 100

C

This experiment was an in vitro study conducted in Saveetha Dental College, the sample we used was the commercially available powder , so it was easy for us to carry the further study, but there can be sampling error while using micropipette and we performed only in vitro procedure was already done with already obtained standard procedural value [Diclofenac sodium]. The samples were prepared in an unbiased manner by the random sampling method and the concentration used in the study used was 10µl, 20µl, 30µl, 40µl, 50µl. As an inclusion criteria, in our study we performed *Pterocarpus santalinus* anti-inflammatory and anti-diabetic activity. As an exclusion criteria, other activities for *Pterocarpus santalinus* can also be performed. The validation of the procedure was done by the principal investigator and by the experts in nanotechnology. In order to avoid the sampling error, the amount of *Pterocarpus santalinus* was measured and shown to the lab technician and also the preparation of the plant extract was analysed by the lab technician. The spearman correlation analysis was performed to analyse *Pterocarpus santalinus's* anti-inflammatory and anti-diabetic activity using SPSS software version 23.0 and Non parametric correlation was significant at p value less than 0.05.

## RESULTS AND DISCUSSION
### Anti-inflammatory activity



**Figure 1** Preparation of plant extract a) The powder of *Pterocarpus santalinus* was measured in the weighing machine b) *Pterocarpus santalinus* was taken in a beaker c) Ethanol was measured in the measuring cylinder. d) *Pterocarpus santalinus* ethanolic extract was prepared.
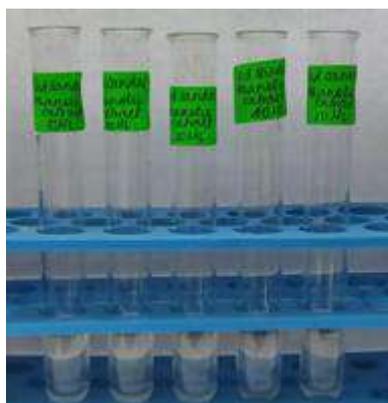


**Figure 2** 0.05 mL of *Pterocarpus santalinus* of various fixation(10µL,20µL,30µL,40µL,50µL) was added to 0.45 mL bovine serum albumin(1% aqueous solution).
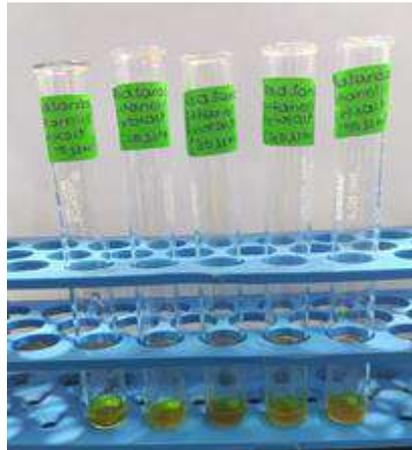
**Figure 3** Different concentrations of nanoparticles ( 10μl , 20μl , 30μl , 40μl , 50μl ) waspre - incubated with 100 μl of alpha amylase solution (1 % w/v ) was further added to it.

**Table 1** The above table shows the Anti-inflammatory activity along with the percentage of inhibition.

| S.no | Concentration(μL) | Wavelength(nm) | Absorbents(wt %) | Percentage of inhibition |
|------|-------------------|----------------|-------------------|--------------------------|
| 1. | 10 | 660.0 nm | 0.124 | 87.6 |
| 2. | 20 | 660.0 nm | 0.133 | 86.7 |
| 3. | 30 | 660.0 nm | 0.138 | 86.2 |
| 4. | 40 | 660.0 nm | 0.252 | 74.8 |
| 5. | 50 | 660.0 nm | 0.211 | 78.9 |

**Table 2** The above table shows the Anti-diabetic activity along with the Percentage of inhibition

| S.no | Concentration(μL) | Wavelength(nm ) | Absorbents(wt % ) | Percentage ofinhibition |
|------|-------------------|-----------------|-------------------|-------------------------|
| 1. | 10 | 540.0 | 0.112 | 88.8 |
| 2. | 20 | 540.0 | 0.11 | 89 |
| 3. | 30 | 540.0 | 0.111 | 88.9 |
| 4. | 40 | 540.0 | 0.112 | 88.8 |
| 5. | 50 | 540.0 | 0.11 | 89 |
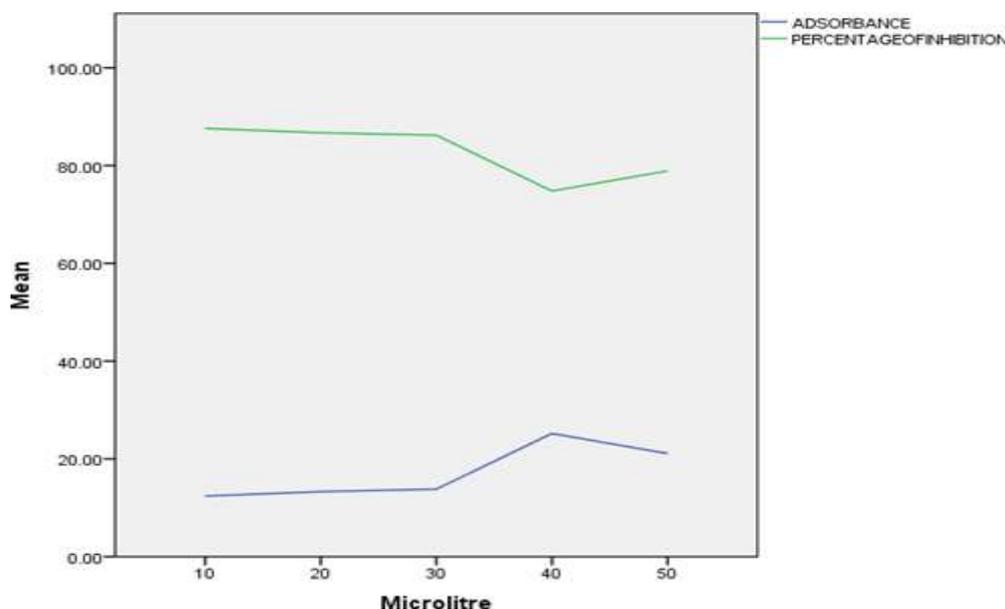


**Figure 5** The above line graph indicates the Anti-inflammatory activity for absorbance valueand percentage of inhibition. The X axis shows the concentration of the extract and the Y axisshows the mean value of absorbance and percentage of inhibition.
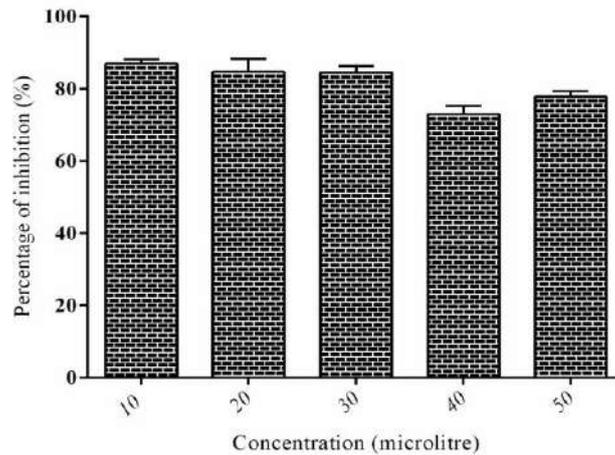
**Figure 6** Bar graph represents negative spearman correlation of anti- inflammatory activity with increase in concentration of the ethanolic plant extract of *Pterocarpus santalinus* (r=-1). Non parametric correlation was significant at p value less than 0.05. X axis shows the concentration of the extract in microlitre and the Y axis shows the percentage of inhibition.
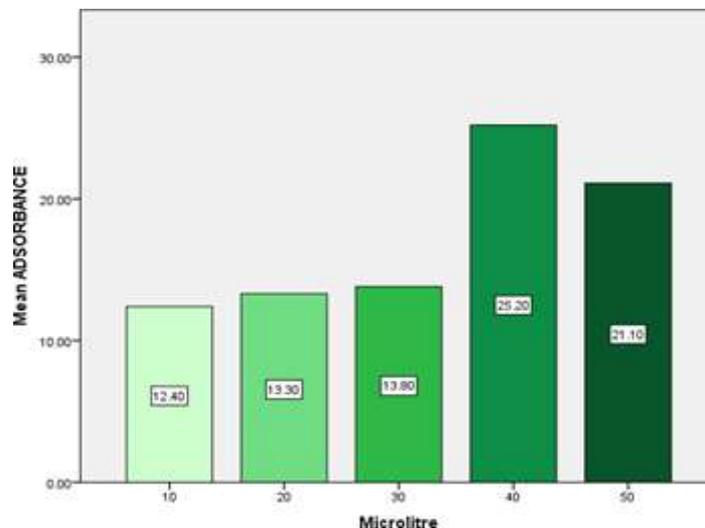


**Figure 7 :** The above graph represents a rise in absorbance in relation to an increase in concentration of anti- inflammatory activity of the ethanolic plant extract of *Pterocarpus santalinus*. X axis shows the concentration of the extract and the Y axis shows the absorbancevalue.
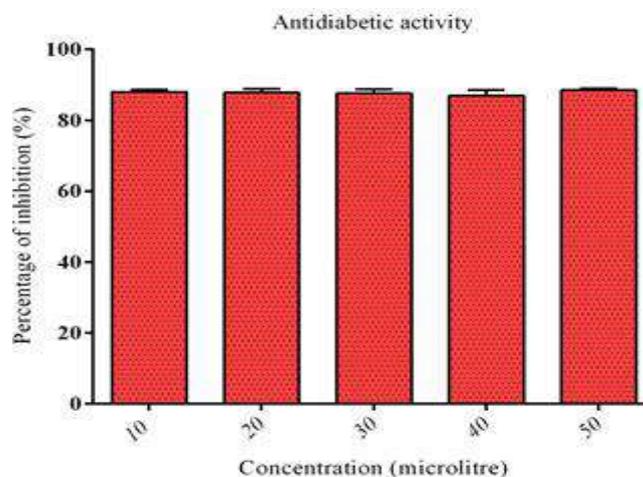


**Figure 8 :** Bar graph represents positive spearman correlation of anti- diabetic activity with increase in concentration of the ethanolic plant extract of *Pterocarpus santalinus* (r=+1). Non parametric correlation was significant at p value less than 0.05. X axis shows the concentration of the extract in microlitre and the Y axis shows the percentage of inhibition.

## Anti-inflammatory

In this study the anti-inflammatory activity was assessed in five different concentrations of reaction mixture from 10 μL, 20 μL, 30 μL, 40 μL and 50 μL. The percentage of inhibition was 87.6%, 86.7%, 86.2%, 74.8%, 78.9% respectively. Which plant extract 10 μL of concentration exhibited a high anti-inflammatory activity of 87.6% which was very close to the standard which exhibited 95% inhibition of inflammation.

## Anti-diabetic

In this study the anti-diabetic activity was assessed in five different concentrations of reaction mixture from 10μL, 20μL, 30μL, 40μL and 50μL. The adsorbents were 88.8%, 89%, 88.9%, 88.8%, 89% respectively. The plant extract 20μL and 50 μL of concentration exhibited a high anti-inflammatory activity of 89% which was very close to the standard which exhibited 95% inhibition of diabetic.

*Pterocarpus santalinus* (red sandalwood) is one among the medicinal commercially available plant species which is used in traditional medicine and they are rich in flavonoids and phenols(3). A wide variety of potential and effectiveness can be reported from *P. santalinus* including antioxidative, anti cancerous, anti inflammatory, antidiabetic properties and protective effects on the liver, gastric mucosa, and nervous system. The bioeffective compound present in *Pterocarpus santalinus* is responsible for anti diabetic and anti inflammatory (5). In vitro study, it can be expanded as in vivo study sample size is less , very less concentration is taken. Sampling errors can occur. Greener medicine nowadays is highly wanted in our country because greener medicines have very much less side effects than synthetic medicine.

Denaturation of the tissue proteins causes inflammatory disease. So for drug development the anti inflammatory action should involve substances that are antiinflammatory action. Edema formation will always occur just as a result of production of various inflammatory mediators like cyclooxygenase, arachidonic acid metabolite and histamine. Recent reports about the relation between impaired antioxidant status and periodontal disease/stomatitis. Role of reactive species in the scavenging effects and inflammatory process of the PSMWE on reactive oxygen species could be considered important for the anti-inflammatory effect (37). The compound phenanthrene dione, one new chalcone, pterolinus K , pterolinus L were isolated from the heartwood extract of *Pterocarpus santalinus (38)*.

In the previous studies performed by Aditya Jain, et al , (39) they performed anti-inflammatory activity using silver nanoparticles using cumin oil. So this can be used along with anti-inflammatory drugs like NSAIDS. In other studies performed by Amritha Varshini, et al (40) they did a synergistic study for anti-inflammatory for chlorogenic acid and L-theanine, the results obtained was it has low anti-inflammatory activity compared to antioxidant activity. Another study performed by Suneetha, et al (41), suggested that Padina tetrastromatica is having good anti-diabetic character, STZ induced. Type 2 anti-diabetic rats, it also experts protective against pancreas injury associated with diabetes. In another previous study performed by Rajeshkumar, et al (42) anti-diabetic activity of novel algal formulations against Streptozotocin induced diabetes in albino rats were performed.

The attribution to hyperglycemia, hypoinsulinemia, and increased proteolysis leads to The reduction in body weight after STZ-induced DM (43). The treatment for the diabetic animals with the plant extract may result in the improvement of the body weight because of its high content of flavonoids. The compound Flavonoids have the ability to stimulate the β-cells to release insulin, ameliorate insulin secretion, decrease hyperglycemia, and restore the body weight (44). Flavonoids like Polyphenolic compounds, phenolic acids and tannins, commonly found in plants have been reported to have multiple biological effects, including antioxidant activity. Therefore, presence of flavonoids and polyphenolic compounds that is used in the extract as evidenced for phytochemical screening suggests that these compounds might be responsible for antioxidant and anti-inflammatory effects (37). *Pterocarpus santalinus* extract, the majority components are very effective and essential ; the main representative of the active ingredient was Squalene, cedrol, alpha.-Bisabolol, Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester, P-Cresol, (-) - Spathulenol and Heptacosane (45). The limitation of this study is, since it is an in vitro study and it has to be expanded as in vivo study, and sample size was less, very less concentration was taken and the sampling error could have occured. The future scope of the study is that greener medicine nowadays is highly wanted in our country because greener medicines have very much less side effects than synthetic medicine.

## CONCLUSION :

From the current study it can be concluded that *Pterocarpus santalinus* shows high anti inflammatory at and anti diabetic higher concentrations. Further experimentation may be done by replacing the chitosan or by increasing the concentration. This topic is relatively useful in current trends.

**REFERENCE :**

1. Kharroubi AT, Darwish HM. Diabetes mellitus: The epidemic of the century. World J Diabetes. 2015 Jun 25;6(6):850–67.

2. Kondeti VK, Badri KR, Maddirala DR, Thur SKM, Fatima SS, Kasetti RB, et al. Effect of Pterocarpus santalinus bark, on blood glucose, serum lipids, plasma insulin and hepatic carbohydrate metabolic enzymes in streptozotocin-induced diabetic rats. Food Chem Toxicol. 2010 May;48(5):1281–7.

3. El-Badawy RE, Ibrahim KA, Hassan NS, El-Sayed WM. Pterocarpus santalinus ameliorates streptozotocin-induced diabetes mellitus via anti-inflammatory pathways and enhancement of insulin function. Iran J Basic Med Sci. 2019 Aug;22(8):932–9.

4. Preethikaa S, Brundha MP. Awareness of diabetes mellitus among general population. Research Journal of Pharmacy and Technology. 2018;11(5):1825–9.

5. Bulle S, Reddyvari H, Nallanchakravarthula V, Vaddi DR. Therapeutic Potential of Pterocarpus santalinus L.: An Update. Pharmacogn Rev. 2016 Jan;10(19):43–9.

6. Maroon JC, Bost JW, Maroon A. Natural anti-inflammatory agents for pain relief. Surg Neurol Int. 2010 Dec 13;1:80.

7. Scherzberg M-C, Kiehl A, Zivkovic A, Stark H, Stein J, Fürst R, et al. Structural modification of resveratrol leads to increased anti-tumor activity, but causes profound changes in the mode of action. Toxicol Appl Pharmacol. 2015 Aug 15;287(1):67–76.

8. Timothy CN, Samyuktha PS, Brundha MP. Dental pulp Stem Cells in Regenerative Medicine--A Literature Review. Research Journal of Pharmacy and Technology. 2019;12(8):4052–6.

9. Haruna WC, Simeon JO, Builders M, Tosin JO. Effect of Ethanol Leaf Extract of Pterocarpus santalinus Extract on Kidney of Wister Rats. Evaluation. 2019;4th.

10. Krishnaveni KS, Srinivasa Rao JV. An isoflavone from Pterocarpus santalinus [Internet]. Vol. 53, Phytochemistry. 2000. p. 605–6. Available from: http://dx.doi.org/10.1016/s0031-9422(99)00526-9

11. Kumar D, Murthy GS. Impact of pretreatment and downstream processing technologies on economics and energy in cellulosic ethanol production. Biotechnol Biofuels. 2011 Sep 5;4:27.

12. Yu T, Lee J, Lee YG, Byeon SE, Kim MH, Sohn E-H, et al. In vitro and in vivo anti-inflammatory effects of ethanol extract from Acer tegmentosum. J Ethnopharmacol. 2010 Mar 2;128(1):139–47.

13. Arunkumar AN, Joshi G. Pterocarpus santalinus (red sanders) an endemic, endangered tree of India: Current status, improvement and the future. J Trop For Environ [Internet]. 2014 Dec 27;4(2). Available from: http://journals.sjp.ac.lk/index.php/JTFE/article/view/2063

14. Jiang S, Ye D, Huang J, Shang Y, Zheng Z. SmartSteganogaphy: Light-weight generative audio steganography model for smart embedding application. Journal of Network and Computer Applications. 2020 Sep 1;165:102689.

15. Arunakumara K, Walpola BC, Subasinghe S, Yoon M-H. Pterocarpus santalinus Linn. f.(Rath handun): A review of its botany, uses, phytochemistry and pharmacology. Hanguk Ungyong Saengmyong Hwahakhoe Chi. 2011;54(4):495–500.

16. Anita R, Paramasivam A, Priyadharsini JV, Chitra S. The m6A readers YTHDF1 and YTHDF3 aberrations associated with metastasis and predict poor prognosis in breastcancer patients. Am J Cancer Res. 2020 Aug 1;10(8):2546–54.

17. Jayaseelan VP, Paramasivam A. Emerging role of NET inhibitors in cardiovasculardiseases. Hypertens Res. 2020 Dec;43(12):1459–61.

18. Sivakumar S, Smiline Girija AS, Vijayashree Priyadharsini J. Evaluation of the inhibitory effect of caffeic acid and gallic acid on tetR and tetM efflux pumps mediatingtetracycline resistance in Streptococcus sp., using computational approach. Journal of King Saud University - Science. 2020 Jan 1;32(1):904–9.

19. Smiline Girija AS. Delineating the Immuno-Dominant Antigenic Vaccine Peptides Against gacS-Sensor Kinase in Acinetobacter baumannii: An in silico Investigational Approach. Front Microbiol. 2020 Sep 8;11:2078.

20. Iswarya Jaisankar A, Smiline Girija AS, Gunasekaran S, Vijayashree Priyadharsini J. Molecular characterisation of csgA gene among ESBL strains of A. baumannii and targeting with essential oil compounds from Azadirachta indica. Journal of King SaudUniversity - Science. 2020 Dec 1;32(8):3380–7.

21. Girija ASS. Fox3+ CD25+ CD4+ T-regulatory cells may transform the nCoV's finaldestiny to CNS! J Med Virol [Internet]. 2020 Sep 3; Available from: http://dx.doi.org/10.1002/jmv.26482

22. Jayaseelan VP, Ramesh A, Arumugam P. Breast cancer and DDT: putative interactions, associated gene alterations, and molecular pathways. Environ Sci Pollut Res Int. 2021 Jun;28(21):27162–73.

23. Arumugam P, George R, Jayaseelan VP. Aberrations of m6A regulators are associated with tumorigenesis and metastasis in head and neck squamous cell carcinoma. Arch OralBiol. 2021 Feb;122:105030.

24. Kumar SP, Girija ASS, Priyadharsini JV. Targeting NM23-H1-mediated inhibition oftumour metastasis in viral hepatitis with bioactive compounds from Ganoderma lucidum: A computational study. pharmaceutical-sciences [Internet]. 2020;82(2). Available from: https://www.ijpsonline.com/articles/targeting-nm23h1mediated-inhibition-of-tumour-me tastasis-in-viral-hepatitis-with-bioactive-compounds-from-ganoderma-lucidum-a-comp-3883.html

25. Girija SA, Priyadharsini JV, Paramasivam A. Prevalence of carbapenem-hydrolyzing OXA-type β-lactamases among Acinetobacter baumannii in patients with severe urinarytract infection. Acta Microbiol Immunol Hung. 2019 Dec 9;67(1):49–55.

26. Priyadharsini JV, Paramasivam A. RNA editors: key regulators of viral response in cancer patients. Epigenomics. 2021 Feb;13(3):165–7.

27. Mathivadani V, Smiline AS, Priyadharsini JV. Targeting Epstein-Barr virus nuclear antigen 1 (EBNA-1) with Murraya koengii bio-compounds: An in-silico approach. ActaVirol. 2020;64(1):93–9.

28. Girija As S, Priyadharsini J V, A P. Prevalence of Acb and non-Acb complex in elderlypopulation with urinary tract infection (UTI). Acta Clin Belg. 2021 Apr;76(2):106–12.

29. Anchana SR, Girija SAS, Gunasekaran S, Priyadharsini VJ. Detection of csgA gene incarbapenem-resistant Acinetobacter baumannii strains and targeting with Ocimum sanctum biocompounds. Iran J Basic Med Sci. 2021 May;24(5):690–8.

30. Girija ASS, Shoba G, Priyadharsini JV. Accessing the T-Cell and B-Cell Immuno-Dominant Peptides from A.baumannii Biofilm Associated Protein (bap) as Vaccine Candidates: A Computational Approach. Int J Pept Res Ther. 2021 Mar 1;27(1):37–45.

31. Arvind P TR, Jain RK. Skeletally anchored forsus fatigue resistant device for correction of Class II malocclusions-A systematic review and meta-analysis. Orthod Craniofac Res.2021 Feb;24(1):52–61.

32. Venugopal A, Vaid N, Bowman SJ. Outstanding, yet redundant? After all, you may beanother Choluteca Bridge! Semin Orthod. 2021 Mar 1;27(1):53–6. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectivenessof 2% Articaine as an anesthetic agent in children: randomized controlled trial. Clin OralInvestig. 2019 Sep;23(9):3543–50.

33. Varghese SS, Ramesh A, Veeraiyan DN. Blended Module-Based Teaching in Biostatistics and Research Methodology: A Retrospective Study with PostgraduateDental Students. J Dent Educ. 2019 Apr;83(4):445–50.

34. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial [Internet]. Vol. 24, Clinical Oral Investigations. 2020. p. 3275–80. Available from: http://dx.doi.org/10.1007/s00784-020-03204-9

35. Bhutkar M, Bhise S. In vitro hypoglycemic effects of Albizzia lebbeck and Mucuna pruriens. Asian Pac J Trop Biomed. 2013 Nov 1;3(11):866–70.

36. Kumar D. Anti-inflammatory, analgesic, and antioxidant activities of methanolic wood extract of Pterocarpus santalinus L. J Pharmacol Pharmacother. 2011 Jul;2(3):200–2.

37. Wu S-F, Hwang T-L, Chen S-L, Wu C-C, Ohkoshi E, Lee K-H, et al. Bioactive components from the heartwood of Pterocarpus santalinus. Bioorg Med Chem Lett. 2011 Sep 15;21(18):5630–2.

38. Jain A, Anitha R, Rajeshkumar S. Anti inflammatory activity of Silver nanoparticles synthesised using Cumin oil. Research Journal of Pharmacy and Technology. 2019;12(6):2790–3.

39. Rampal RK, Maria P-O, Varshini HSA, Levine RL, Cao A. Synergistic Therapeutic Efficacy of Combined JAK1/2, Pan-PIM, and CDK4/6 Inhibition in Myeloproliferative Neoplasms. Blood. 2016;128(22):634–634.

40. Ponnanikajamideen M, Suneetha V, Rajeshkumar S. Antidiabetic, antihyperlipedimic and antioxidant activity of marine brown seaweed Padina tetrastromatica.

41. Rajeshkumar S, Divya B, Malarkodi C. Antidiabetic activity of novel algal formulations (Padina tetrastromatica and Turbinaria conoides) against Streptozotocin induced diabetes in albino rats. International Journal of Pharmaceutical Research. 2017;9(2):55.

42. Bhuvaneswari P, Krishnakumari S. Nephroprotective effects of ethanolic extract of Sesamum indicum seeds (Linn.) in streptozotocin induced diabetic male albino rats. International Journal of Green Pharmacy (IJGP) [Internet]. 2012 [cited 2021 Feb 15];6(4). Available from: http://greenpharmacy.info/index.php/ijgp/article/view/284

43. Zhang F, Feng J, Zhang J, Kang X, Qian D. Quercetin modulates AMPK/SIRT1/NF-κB signaling to inhibit inflammatory/oxidative stress responses in diabetic high fat diet-induced atherosclerosis in the rat carotid artery. Exp Ther Med. 2020;20(6):1–1.

44. Jiang S, Wei Y, Liu Z, Ni C, Gu H, Peng W. Molecules and functions of rosewood: Pterocarpus santalinus. Journal of King Saud University - Science. 2020 Mar 1;32(2):1712–7.

## PROGRESSIVE METHOD FOR ASSESSING THE COMPONENT HARMONIZATION OF THE COUNTRIES` DEVELOPMENT

### [1]Pereverzieva Anna and [2]Volkov Volodymyr
[1]Zaporizhzhia National University, Doctor of Economics, associate professor, professor of the Department of International Economics, Natural Resources and Economics of International Tourism, Zaporizhzhia, Ukraine
[2]Zaporizhzhia National University, Zaporizhzhya national university, Doctor of Technics, Professor, Professor of the Department of Entrepreneurship, Management of Organizations and Logistics

**ABSTRACT**

*The study objective is to propose a progressive method of component harmonization of countries` development applying quantitative and qualitative indicators. The practical application of the harmonization method is considered on the basis of three global indicators: the human development index, the happiness (life satisfaction) index and the ecological efficiency index.*

*The composite development index has been calculated on the basis of the named international indicators applying the standardization method to bring indicators to a single measure, and a multiplicative model which advantage is the possibility of simultaneous consideration and harmonization of low and high values. Calculations have been made for 25 countries. Calculations have been made by three methods of harmonization between integrated development index`s components: the Golden Ratio. The harmonization methods have been applied as the case of Estonia, the EU country, which showed the highest growth of the composite development index (+0,023) and, the EU country, with the lowest growth (+0,01) during 2019-2020s.*

*Based on the Golden Ratio, the differences and lack of interaction between the development components like human development, life satisfaction and environmental efficiency in EU countries during 2019-2020s, as well as their quantitative analysis, have been figured out. Application of the proposed toolkit to study the level of composite development at the EU countries has confirmed the disharmony with the predominance of the human development index. The practical application of the "equilibrium triangle" model to the harmonization of a country's composite development components, has allowed to state that the distances (sides of a triangle) "human development-happiness" and "human development-ecological efficiency" components should be equal. In case of equilateral triangle, the equality of indices meets all distances: "human development- happiness", "human development-ecological efficiency" and "happiness-ecological efficiency".*

*The proposed progressive method of harmonization is universal, because it allows expanding the number of indicators to determine the composite development and use other international indicators determined by the objective of the study. If more than three indicators are applied, then the geometric interpretation of the harmonization will be a regular N angle.*

*Key words. Harmonization, human development, life satisfaction, ecological efficiency, composite development, Golden Ratio method, equilibrium triangle and equilateral triangle method.*

### INTRODUCTION

Harmonization is an important step towards implementing the concept of sustainable composite development at the national, regional and local levels amid economic instability, since sustainable development builds foundations for the future generations, makes it possible to develop harmoniously at the present stage and offsets the discord of previous development. Inconsistency of economic development and environmental standards, dominance of industries with high share of resource and energy-intensive outdated technologies, raw material-biased exports, as well as low level of labour culture and consumption led to crisis changes in nature, which negatively affected national, regional, urban and individual wellbeing.

Nowadays there is a need to harmonize the environmental, economic and social sustainable development components and to determine the nature of correlation "society – nature", which ensures the equal access to the resources of present and future generations. "Society - Economy" requires balanced income distribution and overcoming poverty. "Nature-economy" is not less important as it needs cost assessment of man-made environmental impacts. A harmonious combination of "nature-economy-society" is the key challenge of times, both at interethnic, regional and local levels.

In this regard, there is a need to develop a scientific approach to the component harmonization of sustainable development, which affects not only the level of economic well-being, but also the society`s welfare in general and build the background for the development of future generations.

From the aforementioned one we can conclude that the main task for each country is not only the attraction of as much resources as possible and their rational use but also harmonized balance between them.

Thus, setting harmonization between development components is a priority task at national, regional and local levels.

## THEORETICAL FRAMEWORK

To determine the methods for assessing the degree of harmonization and instruments for improving its level, it is advisable to consider the theoretical achievements regarding the concept of "harmonization". The term "harmonization" is a derivative of "harmony", which being translated from the ancient Greek, means consistency, coherence and relation, that is, internal and external orderliness and integrity of phenomena and processes. In a broad sense, harmony is a generalization of the composition laws, in a narrower – the rules of building and coordination of elements. Besides, harmony is organization of form`s or environment`s elements, which excellence is achieved in terms of aesthetic norms for this style or national region. Harmony involves the consistency that meets the laws of expediency, optimality and beauty. It is their organic unity. That is, it establishes the pattern of the elements` internal connections and reveals general logic of development, the unity of the form and content and captures the most characteristic features of a style, the highest stage of its development.

Moreover, it is possible to interpret the concept of "harmonization" as related to the concept of "harmony" as a device and ordering, that is, the activity aimed at overcoming the disorder and meeting the coherence and the union of something been "torn".

The correlation of society and nature considers the strategy of harmonization as a desire to better coordinate two dependencies – human being from nature and nature from human being. Harmonization of the relationship between society and nature can be carried out as a result of the transformation of environmental consciousness and activities when humanity, deliberately recognizing the priority of the laws of nature, will take on the functions of a saver for the rapid and complete harmonization of the relationship between society and nature.

The concept of the "coexistence harmony of a society and nature" highlights a peculiar ideal of their coexistence and development that is a relatively dynamic equilibrium of all their most important trends of interaction or balanced processes of social consumption and natural resources` restoration. The ideal`s achievement is preceded by a high optimality of relations between society and nature. This means that at each stage of a society and nature interaction seeks for a more or less harmonious ratio of social and environmental purposes and needs, the choice of optimal and balanced goals by the laws of nature functioning and social development. For this reason, one should set the environmental limits of human activity which can provide a dynamic equilibrium of general consumption processes and natural resources restoration. Further progress in the development of civilization is impossible without them.

Consequently, harmonization is a mutual agreement, linking into a single system, unification, coordination, ordering and ensuring mutual compliance of economic measures between systems and subsystems, structure and infrastructure of a country.

In the study, harmonization means balancing between human development, life satisfaction and ecological efficiency. Therefore, we will focus on the theoretical and practical achievements regarding these components.

The need to supplement the human development index by an additional indicator of sustainability was substantiated by (Gruzina, Y., Firsova, I., Strikellkowski, W. 2021). Scholars`proposed to introduce a concept of sustainable human development index (SHDI), which fully defines country`s potential but does not emphasize the achieved result. The need to improve human development by expanding its content was substantiated by (Prados de la Escosura, Leandro 2021). Scientists proposed an augmented human development index (AHDI), which combines achievements in the field of health, education, material standard of living and political freedom. Continuing the subjects, the scholars (Mangaraj, B.K.; Aparajita, Upali, 2020) reviewed the concept of building a human development index by proposing a relative GHDI index relative to the basic HD level, which depends on the year, and is calculated based on the objectives of human development indicators established by the United Nations Development Programme, that is the individual results of all the studied countries. The studies also revealed that calculations of HDI indicators have certain disadvantages, such as methodology, selection of indexes and measurements (Omrani, Hashem; Alizadeh, Arash; Amini, Mohaddeseh, 2020).

The paper proposes a new approach to calculating scores of the human development index. First, new and additional criteria are being selected in each index of health, education and standard of life, then the specific scales of criteria are being determined in each measurement. Scientists (Van Puyenbroeck, Tom; Rogge, Nicky

2020) also emphasized disadvantages of the index calculation methodology. Scientists (Kawada, Yoko; Nakamura, Yuta; Otani, Shuhei, 2019) proposed a new formula for calculating HDI. Methods of optimization and improvement of the human development index, which is an integral part of the countries` ranking in terms of their socio-economic development, were studied by (Kuc-Czarnecka, Marta, 2019). The optimization of the progressive development will be carried out by re-scaling the current specific scales so that they highlight the real effect of each component, taken into account in the process of the HDI calculation. To solve the problems of calculating scientists (Qiu, Qihua; Sung, Jaesang; Davis, Will, 2018) proposed to evaluate human development through three auxiliary variables that determine the situation with the environment, stability abd incomes; besides, the index includes the Millennium Development Goals. There is a point of view among scholars that the main reason for the low level of human development is poverty (Hasan, Zubair, 2020).

A significant number of studies is devoted to human development analysis in the EU countries. The interconnection between economic diversification and human development in the EU countries was investigated by Ali, Muhammad; Cantner, Uwe (Ali, Muhammad; Cantner, Uwe 2020). A two-dimensional relationship between human development and economic freedom indexes in European countries was proved by (Gezer, Alper 2020). Analysis of the relationship between human development index (HDI) and the Corruption Perception Index (CPI) was made by (Sarabia, Maria; Creecente, Fernando; Teresa del Val, Maria, 2019). Studying the determinants of socio-economic development of the EU member states scientists (Babiarz, Patryk; Grabinski, Tadeusz; Migala-Warchol, Aldona, 2018) proposed a structure, modeled by human development index, which takes into account a wide set of variables covering economic outcomes, science and technology, healthcare, education and living conditions.

Let us consider the results of theoretical and practical studies of life satisfaction (human happiness index), which is the second component of composite development of our progressive method. It was proposed by (Choudhury, M., 2019) to consider the human happiness index as an alternative to the development assessment. Human development involves not only health care, formal education and economic growth, as indicated by the UNDP index. For example, the study of (Pugno, M., 2019) proposed broader interpretation of the concept of "human development": growth of personal human skills interacting within social and economic context making people the agents of their own lives, that is happy, or satisfied. In the study of human welfare and progress (Pugno, M., 2015) two different approaches were highlighted, but it seems they have opposite prospects and even opposing weaknesses. The approach to the abilities proposed by A. Sen, focuses on objective factors that contribute to the person`s well-being. Besides, scientists (Capps, D., Carlin, N., 2013) proved the existence of empirical correlation between happiness and the level of economic development, as well as between happiness and the level of democracy in a society.

## DATA AND METHODS

Let us consider the practical application of the harmonization methods on the basis of a composite indicator, which consists of three sub-indexes: the human development index ($I_{HD}$), the human happiness index or life satisfaction ($I_{HAP}$) and the ecological efficiency index ($I_{EP}$).

Let us study the components of the composite development index of the EU countries during 2019-2020s (Table 1)

**Tab. 1** Components of the composite development index of the EU countries during 2019-2020s

| № | Country | The components of index complex development ($I_{CD}$), роки | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2019 | | | 2020 | | |
| | | $I_{HD}$ | $I_{HAP}$ | $I_{EP}$ | $I_{HD}$ | $I_{HAP}$ | $I_{EP}$ |
| 1 | Austria | 0,921 | 7,294 | 79,0 | 0,922 | 7,213 | 79,6 |
| 2 | Belgium | 0,930 | 6,864 | 77,4 | 0,931 | 6,839 | 73,3 |
| 3 | Bulgaria | 0,813 | 5,102 | 67,9 | 0,816 | 5,598 | 57,0 |
| 4 | Great Britain | 0,928 | 7,165 | 79,9 | 0,932 | 6,798 | 81,3 |
| 5 | Hungary | 0,850 | 6,000 | 65,0 | 0,854 | 6,038 | 63,7 |
| 6 | Germany | 0,946 | 7,076 | 78,4 | 0,947 | 7,312 | 77,2 |
| 7 | Greece | 0,881 | 5,515 | 73,6 | 0,888 | 5,788 | 69,1 |
| 8 | Denmark | 0,939 | 7,646 | 81,6 | 0,940 | 7,515 | 82,5 |
| 9 | Ireland | 0,951 | 7,094 | 78,8 | 0,955 | 7,035 | 72,8 |
| 10 | Spain | 0,905 | 6,401 | 78,4 | 0,904 | 6,502 | 74,3 |

| 11 | Italy | 0,890 | 6,387 | 77,0 | 0,892 | 6,488 | 71,0 |
| 12 | Latvia | 0,863 | 5,950 | 66,1 | 0,866 | 6,229 | 61,6 |
| 13 | Lithuania | 0,876 | 6,215 | 69,3 | 0,882 | 6.391 | 62,9 |
| 14 | Luxemburg | 0,913 | 7,305 | 79,1 | 0,916 | 7,324 | 82,3 |
| 15 | Netherland | 0,942 | 7,449 | 75,5 | 0,944 | 7,504 | 75,3 |
| 16 | Poland | 0,877 | 6,186 | 64,1 | 0,880 | 6,139 | 60,9 |
| 17 | Portugal | 0,860 | 5,911 | 71,9 | 0,864 | 5,768 | 67,0 |
| 18 | Romania | 0,823 | 6,112 | 64,8 | 0,828 | 6,140 | 64,7 |
| 19 | Slovenia | 0,912 | 6,363 | 67,6 | 0,917 | 6,462 | 72,0 |
| 20 | Finland | 0,937 | 7,809 | 78,6 | 0,938 | 7,889 | 79,8 |
| 21 | France | 0,898 | 6,664 | 84,0 | 0,901 | 6,714 | 80,0 |
| 22 | Croatia | 0,848 | 5,505 | 65,5 | 0,851 | 6,508 | 63,1 |
| 23 | the Czech Republic | 0,898 | 6,911 | 67,7 | 0,900 | 6,897 | 71,1 |
| 24 | Sweden | 0,943 | 7,354 | 80,5 | 0,945 | 7,314 | 78,7 |
| 25 | Estonia | 0,889 | 6,022 | 64,3 | 0,900 | 6,453 | 65,3 |

**Source:** Human development index 2021. URL: http://hdr.undp.org/sites/default/files/hdr2020.pdf

World Happiness Report 2021. URL: https://happiness-report.s3.amazonaws.com/2021/WHR+21.pdf

2020 EPI REPORT. URL: https://epi.yale.edu/downloads/epi2020report20210112.pdf

In our opinion, if one analyzes each of the indicators separately, he/she will only get the outcomes of country's development in a certain aspect, which limits its future development. Therefore, it is important to consider all components simultaneously, indicating composite and multiple development. We propose to determine the general index as a set of three indicators: the human development index, the life satisfaction index ("human happiness") and the ecological efficiency index.

To calculate the general index, it is necessary to bring indicators in accordance with each other by means of standardization. The index calculation procedure provides for statistical indicators` standardization, which is based on the formula:

$$I_z = \frac{I_{fact}}{I_{max}}, \qquad (1)$$

where $I_z$ – standardized index;

$Z_{fact}$ – real value of index;

$Z_{max}$ – maximum value of index (for the inclusive development index - 10; for the human happiness index - 10; for the ecological efficiency index - 100);

The standardization results of the composite development index`s components are presented in Table 2.

**Tab. 2** Standardization of the composite development index`s components of the EU countries

| № | Country | The normal components of index complex development ($I_{CD}$), роки | | | | | |
| | | 2019 | | | 2020 | | |
| | | $I_{HD}$ | $I_{HAP}$ | $I_{EP}$ | $I_{HD}$ | $I_{HAP}$ | $I_{EP}$ |
| 1 | Austria | 0,921 | 0,729 | 0,790 | 0,922 | 0,721 | 0,796 |
| 2 | Belgium | 0,930 | 0,686 | 0,774 | 0,931 | 0,684 | 0,733 |
| 3 | Bulgaria | 0,813 | 0,510 | 0,679 | 0,816 | 0,560 | 0,570 |
| 4 | Great Britain | 0,928 | 0,717 | 0,799 | 0,932 | 0,680 | 0,813 |
| 5 | Hungary | 0,850 | 0,600 | 0,650 | 0,854 | 0,604 | 0,637 |
| 6 | Germany | 0,946 | 0,708 | 0,784 | 0,947 | 0,731 | 0,772 |
| 7 | Greece | 0,881 | 0,552 | 0,736 | 0,888 | 0,579 | 0,691 |
| 8 | Denmark | 0,939 | 0,765 | 0,816 | 0,940 | 0,752 | 0,825 |
| 9 | Ireland | 0,951 | 0,709 | 0,788 | 0,955 | 0,704 | 0,728 |

| 10 | Spain | 0,905 | 0,640 | 0,784 | 0,904 | 0,650 | 0,743 |
|---|---|---|---|---|---|---|---|
| 11 | Italy | 0,890 | 0,639 | 0,770 | 0,892 | 0,649 | 0,710 |
| 12 | Latvia | 0,863 | 0,595 | 0,661 | 0,866 | 0,623 | 0,616 |
| 13 | Lithuania | 0,876 | 0,622 | 0,693 | 0,882 | 0,639 | 0,629 |
| 14 | Luxemburg | 0,913 | 0,731 | 0,791 | 0,916 | 0,732 | 0,823 |
| 15 | Netherland | 0,942 | 0,745 | 0,755 | 0,944 | 0,750 | 0,753 |
| 16 | Poland | 0,877 | 0,619 | 0,641 | 0,880 | 0,614 | 0,609 |
| 17 | Portugal | 0,860 | 0,591 | 0,719 | 0,864 | 0,577 | 0,670 |
| 18 | Romania | 0,823 | 0,611 | 0,648 | 0,828 | 0,614 | 0,647 |
| 19 | Slovenia | 0,912 | 0,636 | 0,676 | 0,917 | 0,646 | 0,720 |
| 20 | Finland | 0,937 | 0,781 | 0,786 | 0,938 | 0,789 | 0,798 |
| 21 | France | 0,898 | 0,666 | 0,840 | 0,901 | 0,671 | 0,800 |
| 22 | Croatia | 0,848 | 0,551 | 0,655 | 0,851 | 0,651 | 0,631 |
| 23 | the Czech Republic | 0,898 | 0,691 | 0,677 | 0,900 | 0,690 | 0,711 |
| 24 | Sweden | 0,943 | 0,735 | 0,805 | 0,945 | 0,731 | 0,787 |
| 25 | Estonia | 0,889 | 0,602 | 0,643 | 0,900 | 0,645 | 0,653 |

**Source:** calculated by authors themselves

Standardizing the values of the EU countries` composite development components, let us calculate the general index of composite development based on the multiplicative model, which involves all indicators together. The model is more "rigid", since it does not allow offsetting low values of indicators due to the indicators, which reflect higher level of development. In our opinion, one should use it when considering all the components, which determine country`s quantitative and qualitative development.

Thus, the composite development index of a country by a multiplicative model is determined by the formula:

$$I_{total} = \sqrt[3]{I_{HD} \cdot I_{HAP} \cdot I_{EPI}} \quad , \qquad (1)$$

where $I_{total}$ – the composite development index of a country;

$I_{HD}$ – the human development index;

$I_{HAP}$ – the life satisfaction index ("human happiness");

$I_{EP}$ – the ecological efficiency index.

The advantage of the multiplicative model is its ability to take into account and harmonize low and high values of indicators. It also indicates the degree of the estimated country`s index compliance with the reality.

The calculation results of the composite development index are presented in Table 3.

**Tab. 3** The composite development index of the EU countries during2019-2020s

| № | Country | The index complex development ($I_{CD}$), роки | | Характер змін |
|---|---|---|---|---|
| | | 2019 | 2020 | ↓ |
| 1 | Austria | 0,810 | 0,809 | ↓ |
| 2 | Belgium | 0,791 | 0,776 | ↓ |
| 3 | Bulgaria | 0,655 | 0,639 | ↓ |
| 4 | Great Britain | 0,810 | 0,802 | ↓ |
| 5 | Hungary | 0,692 | 0,690 | ↓ |
| 6 | **Germany** | 0,807 | 0,812 | ↑ (+0,05) |
| 7 | Greece | 0,710 | 0,708 | ↓ |
| 8 | Denmark | 0,837 | 0,835 | ↓ |
| 9 | Ireland | 0,810 | 0,788 | ↓ |
| 10 | Spain | 0,769 | 0,759 | ↓ |
| 11 | Italy | 0,759 | 0,743 | ↓ |

| 12 | Latvia | 0,698 | 0,693 | ↓ |
| 13 | Lithuania | 0,723 | 0,708 | ↓ |
| 14 | **Luxemburg** | 0,808 | 0,820 | ↑ (+0,012) |
| 15 | **Netherland** | 0,809 | 0,811 | ↑ (+0,02) |
| 16 | Poland | 0,703 | 0,690 | ↓ |
| 17 | Portugal | 0,715 | 0,694 | ↓ |
| 18 | **Romania** | 0,688 | 0,690 | ↑ (0,02) |
| 19 | **Slovenia** | 0,732 | 0,753 | ↑ (0,021) |
| 20 | **Finland** | 0,832 | 0,839 | ↑ (0,07) |
| 21 | **France** | 0,795 | 0,785 | ↓ (0,01) |
| 22 | Croatia | 0,674 | 0,704 | ↑ |
| 23 | **the Czech Republic** | 0,749 | 0,761 | ↑ (0,012) |
| 24 | Sweden | 0,823 | 0,816 | ↓ |
| 25 | **Estonia** | 0,701 | 0,724 | ↑ (0,023) |

**Source:** calculated by authors themselves

Let us consider possible ways of their harmonization: 1) the "Golden Ratio", 2) the rule of "equilibrium triangle" and "equilateral triangle".

The harmonization method based on the "Golden Ratio", allows determining the degree of harmonization between composite development components applying quantitative analysis. It is well known that the "Golden Ratio" could be found both in nature and in artificial objects created by humans. It is synonymous with harmony, which balances and reconciles the "boundaries" between the components. Scientists working in various fields associate the "Golden Ratio" with expediency, optimality and efficiency. As a rule, the "Golden Ratio" is characterized by its inherent minimum or maximum.

The geometric interpretation of the "Golden Ratio" can be represented by dividing a single segment into two parts, in which the ratio of the lengths of the entire segment to its greater part is equal to the ratio of the greater part to the lesser. This ratio is equal to 1.618; while most of the segment will be equal to 0.618, and less – 0.382 (Fig. 1).

The above theoretical considerations could be applied to determine the level of harmonization between the composite development components. It is a necessary step to analyze the real values of the composite development index`s components and its comparison with the harmonized status.
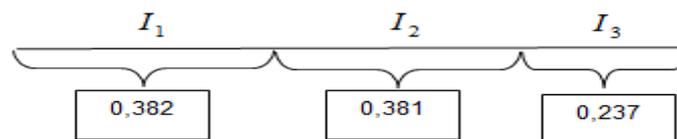


**Fig. 1** The geometric interpretation of the "Golden Ratio"

*Source: built by authors themselves*

Let us consider this progressive method of harmonization on the example of Estonia (Fig. 2 a, b) – the EU country, which achieved the highest growth of the composite development index (+0.023) and France (Fig. 3 a, b) – the country with lowest growth (+0.01).
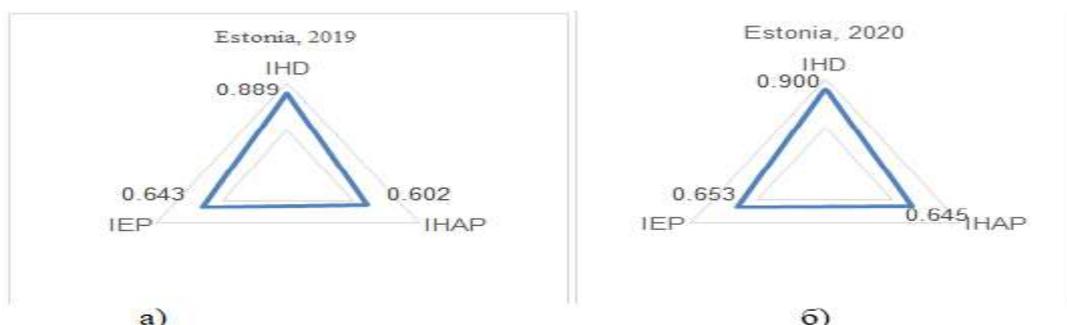


**Fig. 2** Indices of composite development components in Estonia, 2019-2020s

*Source: built by authors themselves*
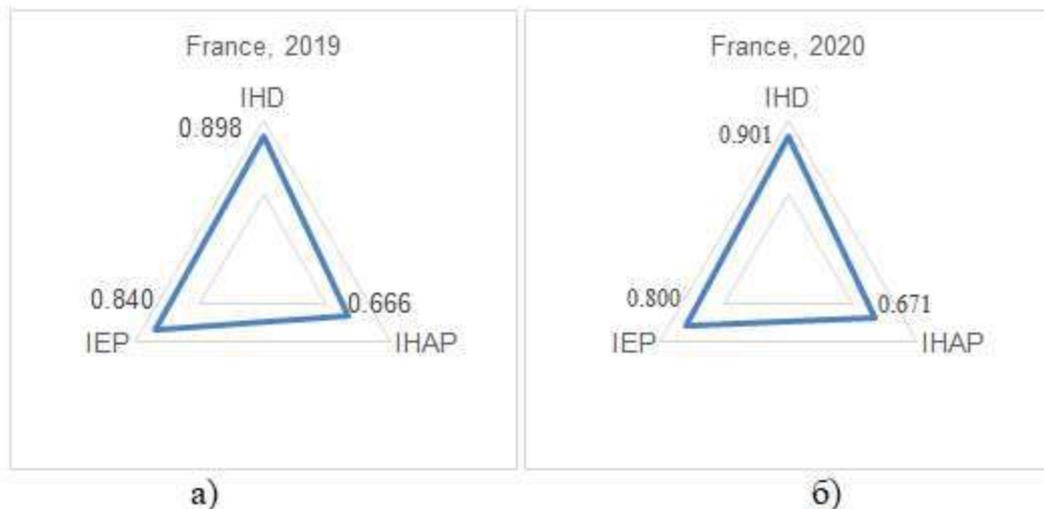
**Fig. 3** Indices of composite development components in France, 2019-2020s

*Source: built by authors themselves*

Fig. 2 and fig. 3 reveal that the human development index was the most important in 2020 for Estonia and France – 0.900 and 0.901, respectively, while in 2019, France showed a better result than Estonia – 0.898 and 0.889, respectively. The human happiness index was least important in 2020 and 2019 for both countries. This allows us to conclude about the contribution of the relevant component to the overall level of composite development. Therefore, the obtained results indicate the lack of harmonization within the component structure of composite development and necessitate the search for ways to achieve a harmonious status.

As it has been noted above, one of the harmonization tools is the application of the "Golden Ratio". Practical implementation of the proposed tools is to determine the degree of harmonization between composite development components for Estonia and France (Table 4).

**Tab. 4 Comparison of real and "harmonized" distribution between sub-indices of composite development**

| Country | Indicators | Real value, years | | Ideal («harmonized») distribution, pcs | Deviation (+/-) | |
|---|---|---|---|---|---|---|
| | | 2019 | 2020 | | 2019 | 2020 |
| *Estonia* | $I_{HD}$ | 0,889 | 0,900 | 0,382 | +0,507 | +0,518 |
| | $I_{HAP}$ | 0,602 | 0,645 | 0,237 | +0,365 | +0,408 |
| | $I_{EP}$ | 0,643 | 0,653 | 0,381 | +0,262 | +0,272 |
| *France* | $I_{HD}$ | 0,898 | 0,901 | 0,382 | +0,516 | +0,519 |
| | $I_{HAP}$ | 0,666 | 0,671 | 0,237 | +0,429 | +0,434 |
| | $I_{EP}$ | 0,840 | 0,800 | 0,381 | +0,459 | +0,419 |

**Source:** calculated by authors themselves

Based on the analysis of the real and "ideal" (harmonized) values of composite development sub-indexes (Table 4), it can be stated that all composite development components for Estonia and France in 2019 and 2020 exceeded the "harmonized" level. Note that in 2020 the excess of the ecological efficiency index for Estonia dropped compared to 2019, which indicates the need for applying measures for the ecological component balancing.

On the basis of the preliminary study, there is a need for analytical calculation of the sides of the triangle components – distances between composite development components and the degree of harmonization. The distances between the two close points of the triangle are calculated by Formula 2:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad (2)$$

If $d$ distance is equal for three sides, it indicates a significant level of harmonization between sub-indexes.

Let us make calculations based on the application of a progressive method on the example of Estonia and France (Table 5).

**Tab. 5 Distances between triangle apexes referring to correlations of the composite development sub-indexes, 2019-2020s**

| country | Indicator | The composite development sub-indexes, years | |
|---|---|---|---|
| | Distances | 2019 | 2020 p |
| Estonia | «$I_{HD}$ ma $I_{HAP}$», $d_1$ | 1,074 | 1,107 |
| | «$I_{HD}$ ma $I_{EP}$», $d_2$ | 1,097 | 1,112 |
| | «$I_{HAP}$ ma $I_{EP}$», $d_3$ | 0,881 | 0,918 |
| France | «$I_{HD}$ ma $I_{HAP}$», $d_1$ | 1,118 | 1,123 |
| | «$I_{HD}$ ma $I_{EP}$», $d_2$ | 1,230 | 1,205 |
| | «$I_{HAP}$ ma $I_{EP}$», $d_3$ | 1,072 | 1,044 |

**Source:** calculated by authors themselves

Let us analyze the values of composite development components for Estonia and France, taking into account the equilibrium and equilateral triangle models. The distances «$I_{HD}$ and $I_{HAP}$» and «$I_{HD}$ and $I_{EP}$» must be equal according to the equilibrium triangle model. Estonian results reveal the growing distance between all indicators in 2020, while for France, only the distance for «$I_{HD}$ and $I_{HAP}$» indicators rises in 2020. The calculations confirm our theoretical substantiation for the disharmony between country`s composite development components by the equilateral triangle model, according to which all distances should be equal and form a third of the whole.

Within the rule of equilibrium and equilateral triangle one can define the "ideal" values of composite development components (Table 6 – Table 7).

**Tab. 6 Real and "ideal" (harmonized) values of distances between composite development components for Estonia and France, 2019**

| Country | Distances | the rule of equilibrium triangle | | the rule of equilateral triangle |
|---|---|---|---|---|
| | | Real values | Ideal values | |
| Estonia | «$I_{HD}$ ma $I_{HAP}$» | 0,889 | 0,746 | 0,711 |
| | «$I_{HD}$ ma $I_{EP}$» | 0,602 | 0,746 | 0,711 |
| | «$I_{HAP}$ ma $I_{EP}$» | 0,643 | 0,643 | 0,711 |
| France | «$I_{HD}$ ma $I_{HAP}$» | 0,898 | 0,782 | 0,801 |
| | «$I_{HD}$ ma $I_{EP}$» | 0,666 | 0,782 | 0,801 |
| | «$I_{HAP}$ ma $I_{EP}$» | 0,840 | 0,840 | 0,801 |

**Source:** calculated by authors themselves

**Tab. 7 Real and "ideal" (harmonized) values of distances between composite development components for Estonia and France, 2020**

| Country | Distances | the rule of equilibrium triangle | | the rule of equilateral triangle |
|---|---|---|---|---|
| | | Real values | Ideal values | |
| Estonia | «$I_{HD}$ ma $I_{HAP}$» | 0,900 | 0,776 | 0,733 |
| | «$I_{HD}$ ma $I_{EP}$» | 0,645 | 0,776 | 0,733 |
| | «$I_{HAP}$ ma $I_{EP}$» | 0,653 | 0,653 | 0,733 |
| France | «$I_{HD}$ ma $I_{HAP}$» | 0,901 | 0,786 | 0,791 |
| | «$I_{HD}$ ma $I_{EP}$» | 0,671 | 0,786 | 0,791 |
| | «$I_{HAP}$ ma $I_{EP}$» | 0,800 | 0,800 | 0,791 |

**Source:** calculated by authors themselves

Tables` 6 and 7 data analysis illustrates that in 2019, values of the distances between composite development components for both countries are higher according the equilibrium and equilateral triangle model compared to 2020. That is, their development is gradually approaching the calculated harmonized ("ideal") status. Let us emphasize that the model selection, that is the "equilibrium triangle" model or the "equilateral triangle" model, is determined by the prior given strategic development guidelines. If the main goal is the equality between two components, then the level of development is determined by the "equilibrium triangle" model. Achieving

equality between three components meets the "ideal" position of the "equilateral triangle" model.

## CONCLUSIONS

On the basis of the study, it can be summed up that the main task is not to achieve the highest value of the component but in supporting the harmonized correlation between them determined by the correct geometric figure. Achieving this position is possible on the basis of mutual agreement policy, which would have contributed to a rational redistribution of tangible and intangible resources and, accordingly, the development harmonization from micro- to megalevel.

The component harmonization of composite development, which involves components` coherency and coordination acts as the necessary condition for the country's development amid uncertainty and stronger impact of global challenges. The correlation must meet certain rules that determine the harmonization tools. In our opinion, one of the most effective instruments from the theoretical and practical points of view is harmonization based on the "Golden Ratio", which allows not only to reveal the difference and lack of interaction between elements, but also to make quantitative analysis. The application of the proposed progressive method to study the level of composite development of the EU countries confirmed the disharmony with predominance of the human development index. This requires development of the appropriate harmonization mechanism based on resource redistribution to support one component at the proper level and other`s improvement.

Harmonization analysis allows us to conclude that the triad of composite development components can form an equilibrium or equilateral triangle. The practical application of the "equilibrium triangle" model to the harmonization of the country`s composite development components allows to state that the segments determining "human development-human happiness" and "human development-ecological efficiency" must be equal. In case of equilateral triangle, the equality characterizes all segments: "Human development-human happiness", "human development-ecological efficiency", and "human happiness-ecological efficiency".

## REFERENCES

- Human development index 2021. URL: http://hdr.undp.org/sites/default/files/hdr2020.pdf

- World Happiness Report 2021. URL: https://happiness-report.s3.amazonaws.com/2021/WHR+21.pdf.

- 2020 EPI REPORT. URL: https://epi.yale.edu/downloads/epi2020report20210112.pdf.

- Institutional architecture and dynamics of economic reforms / under. ed. Dr. Econ. Sciences A. Gritsenko. - Kh.: Fort, 2008. - 928 p. / p. 2.3 Kryuchkova I. The law of the golden section as the basis of the structural perfection of application and its application in economic research. P. 64–90.

- Form harmonization. The concept of harmony. URL: http://furlib.ru/books/item/f00/s00/z0000004/st033.shtml.

- Gruzina, Y., Firsova, I., Strielkowski, W. (2021) Dynamics of human capital development in economic development cycles. ECOLOGICAL ECONOMICS. Vol. 185.

- Prados de la Escosura, Leandro (2021) Augmented human development in the age of globalization(dagger).ECONOMIC HISTORY REVIEW.

- Mangaraj, B. K.; Aparajita, Upali (2020) Constructing a generalized model of the human development index. SOCIO-ECONOMIC PLANNING SCIENCES. Vol. 70.

- Omrani, Hashem; Alizadeh, Arash; Amini, Mohaddeseh A new approach based on BWM and MULTIMOORA methods for calculating semi-humandevelopment index: An application for provinces of Iran. SOCIO-ECONOMIC PLANNING SCIENCES. Vol. 70.

- Van Puyenbroeck, Tom; Rogge, Nicky (2020) Comparing regional human development using global frontier difference indices. SOCIO-ECONOMIC PLANNING SCIENCES. Vol. 70.

- Kawada, Yoko; Nakamura, Yuta; Otani, Shuhei (2019) An Axiomatic Foundation of the Multiplicative Human Development Index. REVIEW OF INCOME AND WEALTH. Vol. 65. №4. P. 771-784.

- Kuc-Czarnecka, Marta (2019) Sensitivity analysis as a tool to optimise Human Development Index EQUILIBRIUM-QUARTERLY JOURNAL OF ECONOMICS AND ECONOMIC POLICY Vol. 14. №3. P. 425-440.

- Qiu, Qihua; Sung, Jaesang; Davis, Will (2018) Using spatial factor analysis to measure human development. JOURNAL OF DEVELOPMENT ECONOMICS. Vol. 132. P. 130-149.

- Hasan, Zubair (2020) Elevating Human Development in Muslim Countries: Need Fulfillment versus Basic Income Provision. TURKISH JOURNAL OF ISLAMIC ECONOMICS-TUJISE. Vol. 7. №2. P. 1-16.

- Ali, Muhammad; Cantner, Uwe (2020) Economic diversification and human development in Europe. EURASIAN ECONOMIC REVIEW. Vol. 10. №2. P. 211-235.

- Gezer, Alper (2020) THE IMPACT OF ECONOMIC FREEDOM ON HUMAN DEVELOPMENT IN EUROPEAN TRANSITION ECONOMIES. COMPUTATION AND ECONOMIC CYBERNETICS STUDIES AND RESEARCH. Vol. 54. №3. P. 161-178.

- Sarabia, Maria; Crecente, Fernando; Teresa del Val, Maria (2019) The Human Development Index (HDI) and the Corruption Perception Index (CPI) 2013-2017: analysis of social conflict and populism in Europe.

- ECONOMIC RESEARCH-EKONOMSKA ISTRAZIVANJA. Vol. 33. №1. P. 2943-2955.

- Babiarz, Patryk; Grabinski, Tadeusz; Migala-Warchol, Aldona (2018) THE APPLICATION OF CUSTOMIZED HUMAN DEVELOPMENT INDEX TO THE ANALYSIS OF SOCIOECONOMIC DEVELOPMENT OF THE EUROPEAN UNION MEMBER STATES. ECONOMICS & SOCIOLOGY. Vol. 11. №4. P. 332-342.

- Choudhury, M. (2019) Human development vis-à-vis gross national happiness in Bhutan: Challenges and achievements ( Book Chapter). 2019.

- Human Security in South Asia: Concept, Environment and Development. P. 132-150

- Pugno, M. (2019) Happiness, human development, and economic (De)growth. Annals of the Fondazione Luigi Einaudi. Vol. 52. №2. P. 151-172.

- Pugno, M. (2015) Capability and Happiness: A Suggested Integration From a Dynamic Perspective. Journal of Happiness Studies. Vol. 16. №6. P. 1383-1399.

- Capps, D., Carlin, N. (2013) Human Chances for Happiness: A Review of Freud's Civilization and Its Discontents. Pastoral Psychology. Vol. 62. №3. P. 271-289.

# SKIMMED MILK AS NOVEL MATERIAL IN ENHANCING AQUEOUS SOLUBILITY OF POORLY SOLUBLE DRUGS

**Prasenjit Sarkar\*, Saumyajyoti Das and Sutapa Biswas Majee**

Division of Pharmaceutics, Department of Pharmaceutical Technology, NSHM Knowledge Campus, Kolkata-Group of Institutions, 124 BL Saha Road, Kolkata, West Bengal, India

## ABSTRACT

*Poor aqueous solubility of drugs poses challenge to efficient therapy in disease management following oral route of administration. Among the various strategies employed to enhance solubility, dissolution and availability of poorly soluble drugs in optimum amount in blood circulation, use of different classes of hydrophilic and/or water-soluble substances with varying physicochemical characteristics seems to be a viable option. Skimmed milk is an example of such substance known as carrier which is being explored in the formation of solid dispersions of poorly water-soluble drugs. The present review introduces the concept of solid dispersions to the readers with a brief discussion on different carriers and literature review on skimmed milk-based solid dispersions, their methods of preparation and characterisation and finally culminating with the positive outcomes as a result of the approach.*

*Keywords : Carrier, Skimmed milk, Solid dispersion, Spray drying, Lyophilisation, In vitro drug release, Salt formation.*

## INTRODUCTION

The oral route of drug administration is the most common and preferred method of drug delivery due to convenience and ease of ingestion. From a patient's perspective, swallowing a dosage form is a comfortable and a familiar means of taking medication than taking injections[1]. Other advantages of oral route include cost effectiveness, least sterility constraints, flexibility in the design of dosage form, consistent production, simplicity of dosing and dosage precision[2-5].

Although the oral route of administration is preferred, for many drugs it can be a problematic and inefficient mode of delivery for a number of reasons. Limited drug absorption resulting in poor bioavailability is paramount amongst the potential problems that can be encountered when delivering an active agent via the oral route[3,6]. Drug absorption from the gastrointestinal (GI) tract can be limited by a variety of factors with the most significant contributor being poor aqueous solubility and/or poor membrane permeability of the drug molecule. When delivering an active agent orally, it must first dissolve in gastric and/or intestinal fluids before it can travel across the membranes of the GI tract to reach systemic circulation. Therefore, a drug with poor aqueous solubility will typically exhibit dissolution rate limited absorption and low bioavailability after oral administration since their bioavailability is largely dependent on the dissolution of the drug in the gastrointestinal fluids[7-10].

Solubility is one of the important parameters to achieve desired concentration of drug in systemic circulation for obtaining required pharmacological response. Poorly water soluble drugs are characterized by slow absorption, inadequate and variable bioavailability and thus often require high doses in order to reach therapeutic plasma concentrations after oral administration. Problem of low aqueous solubility is a major challenge for formulation scientist in developing a successful dosage form[1,2]. Improvement in solubility can be achieved by use of several hydrophilic or water-soluble substances or cross-linked polymers or cellulosic derivatives. Examples include croscarmellose sodium, crospovidone, sodium starch glycolate, low-substituted hydroxypropyl cellulose, urea, lactose, mannitol, polyethylene glycols of MWs 4000, 6000, 8000, 10000, β-cyclodextrin, skimmed milk etc. Cross-linked polymers belong to a group of special chemicals known as superdisintegrants which promote rapid disintegration of bigger particles or tablets into smaller units by virtue of their ability to absorb water by capillary action and swell to a volume several times of their own weight [8,10,11]. Cyclodextrins (CD) are a group of cyclic oligosaccharides, having a torus structure with primary and secondary hydroxyl groups orientated outwards. Consequently, they have a hydrophilic exterior and a hydrophobic internal cavity. This cavity enables cyclodextrins to complex guest drug molecules and hence alter the properties of the drugs such as solubility, stability, bioavailability and toxicity profiles. ß-CD, the most widely used native cyclodextrins, is limited in its pharmaceutical application by its low aqueous solubility. Therefore, derivatives such as hydroxypropyl-ß-CD (HP-ß-CD) and sulphobutylether-ß-CD (SE-ß-CD) have been developed to produce more water-soluble and less toxic entities[12,13]. Solubility enhancement by employing any one or more of the abovementioned substances/polymers can be achieved by forming "solid dispersions"[4,5]. Salt

formation of poorly soluble drug candidates (weak acids and bases) has been a strategy for several decades to enhance solubility. It is an effective method in parenteral and other liquid formulations, as well as in solid dosage forms. For the salt formation drug should have ionizable. There should be minimum difference of 2-3 pKa units between the drug and the counter ion. Counter ion should decrease crystal lattice forces. It should be FDA approved or should have enough toxicological data to support the selection of the counter ion[14-16].

Skimmed milk is readily available, cheap and easy to handle and thus has been employed as solid dispersion carrier for solubility, dissolution and bioavailability enhancement of poorly water-soluble drugs. In this review an endeavour has been made to discuss about the possibilities of skimmed milk-based solid dispersions, their methods of preparation and characterisation and extent of improvement in solubility and dissolution rate by using skimmed milk.

## Brief introduction of solid dispersion

Solid dispersion refers to the group of solid products consisting of at least two different components, generally a hydrophilic carrier and poorly water-soluble drug where the carrier can be either crystalline or amorphous[3,17]. The concept of solid dispersions was originally proposed by Sekiguchi and Obi, who investigated the generation and dissolution performance of eutectic melts of a sulfonamide drug, griseofulvin and a water-soluble carrier, urea in the early 1960s[18,19]. Solid dispersions hold great promise in increasing solubility, dissolution, absorption, bioavailability and hence, therapeutic efficacy of poorly water-soluble drugs in dosage form. In a solid dispersion, the drug is dispersed molecularly in solid state in solid carrier system. The mechanisms of enhancement of solubility and dissolution rate by employing solid dispersion include improvement in wettability and dispersibility, transformation of crystalline form of drug to its amorphous form, particle size reduction, reduction in aggregation and agglomeration tendency of drug particles [3,5,7].

## Classification of solid dispersion

*First generation solid dispersions*

These are prepared with crystalline carriers. Urea and sugars were the first crystalline carriers that were used in the preparation of solid dispersions. These have a disadvantage of being thermodynamically unstable and they do not release drug at a faster rate[7,15].

*Second generation solid dispersion*

In this generation of solid dispersions amorphous carriers are used instead of crystalline carriers. The drug is molecularly dispersed in the polymeric carrier. The polymeric carriers are divided into synthetic polymers such as povidone, polyethylene glycols and polymethacrylates, natural and semi-synthetic polymers such as hydroxypropyl methyl cellulose, skimmed milk, ethyl cellulose, starch derivatives like cyclodextrin[11,15].

*Third generation solid dispersion*

These solid dispersions contain a surfactant carrier, or a mixture of amorphous polymers and surfactants as carriers. They achieve the highest degree of bioavailability for the drugs with poor solubility. Examples of carriers include inulin, poloxamer 407 etc[15].

## Pharmaceutical applications of solid dispersions

Apart from enhancing bioavailability of poorly water soluble drugs by bringing an increase in the solubility/dissolution rate of such drugs, solid dispersions also help in achieving uniform distribution of small doses of drug in the solid state[20-22]. Solid dispersions facilitate stabilization and protection of drugs vulnerable to decomposition by hydrolysis, oxidation, racemization, photo-oxidation etc. Masking of unpleasant taste and smell and avoidance of undesirable incompatibilities are also possible. Liquid active pharmaceutical ingredients (APIs) may be converted into solid formulations for ease of handling and better shelf-life stability as observed with unsaturated fatty acids, essential oils, benzaldehyde, etc[3,23,24].

## Carriers in solid dispersions

Carriers play a major role in formulation of solid dispersions as their properties exert a significant influence on the release profile of the dispersed drug[25]. They can be hydrophilic or hydrophobic in nature, depending on which there can be solid dispersions promoting rapid dissolution of poorly water-soluble drug or dispersions with sustained release characteristics resulting in overall improvement in bioavailability. Skimmed milk is a natural hydrophilic polymer that is used to enhance the solubility of poorly soluble drugs.

## Skimmed milk

Components of skimmed milk are fat (1%), protein (35%), carbohydrates (51%), minerals (7%) and moisture (3.5%). Out of 35 % proteins, casein proteins (79.5%) and whey proteins(20.3%) are the major constituents.

Beta-casein is amphiphilic and acts as a detergent molecule with surfactant property. Whey proteins are reported to be surface active with superior solubility than caseins. Components of casein proteins are alpha casein [alphas1 (30.6%) and alphas2 (8.0%)], beta casein2 (8.4%), gamma casein (2.4%), delta casein and kappa casein (10.1%). Component of whey proteins are beta-lactoglobulin (9.8%), alpha-lactalbumin (3.7%), bovine serum albumin (1.2%), immunoglobulins (2.1%) and miscellaneous (2.4%)[26].

**Literature review on use of skimmed milk in enhancing aqueous solubility**
Solid dispersions (SDs) of cefpodoxime proxetil (CP) were prepared using skimmed milk powder as carrier by solvent evaporation method to increase the solubility and dissolution rate of CP. The optimized SD containing CP and skimmed milk in the ratio of 1:4 showed fastest dissolution (92.35%) than pure CP (30.19%) in 0.1 N HCl at 37±1°C within 60min. SD also increased the aqueous solubility (14.291±0.144 mg/ml) with respect to the pure CP (6.020±0.038 mg/ml) [27].

Solid dispersion formulation of atorvastatin was prepared by lyophilization utilising skimmed milk as a carrier to improve the aqueous solubility. The optimum drug-to-carrier ratio of 1:9 enhanced solubility nearly by 33-fold as compared to pure drug. In vitro drug release studies exhibited a cumulative release of 83.69% as compared to 22.7% for the pure drug[25].

Carvedilol solid dispersions were developed using rota-evaporation and lyophilization in different ratios of drug and carrier (skimmed milk powder) such as 1:1, 1:3, 1:5, and 1:7. The dispersion with skimmed milk powder (1:7) by rota evaporation method and lyophilization method (1:5) showed faster dissolution rate (96.1 % and 94.88 % respectively) in phosphate buffer (pH 6.8). The solubility also increased from 23.28 μg/ml in case of pure carvedilol to 224.68 μg/ml and 205.31 μg/ml in case of the solid dispersions[28].

Solid dispersion formulation of simvastatin was prepared by lyophilization utilizing skimmed milk as a carrier to improve the aqueous solubility. The optimum drug-to-carrier ratio of 1:9 enhanced solubility nearly by 30-fold as compared to pure drug. In-vitro drug release studies exhibited a cumulative release of 86.69% as compared to 25.19% for the pure drug in 0.05M phosphate buffer (pH 6.8)[29].

Solid dispersion of eprosartan in skimmed milk powder containing drug: carrier ratio of 1:9 exhibited the best release with a cumulative release of 82.67 % as compared to 6.919 % for the pure drug in 0.2M phosphate buffer (pH 7.5)[30].

Tadalafil solid dispersion was prepared by spray drying method using skimmed milk as carrier. Fast dissolving tablets containing tadalafil solid dispersion were developed by direct compression using crospovidone, croscarmellose sodium or sodium starch glycolate as superdisintegrant in different ratios with microcrystalline cellulose PH-102 along with directly compressible mannitol. Tablet with 4% w/w crospovidone demonstrated wetting time of 35 secs and released 99.73% drug in 30 min enabling fast dissolution of poorly water-soluble drug[31].

**Preparation of skimmed milk**
Skimmed milk powder may be obtained from liquid milk by lyophilisation, spray drying or by employing rotary evaporator.

Double-toned milk was stirred on a magnetic stirrer for 2-4 h and extra fat in the milk was accumulated and removed. The milk was then lyophilized for 72 h and the humidity of sample was reduced to 3% and 25 ml skimmed milk yielded 2.615 gm powder. The obtained skimmed milk powder was sieved through 250 μm mesh[25,29,31].

One liter of skimmed milk was dried in rotary evaporator at 35-40°C and 100 rpm under vacuum for 40-60 min. The obtained sticky semisolid mass was placed in desiccator for 48-72 h to get free flowing powder or dried in an oven (100 ml of milk yielded approximately 10.1 g powder) and passed through sieve no. #80 or sieve no. #65 and stored in desiccator for further use[32,33].

Accurately measured skimmed milk (100 ml) was spray dried at flow rate of 5ml/min and with inlet temperature 140°C, outlet temperature 90°C using spray dryer. It yielded 9.2 g of free flowing powder and passed through sieve # 65[34].

**Methods for preparing skimmed milk based solid dispersion**

*Kneading*

In this method, skimmed milk is mixed with water and transformed to paste. Drug is then added and kneaded for particular time. The kneaded mixture is then dried and passed through sieve if necessary [35].

*Solvent evaporation*

Both drug (poorly water soluble drug) and carrier (skimmed milk) are dissolved in organic solvent. After dissolution, the solvent is evaporated. The solid mass is ground, sieved and dried. Solid dispersion of loratadine with skimmed milk in ethanol was prepared by solvent evaporation method[36].

*Spray-Drying*

Drug is dissolved in suitable solvent and the required amount of carrier is dissolved in water. Solutions are then mixed by sonication or other suitable method to produce a clear solution, which is then spray dried using spray dryer. Solid dispersion of oxcarbazepine was prepared by dissolving drug in ethanol and skimmed milk in water followed by spray drying [37].

*Lyophilization*

Freeze-drying involves transfer of heat and mass to and from the product under preparation. This technique was proposed as an alternative method to solvent evaporation. Lyophilization has been thought of a molecular mixing technique where the drug and carrier are co dissolved in a common solvent, frozen and sublimed to obtain a lyophilized molecular dispersion[25,31].

**Characterization of solid dispersions**

Solid dispersions are mainly known for their application in dissolution rate and bioavailability enhancement. The enhanced dissolution rate can be examined by using standard dissolution methods which involves use of USP dissolution test apparatus[15,19]. Another parameter studied in case of solid dispersion is the physical state of drug and polymer, like state of material (amorphous or crystalline) and degree of crystallinity. Many analytical and instrumental techniques are used in study of solid dispersions. Techniques used for characterization can be thermal methods, spectroscopic methods, microscopic methods, microthermal analysis, macroscopic techniques, etc[1,3-7,38]. Their significance and characteristic features are listed in Table 1.

**Table 1. Various methods for characterization of solid dispersions and their significance.**

| Characteristics | Methods used | Significance |
|---|---|---|
| Surface microscopy | Scanning electron microscopy, hot stage microscopy, polarized light optical microscopy | To examine microscopy and crystallinity |
| **Physical state examination** | **Differential scanning calorimetry, Powder X-ray diffraction** | **To find out physical state of sample, crystallinity and degree of crystallinity of drug, polymer, solid dispersion.** |
| Structure elucidation | Solid state nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy | To investigate bonding between drug and carrier e.g. hydrogen bonding |
| Drug-carrier interactions | Differential scanning calorimetry, Nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy | To study physical and chemical interactions between drug and polymer |
| Dissolution rate | Dissolution studies, dynamic solubility studies | To study rate and extent of drug release |
| Stability | Differential scanning calorimetry, nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy | To study physical and chemical interactions between drug and polymer during its manufacturing and storage period. |

**CONCLUSION**

In a nutshell, skimmed milk seems to be a good carrier in the development of solid dispersions for increasing solubility and dissolution of poorly water-soluble drugs. Method of production of skimmed milk powder from liquid milk is not a challenging one and yield is satisfactory. The milk powder thus produced can be used in the preparation of solid dispersions by various simple methods.

## REFERENCES

1.  Savjani KT, Gajjar AK, Savjani JK. Drug solubility: Importance and enhancement techniques. Int Sch Res Net. 2012;2012:1-10.

2.  Narayan K. Technologies to improve the solubility, dissolution and bioavailability of poorly soluble drugs. J Anal Pharm Res. 2018;7(1):44-50.

3.  Tekade AR, Yadav JN. A review on solid dispersion and carriers used therein for solubility enhancement of poorly water soluble drugs. Adv Pharm Bull. 2020;10(3):359-69.

4.  Maheshwari RK, Indurkhya A. Novel application of mixed hydrotropic solubilisation technique in the formulation and evaluation of hydrotropic solid dispersion of aceclofenac. Asian J Pharm. 2010;4(3):235-8.

5.  Gulia R, Singh S, Sharma N, Arora S. Hydrotropic solid dispersions: A robust application to undertake solubility challenge. Plant Arch. 2020;20(1):3279-84.

6.  Patel DM, Patel SP, Patel CN. Formulation and evaluation of fast dissolving tablet containing domperidone ternary solid dispersion. Int J Pharm Invest. 2014;4(4):174-81.

7.  Ha ES, Baek IH, Cho W, Hwang SJ, Kim MS. Preparation and evaluation of solid dispersion of atorvastatin calcium with soluplus® by spray drying technique. Chem Pharm Bull. 2014;62(6):545-51.

8.  Suthar RM, Chotai NP, Shah DD. Formulation and evaluation of fast dissolving tablets of ondansetron by solid dispersion in superdisintegrants. Indian J Pharm Edu Res. 2013;47(3):49-55.

9.  Suthar RM, Chotai NP, Patel HK, Patel SR, Shah DD, Jadeja MB. In vitro dissolution enhancement of ondansetron by solid dispersion in superdisintegrants. Dissolution Technol. 2013;2013:34-38.

10. Mohanachandran PS, Sindhumol PG, Kiran TS. Superdisintegrants: An overview. Int J Pharm Sci Rev Res. 2011;6(1):105-9.

11. Chaulang G, Patel P, Hardikar S, Kelkar M, Bhosale A, Bhise S. Formulation and evaluation of solid dispersions of furosemide in sodium starch glycolate. Trop J Pharm Res. 2009;8(1):43-51.

12. Nagarsenker MS, Meshram RN, Ramprakash G. Solid dispersion of hydroxypropyl beta-cyclodextrin and ketorolac: Enhancement of in-vitro dissolution rates, improvement in anti-inflammatory activity and reduction in ulcerogenicity in rats. J Pharm Pharmacol. 2000;52(8):949-56.

13. Sapkal SB, Shinde SA. Solid dispersion of valsartan for solubility improvement using β-cyclodextrin. MOJ Bioequiv Availab. 2018;5(6):313-9.

14. Serajuddin ATM. Salt formation to improve drug solubility. Adv Drug Deliv. 2007;59:603-16.

15. Bighley LD, Berge SM, Monkhouse DC. Salt forms of drugs and absorption. Encyclopaedia Pharm Technol. 1996;13:453-99.

16. Morris KR, Fakes MG, Thakur AB, *et al.* An integrated approach to the selection of optimal salt form for a new drug candidate. Int J Pharm. 1994;105:209-17.

17. Sareen S, Mathew G, Joseph L. Improvement in solubility of poor water-soluble drugs by solid dispersion. Int J Pharm Invest. 2012;2(1):12-7.

18. Vasconcelos TF, Sarmento B, Costa P. Solid dispersions as strategy to improve oral bioavailability of poor water soluble drugs. Drug Discov. 2007;12(23/24):1068-75.

19. Kaur J, Aggarwal G, Singh G, Rana AC. Improvement of drug solubility using solid dispersion. Int J Pharm Pharm Sci. 2012;4(2):47-53.

20. Alshehria S, Imama SS, Hussaina A, *et al.* Potential of solid dispersions to enhance solubility, bioavailability and therapeutic efficacy of poorly water-soluble drugs: Newer formulation techniques, current marketed scenario and patents. Drug Deliv. 2020;27(1):1625–43.

21. Altamimi MA, Elzayat EM, Qamar W, *et al.* Evaluation of the bioavailability of hydrocortisone when prepared as solid dispersion. Saudi Pharm J. 2019;27:629-36.

22. Alshehri S, Shakeel F, Elzayat E, *et al.* Rat palatability, pharmacodynamics effect and bioavailability of mefenamic acid formulations utilizing hot-melt extrusion technology. Drug Dev Ind Pharm. 2019;45:1610-6.

23. McFall H, Sarabu S, Shankar V, *et al*. Formulation of aripiprazole loaded pH-modulated solid dispersions via hot-melt extrusion technology: In vitro and in vivo studies. Int J Pharm. 2019;554:302-11.

24. Alshehri SM, Shakeel F, Ibrahim MA, *et al*. Dissolution and bioavailability improvement of bioactive apigenin using solid dispersions prepared by different techniques. Saudi Pharm J. 2019;27:264-73.

25. Choudhary A, Rana AC, Aggarwal G, *et al*. Development and characterization of anatorvastatin solid dispersion formulation using skimmed milk for improved oral bioavailability. Acta Pharm Sin B. 2012;2(4):421-8.

26. Moideen MMJ, Alqahtani A, *et al*. Application of the Box–Behnken design for the production of soluble curcumin: Skimmed milk powder inclusion complex for improving the treatment of colorectal cancer. Food Sci Nutr. 2020;8:6643-59.

27. Sharma N, Jain N, Sudhakar CK, Jain S, *et al*. Formulation and evaluation of gastro retentive floating tablets containing cefpodoxime proxetil solid dispersions. Int J Curr Pharm Res. 2012;4(4):82-7.

28. Madhok S, Madhok A. Enhancement of solubility and dissolution of carvedilol by solid dispersion technique using rota-evaporation and lyophilization methods. Int J Drug Res Tech. 2015;5(2):81-102.

29. Sonar PA, Behera AL, *et al*. Preparation and characterization of simvastatin solid dispersion using skimmed milk. Drug Dev Ind Pharm. 2015;41(1):22-7.

30. Rewar S, Bansal BK, Singh CJ, Sharma AK. Preparation and evaluation of eprosartan mesylate solid dispersions. Elixir Pharm. 2015;80(2015):30810-4.

31. Shah M, Patel D. Design and evaluation of fast dissolving tablet containing tadalafil solid dispersion. J Crit Rev. 2020;7(2):579-82.

32. Sanka K, Munjulury VS, *et al*. Enhancement of solubility, dissolution release profile and reduction in ulcerogenicity of piroxicam by inclusion complex with skimmed milk. Drug Deliv. 2014;21(7):560-70.

33. Kamal SS, Kaur D, Kaur P, *et al*. Milk-based oral formulations of ibuprofen: An investigation on the role of milk in improving dissolution rate of drug. J Rep Pharma Sci. 2019;8:47-54.

34. Shah M, Patel D. Development and characterization of tadalafil solid dispersion using skimmed milk for improved the solubility and dissolution release profile. J Pharm Tech. 2020;13(12):6212-17.

35. Arali B, Kumar AY, Setty CM. An approach to enhance dissolution rate of rilpivirine by solid dispersion technique. J Pharm Sci Res. 2019;11(9):3145-52.

36. Hardatt R, Nagpal M, *et al*. Solid dispersion tablets of loratadine using locust bean gum and skimmed milk: A comparative study. Der Pharmacia Lettre. 2016;8(6):43-53.

37. Shah M, Patel D. Development of an oxcarbazepine solid dispersion using skimmed milk to improve the solubility and dissolution profile. Int J Pharm Sci Drug Res. 2019;11(5):204-9.

38. Verma P, Ahuja M, Bhatia M. Novel binary itraconazole-skimmed milk solid dispersion: Preparation and evaluation. Der Pharmacia Lettre. 2016;8(10):55-64.

## AN EMPIRICAL STUDY AND CRITICAL REVIEW OF ENVIRONMENTAL IMPACT ASSESSMENT DRAFT REGULATIONS, 2020 IN INDIA

[1]Avdesh Bhardawaj*, [2]Raghav Bhardwaj and [3]Yadvendra Ahlawat

[1]Head (Research & Development), Juno Terra Technology Private Limited, Delhi, India
[2]Department of Mechanical Engineering, Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur, India
[3]Department of Civil Engineering, The NorthCap University, Gurugram, India

## ABSTRACT

*Environmental Impact Assessment (EIA) is one of the most important and powerful tools for environmental compliance of projects and if implemented in its true spirit, it is very helpful in protecting environment in conjunction with economic growth. There is a constant need to update and upgrade the various regulations that govern the EIA process. Indian government had recently proposed draft EIA regulations, 2020 which received a lot of criticism from environmental experts. This paper is intended to critically examine the various facets of the draft EIA regulations, 2020 and study its weaker points and suggest solutions for improving them. The methodology adopted for this research is twofold. Firstly, it includes a literature review of current EIA regulations, its historical development and present implications. Secondly, direct interview with 42 experts from the fields of environment and policy using an innovative interview questionnaire was conducted to understand their views on the new draft EIA regulations, 2020. Based upon the results of the interview questionnaire, some recommendations have been proposed to refine and improve the draft EIA regulations, 2020 before they are implemented in practice.*

*Keywords: draft EIA regulations 2020; Environmental clearance; Environmental Impact Assessment; Interview questionnaire*

## 1. INTRODUCTION

### 1.1 Definition of EIA

Environmental impact assessment (EIA) has been defined differently by various agencies with the same core meaning. United Nations Environment Programme (UNEP) defines EIA as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making [1, 2]; whereas in India, the Central Pollution Control Board (CPCB) defines EIA as is the process of identifying and evaluating the effects on the environment of impact factors arising from a proposed change in environmental quality [3]. In simple terms EIA is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural, and human-health impacts, both beneficial and adverse. EIA is a tool used to assess the positive and negative environmental, economic, and social impacts of a project. This is used to predict the environmental impacts of a project in the pre-planning stage itself so that decisions can be taken to reduce the adverse impacts.

### 1.2 A brief history of EIA

#### 1.2.1 Origin and early development of EIA worldwide

The concept of EIA started to take place in the 1970s [4]. In 1969, the USA implemented its first National Environment Policy Act (NEPA) 1969 [5]. The EIA was initially practiced by developed nations but slowly it was also introduced in developing nations including India. Columbia (1974) and the Philippines (1978) were the first developing nations who introduced EIA in their policies. By the mid-1990s, some 110 countries applied EIA as a major environmental policy. In 1989, EIA was adopted as the major development project by the World Bank [6]. The United Nations later officially recognized the EIA under Principle 17 of the Rio Declaration, and today more than 100 countries have adopted the EIA process [7]. While the aim of the EIA is to protect the environment, analysts point out that its impact appears to be limited [8]. The UNEP in its 2018 evaluation of national EIA legislations suggested that there was an attempt to weaken the EIA process in some countries in order to speed up the development process [9]. This is exactly what some of the critics of the draft EIA regulations 2020 in India are concerned about.

#### 1.2.2 History of EIA in India

EIA had started in India in 1976-77 when the Planning Commission directed the Department of Science & Technology (DST) to assess the river valley projects from the point of view of the environment. It was later extended for all those projects that required approval from the Public Investment Board (PIB). In 1994, EIA was implemented in effect in India and was revamped in 2006. On January 27, 1994, the Union Ministry of Environment and Forests (MoEF) now renamed as Ministry of Environment, Forests and Climate Change

(MoEFCC), Government of India, under the Environmental (Protection) Act 1986, promulgated an EIA notification making Environmental Clearance (EC) mandatory for expansion or modernization of any activity or for setting up new projects listed in Schedule 1 of the notification. To achieve the objectives of the Act, one of the decisions taken was to make EIA statutory. After following the legal procedure, a notification was issued on 27th January 1994 and subsequently amended on 4th May 1994, 10th April 1997 and 27th January 2000 making environmental impact assessment statutory for 30 activities. This is the principal piece of legislation governing EIA in India. MoEFCC released a new draft Environment Impact Assessment (EIA) 2020 on March 12, 2020 and sought comments from the public, till August 11, 2020 [10]. The ministry received around 1.7 million comments from the public [11] This draft EIA will replace the 2006 EIA notification and has drawn a lot of criticism in its present form.

## 2. OBJECTIVES

The objective of this research is to critically examine the cons of the new draft EIA regulations 2020 and recommend suggestions for its improvement. A list of problems in the draft along with their solutions are furnished in this paper so that the competent authorities can take a note of it and improve the draft.

## 3. RESEARCH METHODOLOGY

The methodology adopted for this research is two-fold. Firstly, a detailed literature review on the current scenario of draft EIA regulations in India has been done to identify the weak areas that can be improved. Secondly, forty-two (42) specialists from the environmental field were approached and interviewed digitally using an interview questionnaire between July 2020 to December 2021 to understand their views on the subject. The specialists included civil and environmental engineers working in the field of EIA, researchers and academicians from this field and policy experts, etc. During the interviews, the respondents were asked about the current scenario of EIA in India, the draft EIA regulations 2020 and its pros and cons. They were also asked to suggest their solutions for making these regulations better. The responses so received were then analysed and the results of the analysis are discussed in this paper. Based upon these responses recommendations have been offered to make the draft EIA regulations, 2020 better, practical and productive. The entire methodology is illustrated in Figure 1. A Non-Disclosure Agreement (NDA) was signed with the respondents to protect their personal identities. But the use and sharing of data regarding questionnaire survey was agreed upon as anonymous for research purposes.
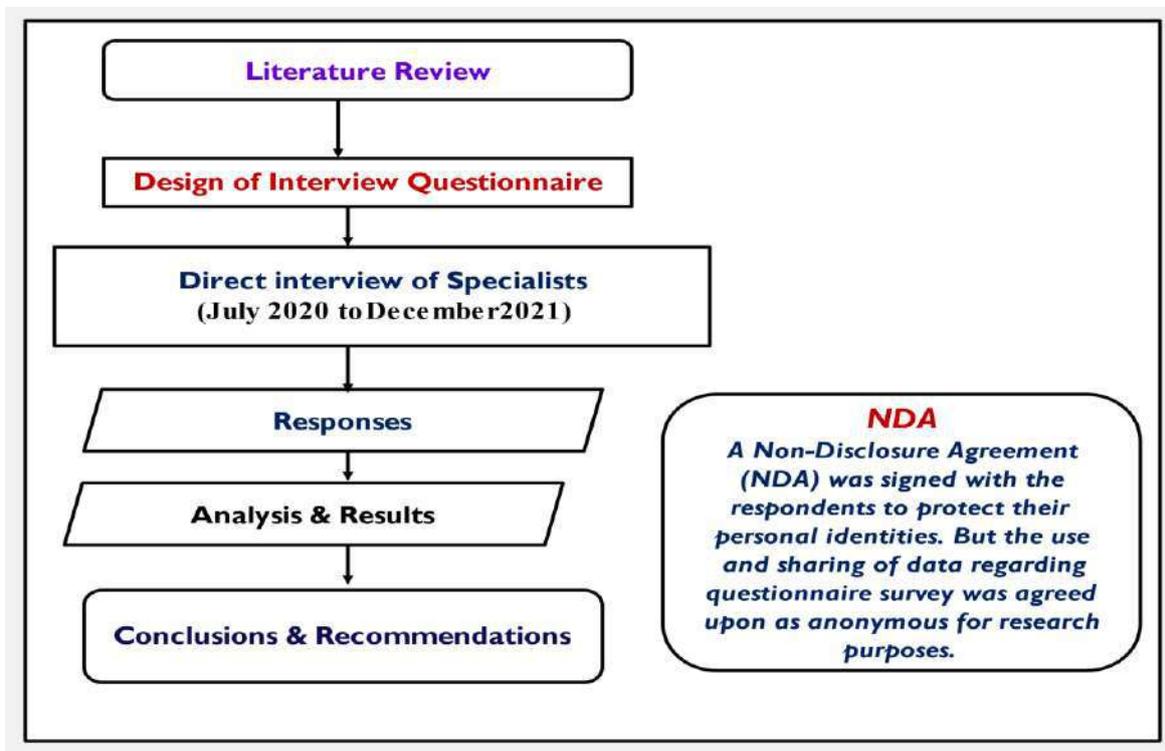


**Figure 1. Methodology diagram adopted for the current research**

## 4. RESULTS

### 4.1 Demographic Profile of Respondents

The demographic profile of all respondents of the interview questionnaire has been tabulated in Table 1.

**Table 1. Demographic profile of respondents**

| S. No | Demographic Factor | Result (in figure) | Result (in %) |
|---|---|---|---|
| 1 | Total Number of Respondents | 42 | 100 |
| 2 | **Sex** | | |
| | Male | 29 | 69 |
| | Female | 13 | 31 |
| | Others | 0 | 0 |
| 3 | **Age Group (in years)** | | |
| | Upto 25 | 2 | 4.7 |
| | 26-35 | 12 | 28.6 |
| | 36-45 | 14 | 33.4 |
| | 46-60 | 8 | 19 |
| | 61 and above | 6 | 14.3 |
| 4 | **Qualifications** | | |
| | Graduate | 0 | 0 |
| | Post Graduate (PG) | 12 | 28.6 |
| | Above PG | 30 | 71.4 |
| 5 | **Work Profile** | | |
| | Academics | 14 | 33.4 |
| | Research | 18 | 42.8 |
| | Policy experts | 8 | 19 |
| | Others | 2 | 4.8 |
| 6 | **Work Experience (in years)** | | |
| | 0-5 | 3 | 7.2 |
| | 6-10 | 10 | 23.8 |
| | 10-20 | 24 | 57.1 |
| | Above 20 | 5 | 11.9 |

## 4.2 Major results from interview questionnaire

The results compiled from direct interview of experts were very interesting and reflected the ground level issues. An overwhelming majority of respondents (98%) were unhappy with the EIA draft regulations, 2020 (figure 2) and wanted major changes in it. When asked about the practicability of these regulations with regard to environmental protection, a strong majority of the respondents (88%) agreed that these draft regulations will only harm the environment in the long run (figure 3).
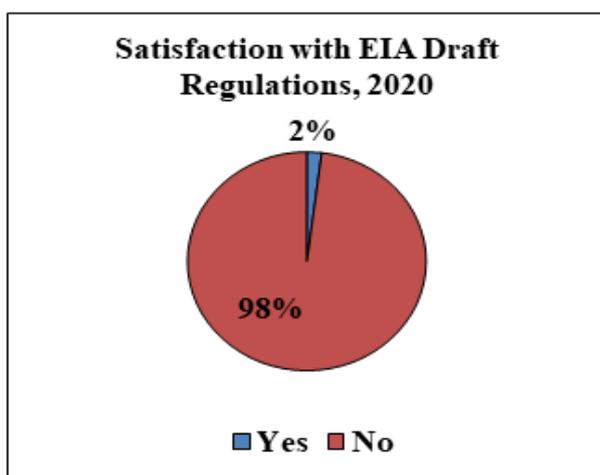


**Figure 2. Satisfaction with EIA draft, 2020**     **Figure 3.  Practicability of EIA draft, 2020**
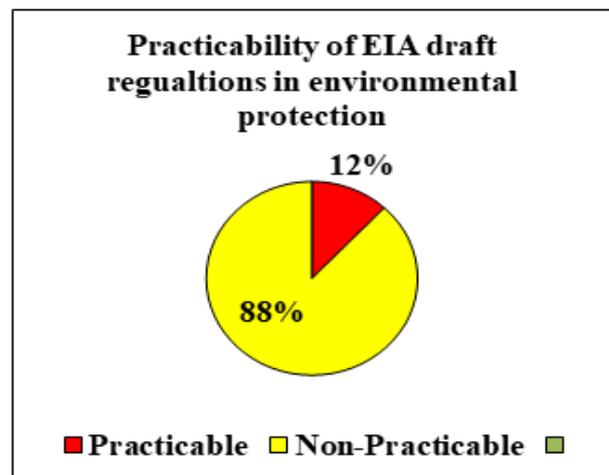
There main problems identified in the EIA draft regulations by the experts were encouragement of violations via post-facto clearance (97.6%), non-transparency in clearance for strategic projects (95.2%), non-conformity to international frameworks and conventions (88%), Strengthens the government but weakens the public (86%), reduced time for public hearings (83.3%), exemption of projects (81%), post-clearance compliance (78.5%), annual submission of reports (74%), etc. All these problems as identified by the respondents have been shown in figure 4.
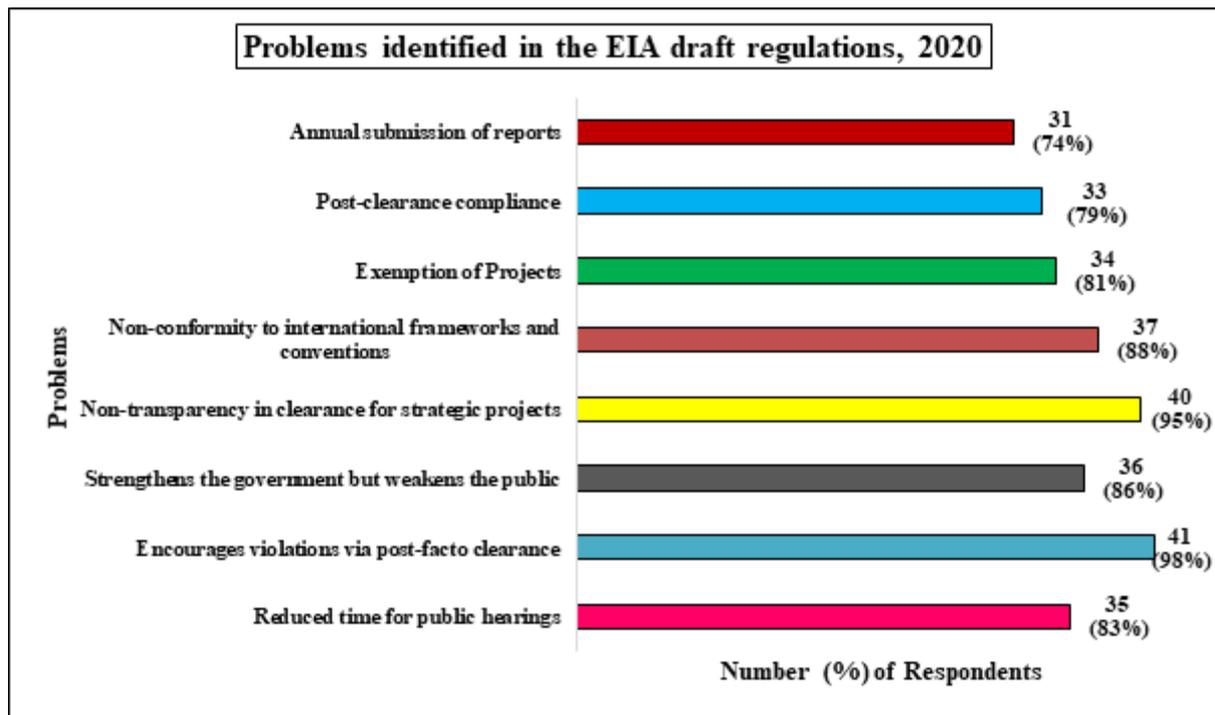
**Figure 4. Problems identified in the EIA draft regulations, 2020**

## 4.3 Need for the draft EIA regulations, 2020

Under the Environment (Protection) Act of 1986, the first EIA notification was issued in 1994. Later, it was replaced by a modified draft in 2006. As per Government of India's statement, the main reason for the draft notification on EIA 2020 was to consolidate all the 55 amendments and 230 office memorandums issued since 2006. This draft EIA will replace the 2006 EIA notification.

## 4.4 Cons of the draft EIA regulations, 2020

Based upon the interview questionnaire and discussions with the experts following problems were identified in the draft EIA regulations, 2020. Solutions to counter them have also been listed below:

**4.4.1 Reduced time for public hearings:** By an amendment to the 1994 EIA notification in 1997, India adopted the principle of public hearing for Environmental Clearance (EC) thus encouraging a mechanism of public participation. The 2020 draft proposes to reduce the notice period for public hearings from 30 days to 20 days, arguing that it is in tune with the times given the growth of internet and mobile telephony. But this will only make it difficult to study the draft EIA report, more so when it is not widely available or provided in the regional languages. The only viable solution for this is to either retain the earlier timeline or creation of a system where public is given updates regarding such public hearings via a dedicated mobile app or direct messaging.

**4.4.2 Encourages violations via post-facto clearance:** The environmentalists argue that the post-facto clearance (where a project that has been operating without environmental clearance, can be regularized or allowed to apply for clearance) is likely to encourage industries to commence operations without bothering clearance and eventually get regularized by paying the penalty amount and thus opening the floodgates of violations. This particular aspect of the regulations needs to be revisited and firms found violating the terms of their establishment, if they have to get the clearance, however, will have to pay a penalty. It must be remembered that environment law cannot countenance the notion of an ex post-facto clearance.

**4.4.3 Strengthens the government but weakens the public:** The draft has no mechanism for diluting the political and bureaucratic stronghold on the EIA process, and thereby on industries. Instead, it suggests to boost the government's discretionary power while limiting public engagement in safeguarding the environment. Also, the draft, by limiting public consultation, is not in consonance with protecting the rights of tribals, natives, etc. Hence the rights of such communities must be specially discussed and put in place.

**4.4.4 Non-transparency in clearance for strategic projects:** While projects concerning national defense and security are naturally considered strategic, the government gets to decide on the strategic tag for other projects. The 2020 draft says no information on such projects shall be placed in the public domain. This opens a window for clearance for any project deemed strategic without having to explain why. This non-transparency will lead to

corrupt practices and is against the right to information. This needs to be modified and worked upon so that there is more transparency in the practices.

**4.4.5 Non-conformity to international frameworks and conventions:** India has been an active participant of the United Nations (UN) Conference on Human, Environment and Development in Stockholm in 1972, the Rio Summit in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Climate Accord which has significantly strengthened its environmental governance. After pledging allegiance to these international environmental instruments and now on the contrary proposing to weaken its EIA regime at the domestic level, India is in a position of cognitive dissonance. Such a non-conformity to pledges made at international negotiations and agreements will weaken India's stance as a global leader in environmental governance and climate politics. Therefore, steps must be taken to strengthen the EIA draft so as to comply with international regulations.

**4.4.6 Exemption of Projects:** A classification approach of projects has been devised in the draft into A, B1 and B2, a host of projects are exempted from public scrutiny. Category B2 projects do not require mandatory Environment Clearance (EC), unlike the Category A and B1 projects. The projects under this exempted category include: offshore and onshore oil, gas and shale exploration, hydroelectric projects up to 25 MW, irrigation projects between 2,000 and 10,000 hectares of command area, small and medium cement plants, acids other than phosphoric or ammonia, sulphuric acid, MSMEs involved in dye and dye intermediates, bulk drugs, synthetic rubbers, All inland waterway projects and expansion or widening of highways, These include roads that cut through forests and dredging of major rivers, aerial ropeways in ecologically sensitive areas, specified building construction and area development projects, built-up area up to 1,50,000 m$^2$, etc. Additionally, all linear projects like pipelines and highways in border areas, falling within 100 kilometers aerial distance from the Line of Actual Control (LAC) are exempt from public hearing. But most of the border areas of India are eco-sensitive zones. So, a possible solution could be a separate special quick EIA for these projects so that India's security concerns like the recent stand-offs with Chinese PLA in the Ladakh region are also taken care of.

**4.4.7 Post-clearance compliance:** It implies that once a project gets approved by the concerned authority, the proponent projects are required to adhere to certain rules laid down in the EIA report in order to ensure that no further environmental damages take place. There are several cases where the proponent projects have substantially failed to comply with the rules. The NGT, for instance, imposed fines for non-compliance with environmental conditions on Jindal Power Limited (JPL) and Coal India South Eastern Coalfields (SECL), in March 2020 [12]. Steps must be taken to ensure post-clearance compliances.

**4.4.8 Annual submission of reports:** The new draft EIA, proposes the submission of compliance reports annually whereas as per the 2006 notification, the compliance report was to be submitted every six months. Environmental experts are of the view that allowing a longer period for filling the compliance report will give an opportunity to project proponents to hide disastrous consequences, which could go unnoticed. In this aspect, the views of environmental experts seems valid and must be considered with due diligence.

**4.4.9 Report prepared solely by project proponents:** Meanwhile, submission of the compliance report will be solely prepared by the project proponents itself, which, without oversight and review, may lead to inaccurate information submitted on the project. This may lead to underreporting or non-reporting of detrimental environmental effects caused by them. Hence provision must be made for independent auditing involving citizen groups along with experts.

**4.4.10 No public reporting for non-compliance:** The EIA Notification 2020 excludes reporting of violations and non-compliance by the public. Instead, the government will take cognizance of reports only from the violator-promoter, government authority, Appraisal Committee or Regulatory Authority. Essentially, it will make it impossible for a citizen to file individual cases related to environmental degradation and pollution due to such violators. This cannot be allowed to happen and such provision must be removed from the draft regulations.

## 6. CONCLUSIONS
It may be concluded that the draft EIA regulations have a lot of discrepancies and a lot of scope for improvements. All such issues must be sorted before it is implemented in practice.

## 7. RECOMMENDATIONS
7.1 The provision of reducing the time for public consultation from 30 to 20 days must not be implemented as of now. Rather, first a working system of two-way information dissemination must be evolved as far as public hearing and its impact upon the whole EIA process is concerned.

7.2 Half yearly or quarterly submission of reports must be made mandatory so that in case of any environmental damage, quick remediation measures may be taken.

7.3 In order to improve ease of doing business, the government should bring down the average delay of 238 days in granting environmental clearance, that emanates from bureaucratic delays and complex laws.

7.4 No exemption of any project from EIA must be allowed. Rather in special cases like construction in border areas, special provisions for quick EIA must be developed. This will also ensure a lot of transparency.

7.5 Grow now, sustain later should not be the policy, as the notion is dangerously tilted against the concept of sustainable development.

7.6 Post-clearance of compliance will only take us backwards in the way to environmental protection. Hence, such a provision must be deleted from the draft regulations.

7.7 As a much appreciated and responsible country in the world, which is taking giant strides towards green clean energy and combating climate change, India should make it a point to make its EIA process in accordance with best EIA practices adopted worldwide. This draft regulation will contradict our position on environmental conservation globally. Rather, India must develop strict regulations so as to be an example for the world to follow.

7.8 The draft regulations essentially strengths the governments and weakens the public, which goes against the fundamental principles of democracy. Politics being so much susceptible to corruption, must not be granted such power. Rather more de-centralization of power must be done to delegate authority and responsibilities to the public.

**REFERENCES**

[1] https://www.cbd.int/impact/whatis.shtml (Accessed on 28.01.2022)

[2] Goals and principles of environment impact assessment (1987). UN Environment Progamme, June 1987.

[3] CPCB (2007). Hazardous Waste Management Series: HAZWAMS/25/2003-04

[4] Dunlap, R. E., & Mertig, A. G. (1991). The evolution of the US environmental movement from 1970 to 1990: An overview. Society & Natural Resources, 4(3), 209-218.

[5] Morgan, R. K. (2012). Environmental impact assessment: the state of the art. Impact assessment and project appraisal, 30(1), 5-14.

[6] Hironaka, A. (2002). The globalization of environmental protection: The case of environmental impact assessment. International Journal of Comparative Sociology, 43(1), 65-78.

[7] Sánchez, L. E., & Croal, P. (2012). Environmental impact assessment, from Rio-92 to Rio+ 20 and beyond. Ambiente & Sociedade, 15, 41-54.

[8] Jay, S., Jones, C., Slinn, P., & Wood, C. (2007). Environmental impact assessment: Retrospect and prospect. Environmental impact assessment review, 27(4), 287-300.

[9] Assessing Environment Impacts: A Global Review of Legislation. (2018) United Nations Environment Programme, Nairobi, 2018.

[10] Draft Environment Impact Assessment Notification-2020. (2020). Ministry of Environment, Forest and Climate Change, Government of India, March 12, 2020.

[11] Environment ministry says 17 lakh comments on draft EIA notification. (2020). Hindustan times, August 11, 2020.

[12] Dukalu Ram & Ors versus Union of India & Ors. National Green Tribunal, Government of India, 2020.

## REFRACTIVITIES AND POLARIZABILITY CONSTANTS STUDY OF TAMSULOSIN & LAMIVUDINE IN METHANOL AND ACETONE MEDIA

### Ganesh Babasaheb Akat[1] and Dr. B.K. Magare[2]

[1]UG & PG Department of Chemistry, Kohinoor Arts, Commerce and Science College, Khultabad, Dist. Aurangabad, 431101 (M.S.) India

[2]UG & PG Department of Chemistry, Shivaji College, Kannad, Dist. Aurangabad. 431103 (M.S.) India

**ABSTRACT**

*Molar refractivities, molar polarizability constants and refractive indices Lamivudine, also called Epivir-HBV, it also cures infection of hepatitis B. This bongs to a class of drugs called nucleoside reverse transcriptase inhibitors (NRTIs). It works by decreasing the amount of HIV and hepatitis B in the blood. Tamsulosin belongs to a class of drugs called alpha-enzyme blockers. It is used to treat men with symptoms of benign prostate enlargement. It is also occasionally taken to treat kidney stones. This has been examined in Methanol and Acetone at varying concentrations (0.63 x 10^{-3} to 10.00 x 10^{-3} M) and temperatures of 27 ^0C (± 0.1 ^0C). The above system's molar refraction was computed theoretically. These observations were used to compare experimental and theoretical molar refraction values. The molar refractivity (R) and molar polarizability (α) values reduce the solute concentration.*

*Keywords: Molar refraction, Refractive indices, polarizability constants, Abb's Refractometer, THF, (3CT) Lamivudine, Tamsulosin.*

Tamsulosin    Lamuvudine (3TC)
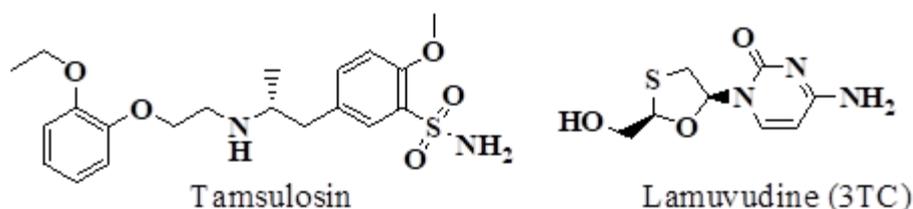
## 1. INTRODUCTION

The most essential additive feature of liquid is that it is having refractive index. When the ray of light passes through from one medium and then through another medium, it undergoes refraction or a change in direction. When it moves from a less denser medium to a denser medium, the direction of refraction changes, as does the angle of refraction, and the refractive index change [1–3]. The refractive index is nothing but the ratio of light's viscosity in a vacuum to its viscosity in another medium and it is affected by wavelength and temperature. The results of this analysis on the dipole association of ligand with its intermolecular attraction between solvent and solution, dielectric constant of the medium, polarizability, and common compensation of dipole obtained directly by light [4,5]. These findings are based on refractive index and are more useful for drug transmission, stability and action hence this research is considered to be very important to study.

The density and refractive index of a binary liquid mixture of Eucalyptol and Hydrocarbon at various temperatures was investigated [6,7]. The dielectric constants and refractive indices of binary mixes of ethyl acetate with toluene, ethyl benzene, o-xylene, p-xylene, and p-dioxane [8–11]. The refractivity properties of several homologous series, such as n-ethanoates, methyl alkenoates, ethyl alkenoates, and others, were measured in the various temperature range of 298.15 to 333.15 ^oK [12–14]. The refractivity of various heterocyclic compounds [15,16]. The refractive index of 1,3 diaryl carbamides in varying percentages of the binary liquid combination was also examined [17]. The refractometry of S-trizinothiocarbamides in varying percentages of the dioxane-water mixture was examined [18]. Drug-amino acid interactions of glycine and aq. isoniazid ternary combinations were studied [19]. The verification of molar refraction as an additive and constitutive property of binary liquid mixtures of water-ethanol and ethanol benzene has been explored by earlier researchers [20]. An also studied [21,22] the estimation of the refractive indices of several binary mixes recently. Conversely, research into the molar refractivity and molar polarizability constants of new substances lamivudine and tamsulosin in the solvent mixes such as Methanol-Water and Acetone-Water under equivalent experimental conditions are limited. As a result, the current work intends to conduct a systematic analysis of the aforesaid new compounds using refractometry at a temperature of 30°C.

## 2. EXPERIMENTAL

The importance of substituted heterocyclic compounds is paramount. The above compounds' solutions are prepared by dissolving an appropriate amount by weight in two distinct solvents: ethanol and tetrahydrofuran

(THF). All the weight was placed on a Contech balance (0.001gm.) for density measurement. At various concentrations ($0.625 \times 10^{-3}$ to $10 \times 10^{-3}$M), by using Abbe's Refractometer the refractive index of solvents and solutions has been determined having accuracy with $\pm$ 0.1 unit. The Prism box is sustained at a fixed temperature by flowing water from the Thermostat at 30°C. A glass test piece with a known refractive index was used to calibrate the refractometer that came with it. Solvent molar refraction and solution mixture molar refraction are calculated using the following equation,

$$Rm = [(n^2+1)/(n^2-1)]m/d = 4\pi N_o \alpha \text{-----------------(1)}$$

$$Rm_{(solution)} = X_1 Rm_1 + X_2 Rm_2 \text{-----------------} \qquad (2)$$

Where,

Rm → molar refraction,

n → refractive index,

d → density of solution,

No→ Avogadro's number,

α → polarizibility constant,

$Rm_1$ & $Rm_2$ → molar refractivity of solvent & solute and

$X_1$ & $X_2$ → mole fraction on solvent & solute in solution.

The exact volume of the substance molecules in a mole is represented by the molar refraction. The solute's molar refraction can be measured as

Rm(solute) = Rm(mixture) - Rm(solvent) --------------------------(3)

To measure the refractive index of solvents and solutions at varying concentrations Abbe's refractometer is used and the values of molar refractions and polarizability constants are estimated and reported in tables 1 to 2 for various systems.

## 3. OBSERVATIONS AND CALCULATIONS

### Table 1: System: Drug-1 (Tamsulosin )

| Concentration in mole/liter | Medium | | | | | |
|---|---|---|---|---|---|---|
| | Methanol-Water | | | Acetone-Water | | |
| | RI | Rm | $\alpha*10^{-25}$ | RI | Rm | $\alpha*10^{-25}$ |
| $10 \times 10^{-3}$ | 1.218 | 1.807 | 6.5 | 1.245 | 1.702 | 6.1 |
| $5 \times 10^{-3}$ | 1.204 | 0.886 | 3.0 | 1.321 | 0.826 | 3.8 |
| $2.5 \times 10^{-3}$ | 1.201 | 0.400 | 1.0 | 1.220 | 0.371 | 1.8 |
| $1.25 \times 10^{-3}$ | 1.181 | 0.156 | 0.1 | 1.207 | 0.138 | 0.9 |
| $0.625 \times 10^{-3}$ | 1.169 | 0.026 | 0.3 | 1.204 | 0.018 | 0.4 |

### Table 2 : System: Drug-2 (Lamivudine)

| Concentration in mole/liter | Medium | | | | | |
|---|---|---|---|---|---|---|
| | Methanol-Water | | | Acetone-Water | | |
| | RI | Rm | $\alpha*10^{-25}$ | RI | Rm | $\alpha*10^{-25}$ |
| $10 \times 10^{-3}$ | 1.211 | 2.218 | 9.1 | 1.248 | 2.082 | 8.6 |
| $5 \times 10^{-3}$ | 1.208 | 1.130 | 4.2 | 1.235 | 1.018 | 4.4 |
| $2.5 \times 10^{-3}$ | 1.201 | 0.610 | 2.4 | 1.222 | 0.472 | 2.2 |
| $1.25 \times 10^{-3}$ | 1.182 | 0.211 | 1.2 | 1.208 | 0.201 | 1.1 |
| $0.625 \times 10^{-3}$ | 1.170 | 0.162 | 0.8 | 1.206 | 0.145 | 0.5 |

## 4. RESULT AND DISCUSSION

The molar refractivity and polarizability constants decrease as the concentration of the solution decrease, as shown in tables 1 to 2. The values of Rm and α are similarly found to be higher in the polar solvent methanol than in the non-polar solvent Acetone. Polar solvents form H-bonds with solutes and may form complexes with them, whereas non-polar solvents do not establish H-bonds with solutes and do not interact with them. Because the dipole in the compound is perpendicular to the longer axis of the molecule, intermolecular attraction occurs,

which is accompanied by an increase in the value of molar refraction and molar polarizability constant as the concentration of solution increases due to mutual dipole compensation. Such research has been reported [23–25].

## REFERENCES

(1) Brodie, S. E. Part 2 Optics and RefRactiOn. *Ophthalmol. E-Book* **2018**, 19.

(2) Clarke, D. N.; Grainger, J. F. *Polarized Light and Optical Measurement: International Series of Monographs in Natural Philosophy*; Elsevier, 2013; Vol. 35.

(3) Tolstoy, V. P.; Chernyshova, I.; Skryshevsky, V. A. *Handbook of Infrared Spectroscopy of Ultrathin Films*; John Wiley & Sons, 2003.

(4) Hsiao, J.-S.; Krueger, B. P.; Wagner, R. W.; Johnson, T. E.; Delaney, J. K.; Mauzerall, D. C.; Fleming, G. R.; Lindsey, J. S.; Bocian, D. F.; Donohoe, R. J. Soluble Synthetic Multiporphyrin Arrays. 2. Photodynamics of Energy-Transfer Processes. *J. Am. Chem. Soc.* **1996**, *118* (45), 11181–11193.

(5) Kwon, J. E.; Park, S. Y. Advanced Organic Optoelectronic Materials: Harnessing Excited-State Intramolecular Proton Transfer (ESIPT) Process. *Adv. Mater.* **2011**, *23* (32), 3615–3642.

(6) Leron, R. B.; Soriano, A. N.; Li, M.-H. Densities and Refractive Indices of the Deep Eutectic Solvents (Choline Chloride+ Ethylene Glycol or Glycerol) and Their Aqueous Mixtures at the Temperature Ranging from 298.15 to 333.15 K. *J. Taiwan Inst. Chem. Eng.* **2012**, *43* (4), 551–557.

(7) Sharma, S.; Patel, P. B.; Patel, R. S.; Vora, J. J. Density and Comparative Refractive Index Study on Mixing Properties of Binary Liquid Mixtures of Eucalyptol with Hydrocarbons at 303.15, 308.15 and 313.15 K. *E-J. Chem.* **2007**, *4* (3), 343–349.

(8) Oswal, S. L.; Oswal, P.; Dave, J. P. VE of Mixtures Containing Alkyi Acetate, or Ethyl Alkanoate, or Ethyl Bromoalkanoate with n-Hexane. *Fluid Phase Equilibria* **1994**, *98*, 225–234.

(9) Oswal, S. L.; Rathnam, M. V. Study of Dielectric Constants & Refractive Indices of Binary Mixtures of Ethyl Acetate with Toluene, Ethylbenzene, o-Xylene, p-Xylene & p-Dioxane. **1987**.

(10) Palaiologou, M. M. Densities, Viscosities, and Refractive Indices of Some Alkyl Esters with 4-Chlorotoluene Systems at (293.15, 298.15, and 303.15) K. *J. Chem. Eng. Data* **1996**, *41* (5), 1036–1039.

(11) Pawar, R. B. TO DETERMINE MOLAR REFRACTION (RM) POLARAZABILITY CONSTANTS (A) & REFRACTIVE INDEX OF SOME PEPTIDES SUCH AS CARNOSINE, GLUTATHIONE DL-PHENYLALANINE & PENTAGLYCINE IN DIFFERENT PERCENTAGE OF METHANOL-WATER MIXTURE BY ANALYTICAL METHOD. **2012**.

(12) Dunmur, D. A.; Manterfield, M. R.; Miller, W. H.; Dunleavy, J. K. The Dielectric and Optical Properties of the Homologous Series of Cyano-Alkyl-Biphenyl Liquid Crystals. *Mol. Cryst. Liq. Cryst.* **1978**, *45* (1–2), 127–144.

(13) Oswal, S. L.; Oswal, P.; Gardas, R. L.; Patel, S. G.; Shinde, R. G. Acoustic, Volumetric, Compressibility and Refractivity Properties and Reduction Parameters for the ERAS and Flory Models of Some Homologous Series of Amines from 298.15 to 328.15 K. *Fluid Phase Equilibria* **2004**, *216* (1), 33–45.

(14) Sarkar, P.; Mandal, P.; Paul, S.; Paul, R.; Dabrowski, R.; Czuprynski, K. X-Ray Diffraction, Optical Birefringence, Dielectric and Phase Transition Properties of the Long Homologous Series of Nematogens 4-(Trans-4′-n-Alkylcyclohexyl) Isothiocyanatobenzenes. *Liq. Cryst.* **2003**, *30* (4), 507–527.

(15) Murase, S.; Ban, M.; Horie, K. Refractive Index Changes of Doped Polymer Films Induced by the Photoelimination of Meso-Ionic Heterocyclic Compounds with and without a Sulfur Atom. *Jpn. J. Appl. Phys.* **1999**, *38* (12R), 6772.

(16) Sonar, A. N.; Pawar, N. S. Studies on Viscosity, Density and Refractive Index of Substituted Heterocyclic Compounds in Different Media. *Rasayan J. Chem.* **2010**, *3* (2), 250–254.

(17) Ubarhande, S. S.; Burghate, A. S.; Berad, B. N.; Turak, J. D. Studies on Refractive Index of 1, 3-Diaryl Carbamides in Different Percentage of Binary Liquid Mixture. *Rasayan J. Chem.* **2011**, *4* (3), 585–587.

(18) Kshirsagar, A. M.; Tayade, D. T. Refractrometry Study of S-Trizinothiocarbamides in Different Percentage of Dioxane-Water Mixture.

(19) Wenzel, M.; Casini, A. Mass Spectrometry as a Powerful Tool to Study Therapeutic Metallodrugs Speciation Mechanisms: Current Frontiers and Perspectives. *Coord. Chem. Rev.* **2017**, *352*, 432–460.

(20) Khan, J.; Farooqui, M.; Quadri, S. H. VERIFICATION OF THE MOLAR REFRACTION AS AN ADDITIVE AND CONSTITUTIVE PROPERTY OF BINARY LIQUID MIXTURES OF WATER-ETHANOL AND BENZENE-ETHANOL. *Rasayan J Chem* **2011**, *4*, 944–946.

(21) An, N.; Zhuang, B.; Li, M.; Lu, Y.; Wang, Z.-G. Combined Theoretical and Experimental Study of Refractive Indices of Water–Acetonitrile–Salt Systems. *J. Phys. Chem. B* **2015**, *119* (33), 10701–10709.

(22) Iglesias, M.; Orge, B.; Tojo, J. Refractive Indices, Densities and Excess Properties on Mixing of the Systems Acetone+ Methanol+ Water and Acetone+ Methanol+ 1-Butanol at 298.15 K. *Fluid Phase Equilibria* **1996**, *126* (2), 203–223.

(23) Madje, B. R.; Ubale, M. B.; Bharad, J. V.; Shingare, M. S. Alum-Promoted Synthesis of 1, 8-Dioxo-Octahydroxanthenes in Water. *South Afr. J. Chem.* **2010**, *63*, 36–39.

(24) Madje, B. R.; Ubale, M. B.; Bharad, J. V.; Shingare, M. S. Alum an Efficient Catalyst for Erlenmeyer Synthesis. *South Afr. J. Chem.* **2010**, *63*, 158–161.

(25) Sonar, A. N.; Pawar, N. S. Studies on Viscosity, Density and Refractive Index of Substituted Heterocyclic Compounds in Different Media. *Rasayan J. Chem.* **2010**, *3* (2), 250–254.

## DIOSCOREA BULBIFERA MODULATES THE ANTIMICROBIAL ACTIVITY OF GENTAMICIN AND CIPROFLOXACIN: AN IN-VITRO STUDY

**Ashlesha Mali\*, Priyanka Mahadik, Neha Ingle, Dr. Vaishali Undale**
Department of Pharmacology, Dr. D. Y. Patil Institute of Pharmaceutical Sciences and Research, Pune, Maharashtra India 41101

## ABSTRACT

*Background & Objective- Antimicrobial infection is the major cause of infectious diseases which can be lead to morbidity and mortality. The problem with current antibiotics is the risk of development of resistance due to irrational use. One of the approaches to reduce the emergence of antibiotic resistance may be the use of herbal drugs concomitantly. Dioscorea bulbifera has been proven for the anti-microbial activity but its MIC (Minimum Inhibitory Concentration) is not evaluated yet. Therefore, in this experiment, the MIC and the herb-drug interaction are being evaluated. The objective of this study is to evaluate the pharmacodynamics interactions of Dioscorea bulbifera with other antibiotics such as Gentamicin and Ciprofloxacin.*

*Material and Method: 1) The MIC study of Dioscorea bulbifera has been done by a two-fold dilution method. 2) The zone of Inhibition study of Dioscorea bulbifera has been done to evaluate the interaction between Dioscorea bulbifera and Gentamicin & Ciprofloxacin.*

*Results: The results of the MIC study showed that the hydro-alcoholic extract of Dioscorea bulbifera was able to prevent the growth of S.aureus, at the concentration of 224μg/ml. The herb-drug interaction study suggested that Dioscorea bulbifera has shown a synergistic effect with Gentamicin and an antagonistic effect with ciprofloxacin.*

*Conclusion: Hydro-alcoholic extract of Dioscorea bulbifera at a concentration of 224μg/ml has antimicrobial activity against S.aureus. The overall results of the present Zone of inhibition study provided evidence that the Dioscorea bulbifera has a synergistic action with Gentamicin and an antagonistic effect with Ciprofloxacin. A further detailed mechanistic study needs to be explored for the potential use of Dioscorea bulbifera as an adjuvant to potentiate the action of Gentamicin so that this will help to reduce the toxicity and the antimicrobial resistance of the Gentamicin.*

*Keywords: Dioscorea bulbifera, MIC, gentamicin, ciprofloxacin, zone of inhibition.*

## INTRODUCTION

Microbial infection is the main cause of infectious diseases which can be direct to morbidity and mortality. While a variety of antibiotics and antimicrobial agents are accessible for the treatment of different antimicrobial infections the trouble with the current antibiotic is the risk of development of resistance due to irrational use. As per the review of WHO, 30 to 60% of Primary Health Centre patients are treated with antibiotics even if needed or not. Antibiotics that were once used to treat diseases caused by bacteria have become resistant to them. For example, Staphylococcus aureus (MRSA) and Neisseria gonorrhoeae are now nearly always resistant to benzylpenicillin. In the past, penicillin antibiotic was used to treat these illnesses.(1)

The most serious problem with antibiotic resistance is that a few bacteria have become resistant to all of the easily available antibiotics. These microorganisms are now capable of causing severe illness, creating a serious public health risk. Significant examples are vancomycin-resistant Enterococcus, methicillin-resistant Staphylococcus aureus, multi-drug resistant Mycobacterium tuberculosis. Therefore, this will be confronted in the treatment of resistant bacteria in the future. Herbs have long been used as food additives and traditional medicine to treat a variety of infectious diseases. Herbs, according to the WHO, might be the best source of a variety of drugs. Herbs should be investigated more thoroughly in order to have a greater understanding of their qualities, safety, and efficacy. The idea of synergy between herbal drugs and antibiotics is a new strategy for treating multidrug-resistant bacteria as antibiotic resistance increases. A synergistic, additive, or antagonistic combination of two medications is possible.(2) Synergistic means that the combined effect is greater than if the second drug's concentration were replaced by the first medication, whereas antagonistic means that the combined effect is less than the single effect. (3)Synergy results in a higher killing rate, drug potentiation, drug elimination prevention, a superior in vivo effect, etc. Understanding the process of synergy could lead to a novel method for treating infectious diseases by decreasing the negative effects caused by high antibiotic doses. Antibiotics and herbal extracts are being explored for a synergistic effect against multidrug-resistant bacteria.(4) One of the approaches to decrease the emergence of antibiotic resistance is maybe the use of herbal drugs concomitantly.(5)

**Material and Methods:**

**1. Minimum Inhibitory Concentration study of *Dioscorea bulbifera***

Materials –

1. Instruments – Autoclave, Incubator, Laminar air Flow.

2. Apparatus – Patri plates, Cork borer, Glass spreader, micropipette

Bacterial Strain used: - *Staphylococcus aureus* ATCC

Method- Agar Dilution Technique

Procedure-

1. Antimicrobial agent and test stock solution were prepared by using a two-fold dilution technique.

2. Antimicrobial agar plates were prepared under aseptic conditions. Each plate was labeled in order to identify the herb-drug and their concentrations.

3. Control agar plates were prepared by pipetting 10 ml of nutrient agar into a sterile Petri dish.

4. From a pure 18–24-hour bacterial culture 4-5 isolated colonies were subcultured to a tube with 3 ml nutrient broth. Vigorously shaken in a water bath at 30°C until it achieves or exceeds the turbidity of 0.5 MacFarland standard. The standardized inoculum was diluted in 1:10 sterile saline solution to obtain the desired concentration of $10^6$ CFU/ml. The 0.1 ml of the $10^6$ CFU/ml inoculum was pipette out and transferred to antimicrobial agar plates.

5. The inoculated agar plates were incubated in an inverted position at 30°C for 18-24 hours.

6. Agar plates were placed on a non-reflecting dark surface and bacterial growth was observed with the naked eye. Bacterial growth on the 2 control plates was observed.(6)

**2. Zone of Inhibition**

Nutrient agar Petri plates were prepared for the growth of the bacterial culture. Test culture was spread on the plates by the spread plate method. Well, was prepared in seeded plates by using a cork borer i.e., sterilized by burning with absolute ethanol.

Plant extracts (0.1ml) of concentration 224µg/ml, Standard drug (0.1 ml) i) Gentamicin of concentration 0.5 µg/ml ii) Ciprofloxacin of concentration 0.25 µg/ml and plant extract + standard drug (0.1ml) were added in the labeled wells and incubated. One well was prepared as a control having (0.1 ml) another pure solvent. Bacterial test culture plates were incubated at 32°C to 37°C for 48 hrs. The sensitivity of the test organism to extract and the standard drug was indicated by a clear zone of inhibition around the well and measuring the diameter of the clear zone of inhibition.(7)

**Results-**

1. Evaluation of Minimum Inhibitory concentration of hydroalcoholic extract of *Dioscorea bulbifera* :-

| Concentration (ug/ml) | Observation |
|---|---|
| 31.25 | + |
| 62.50 | + |
| 125 | + |
| 150 | + |
| 200 | + |
| 221 | + |
| 222 | + |
| 223 | + |
| 224 | - |
| 225 | - |
| 250 | - |
| 500 | - |
| 1000 | - |

**Note –** Here (+) :- Growth of bacteria

(-) :- No growth of bacteria

The MIC of *Dioscorea bulbifera* was found to be 224 µg/ml above which the growth of *S.aureus* was observed to be inhibited.

2. Evaluation of Zone of inhibition of Gentamicin, *Dioscorea bulbifera,* and Gentamicin + *Dioscorea bulbifera* is as follows: -

**Fig 1.** Photograph of nutrient agar plate which indicates the result of the zone of inhibition study of Gentamicin (G), *Dioscorea bulbifera* (D.B.), and Gentamicin + *Dioscorea bulbifera.*



**Fig 1.  Photograph of the nutrient agar plate**
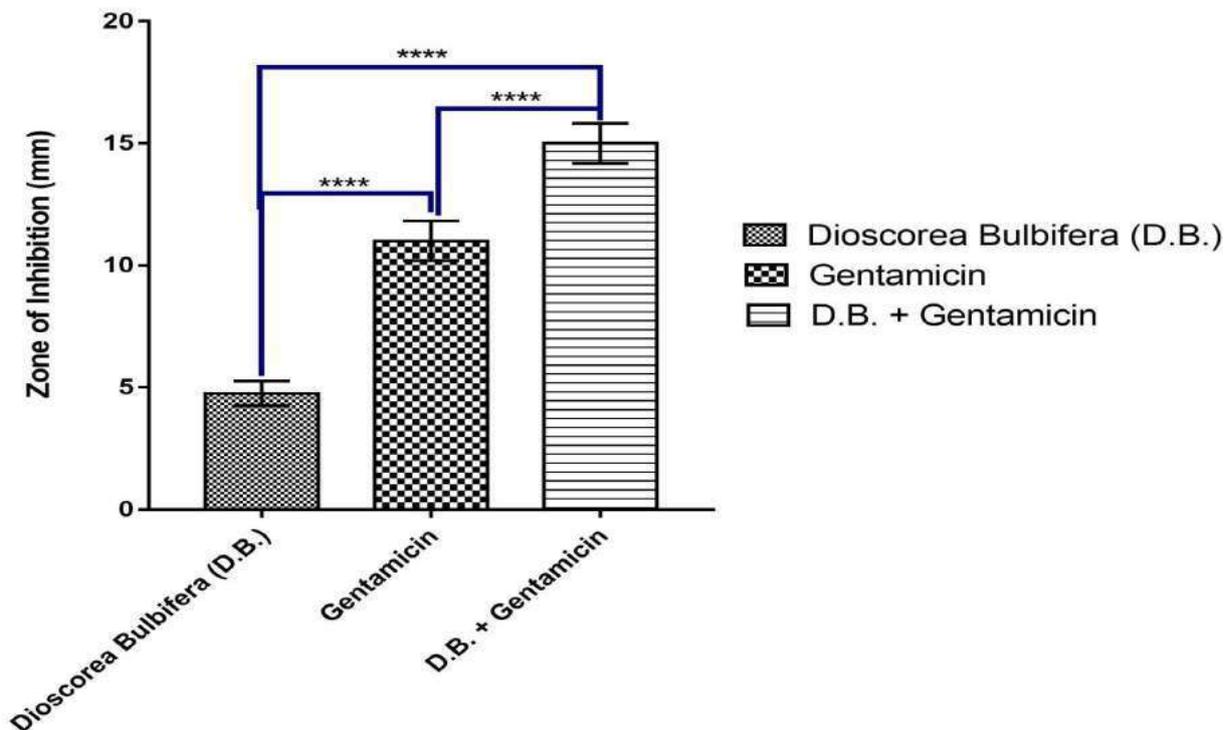


**Fig 2: Graphical representation of zone of inhibition results**

Data expressed as mean ± SEM. N= 6; ****$P < 0.0001$, D.B. compared with Gentamicin and D.B. + Gentamicin, and Gentamicin compared with D.B. + Gentamicin by using One-way ANOVA followed by Bonferroni's test. The statistical analysis showed that a combination of D.B. & Gentamicin has significantly a greater zone of inhibition as compared to the zone of inhibition of D.B. & Gentamicin alone.

2. Evaluation of Zone of inhibition of Ciprofloxacin, *Dioscorea bulbifera* and Ciprofloxacin + *Dioscorea bulbifera* is as follows: -

Fig 3. Photograph of nutrient agar plate which indicates the result of zone of inhibition study of Ciprofloxacin (Cipro), *Dioscorea bulbifera* (D.B.) and Ciprofloxacin + *Dioscorea bulbifera.*

**Fig 3. Photograph of nutrient agar plate**
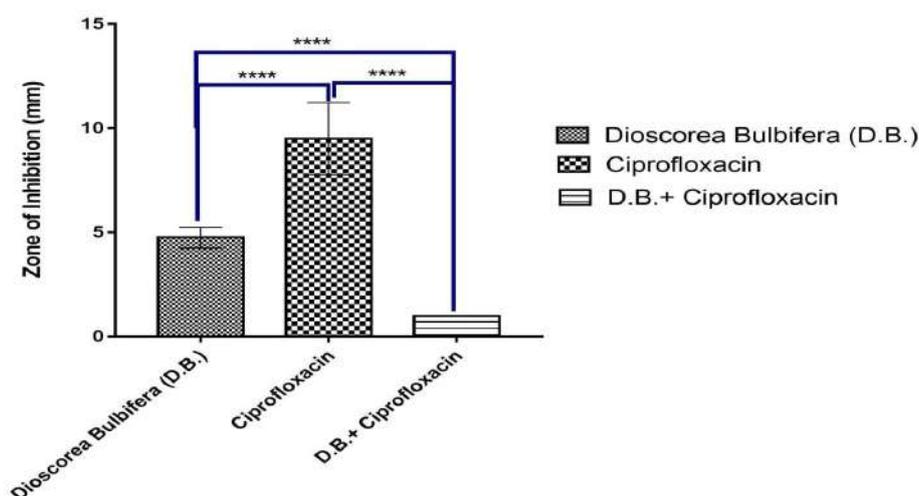


**Fig 4 Graphical representation of zone of inhibition study results**

Data expressed as mean ± SEM. N= 6; ****$P < 0.0001$, D.B. compared with Ciprofloxacin and D.B. + Ciprofloxacin, and Ciprofloxacin compared with D.B. + Ciprofloxacin by using One-way ANOVA followed by Bonferroni's test. The statistical analysis showed that a combination of Ciprofloxacin & D.B. has a significantly lesser zone of inhibition as compared to Ciprofloxacin & D.B. alone.

**Discussion: -** Antimicrobial agents with various chemical compositions and unique modes of action against new and re-emerging infectious illnesses have long been in demand. Bacterial resistance develops as a result of excessive antimicrobial therapy. This is attributed to increased chemotherapeutic failure and antibiotic resistance in pathogenic microbial infectious agents.(8) One of the ways to avoid bacterial resistance may be the use of the herbal drug in combination with antimicrobial drugs. In previous investigations, the antibacterial activity of the ethanolic extract of Dioscorea bulbifera bulbils or rhizomes was not as effective as that of the peel.(9) The minimum inhibitory concentration of hydro-alcoholic extract of Dioscorea bulbifera was determined in staphylococcus aureus and the effect on the zone of inhibition of Ciprofloxacin and Gentamicin.

The Omolade M. A. *et.al.,* determined the MIC of ethanolic extract of *Dioscorea bulbifera* at a concentration ranging between 125 μg/ml and 500 μg/ml.(9) In the present study MIC of hydro-alcoholic extract of *Dioscorea bulbifer*a was found to be 224 μg/ml against *Staphylococcus aureus*. This result shows similarity with previous MIC studies of *Dioscorea bulbifer*a.

The majority of isolates, including *E. coli, Acinetobacter sp., Klebsiella pneumoniae, Salmonella paratyphi, and Candida albicans*, were observed to exhibit significant inhibitory activity against silver nanoparticles of fractionated extract of Dioscorea bulbifera. *K. pneumoniae* had the highest inhibitory activity, with inhibition zone widths of (17 ± 0.15 mm), followed by E. coli (13 ± 0.11) mm and Acinetobacter sp.(11 ± 0.12) as per the study of Ghosh S. *et.al.*(10)

In the present study, hydro-alcoholic extract of *Dioscorea bulbifer*a was studied for its inhibitory activity against *Staphylococcus aureus*; the inhibitory activity was observed with the zone of inhibition diameters (7+ 0.4 mm). The observed decrease in the zone of inhibition as compared to silver nanoparticles might be due to the use of fractionated as well as silver-coated nanoparticles of *Dioscorea bulbifera*.

Evaluation of herb-drug interaction with respect to antimicrobial activity, the effect of the combination of Gentamicin & D. B. and Ciprofloxacin & D.B. on the zone of inhibition was carried out. Zone of inhibition was found to be increased with Gentamicin suggesting the potentiation of antimicrobial activity of Gentamicin with *Dioscorea bulbifera*. The constituents of D.B. might be acting on the contrary, no antimicrobial effect of the combination of Ciprofloxacin and D.B. was found on the zone of inhibition against s. aureus. The microbial growth was observed surrounding the well-containing combination of this ciprofloxacin and D.B. This suggests an antagonistic effect of ciprofloxacin with D.B. The thorough observation showed precipitation of some complex in well. So, the solution of hydro-alcoholic extract of D. B. and ciprofloxacin mixed in the test tube in concentration 1:1 showed the presence of some complex of both drugs. This suggests physical antagonism between Dioscorea bulbifera and ciprofloxacin.

**CONCLUSION:**

The results of MIC determinations indicated that the hydro-alcoholic extract of *Dioscorea bulbifera was* able to prevent the growth of *S. aureus* within a range of concentration 224 µg/ml. In the zone of inhibition study,1) Hydro-alcoholic extract of *Dioscorea bulbifera* has shown the synergistic effect with Gentamicine 2) hydro-alcoholic extract of *Dioscorea bulbifera* has shown antagonistic effect with Ciprofloxacin. Thorough observation showed precipitation of some complex, this suggests physical antagonism between *Dioscorea bulbifera* and Ciprofloxacin. A further detailed mechanistic study needs to be explored for the potential use of Dioscorea *bulbifera* as an adjuvant to potentiate the action of Gentamicin so that this will help to reduce the toxicity and the antimicrobial resistance of the Gentamicin.

**REFERENCES:**

1.  Patrick G. G. Antibiotic-resistant bacteria. New York : Chelsea House; 2007. 128 p.

2.  Introduction and Importance of Medicinal Plants and Herbs | National Health Portal of India [Internet]. [cited 2022 Jan 20]. Available from: https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl

3.  Yeh PJ, Hegreness MJ, Aiden AP, Kishony R. Drug interactions and the evolution of antibiotic resistance. Nat Rev Microbiol [Internet]. 2009 [cited 2022 Jan 20];7(6):460. Available from: /pmc/articles/PMC2855488/

4.  M B, BR S, DK S. Potential of Herbal Drug and Antibiotic Combination Therapy: A New Approach to Treat Multidrug Resistant Bacteria. Pharm Anal Acta. 2016;7(11).

5.  Andersson DI. Persistence of antibiotic resistant bacteria. Curr Opin Microbiol [Internet]. 2003 [cited 2022 Jan 20];6(5):452–6. Available from: https://pubmed.ncbi.nlm.nih.gov/14572536/

6.  Tendencia EA. Minimal inhibitory concentration (MIC) test and determination of antimicrobial resistant bacteria. Lab Man Stand methods Antimicrob Sensit tests Bact Isol from Aquat Anim Environ [Internet]. 2004 [cited 2022 Jan 20];31–55. Available from: https://repository.seafdec.org.ph/handle/10862/1637

7.  Article R, Sen A, In AC. EVALUATION OF ANTIMICROBIAL ACTIVITY OF DIFFERENT SOLVENT EXTRACTS OF MEDICINAL PLANT: MELIA AZEDARACH L. AND AMLA BATRA.

8.  Barbour EK, Al Sharif M, Sagherian VK, Habre AN, Talhouk RS, Talhouk SN. Screening of selected indigenous plants of Lebanon for antimicrobial activity. J Ethnopharmacol [Internet]. 2004 Jul [cited 2022 Jan 20];93(1):1–7. Available from: https://www.researchgate.net/publication/8523877_Screening_of_selected_indigenous_plants_of_Lebanon_for_antimicrobial_activity

9.  Adeosun OM, Arotupin DJ, Toba OA, Adebayo AA. Antibacterial activities and phytochemical properties of extracts of Dioscorea bulbifera Linn (Air Potatoe) tubers and peels against some pathogenic bacteria. undefined. 2016 Mar 20;5(1):20–6.

10. S G, S P, M A, R K, S K, K P, et al. Synthesis of silver nanoparticles using Dioscorea bulbifera tuber extract and evaluation of its synergistic potential in combination with antimicrobial agents. Int J Nanomedicine [Internet]. 2012 Feb [cited 2022 Jan 20];7:483. Available from: https://pubmed.ncbi.nlm.nih.gov/22334779/

## FORMULATION AND EVALUATION OF ORODISPERSIBLE TABLETS FOR THE TREATMENT OF HYPERTENSION

**Sakshi Nainwani[1], Shikha Baghel Chauhan[2] Amisha Chauhan[3]**

[1,3]Research Scholar and [2]Assistant Professor, Amity Institute of Pharmacy, Amity University, Noida, Uttar Pradesh, India

**ABSTRACT**

*In this research paper we focus on the preparation of orodispersible tablets of telmisartan because sometimes patients have a remarkable increase in blood pressure and the instantly increase blood pressure may cause inactiveness, restless and anxious. To tackle such complications orodispersible tablets of telmisartan were formulated by direct compression techniques so that rapid onset of action can be produced to lower down the blood pressure in the normal range. Telmisartan belongs to an antihypertensive class of drug which is soluble in phosphate buffer, and other solvents. The bioavailability of telmisartan is about 42-99% which is better than other drugs that belong to the same class. Here we used several super disintegrants such as treated agar, avicel-101, magnesium stearate, etc. Which increases the rate of dissolution and bioavailability of drugs up to optimum level.*

*Keywords: orodispersible tablet, hypertension, telmisartan.*

## INTRODUCTION

Hypertension is a common arterial disease in which blood pressure increase instantly. Increased blood pressure is characterized by several health complications such as coronary heart attack, stroke, myocardial infarction, chronic kidney disease, and sometimes causes death. A few attributes of cardiovascular disease, including increased blood pressure and pulse, are described by unsurprising changes during the 24 h, generally in synchrony with the rest-movement cycle [1]. BP is commonly expressed as the proportion of the systolic BP (that is, the pressing factor that the blood applies on the blood vessel dividers when the heart contracts) and the diastolic BP (the pressing factor when the heart relaxes). The greater part (90–95%) of patients have an exceptionally heterogeneous 'fundamental' or essential hypertension with a multifactorial quality climate etiology [2]. A positive family ancestry is an incessant event in patients with hypertension, with the heritability (a proportion of the amount of the variety in a characteristic is because of variety in hereditary variables) assessed somewhere in the range of 35% and half in most studies [3].

Stream of blood is based on the heartbeat and the blood pump through the heart. The pressing factor of the heart doesn't remain at a similar level consistently. It differs dependent on exercises at a specific point on the schedule. Hypertension happens due to the long duration of abnormal pressure applied in artries [4].

Hypertension is divided into two main classes. These incorporate primary and secondary hypertension. Primary hypertension is also called fundamental hypertension and it influences 95% of people experiencing the sickness. Reasons for hypertension are not yet referred to, notwithstanding, factors as age, high salt intake, low potassium diet, inactive way of life, stress just as qualities have been found as adding to hypertension. Hypertension happening as an outcome to a result of another problem or a symptom of the drug is referred to as secondary hypertension. Such problems may incorporate renal disappointment or renovascular infection. This kind of circulatory strain is clear in around five to 10% of cases [5].

Telmisartan is an antihypertensive drug that belongs to the class of ACE inhibitors. It is used for the treatment of moderate to severe cases of hypertension, heart diseases, heart attack. Telmisartan is available in the market under the class of antihypertensive drugs. Telmisartan drugs interact with renin and are used to regulate the central regulator of blood pressure as well as electrolyte homeostasis [6].

### Orodispersible tablets

Oral administration is considered the most broadly acknowledged course because it accommodates self-administration, simple manufacturing, patient compliance, and painless treatment. But the most obvious disadvantage of the generally utilized oral measurement like tablets and capsules is trouble in swallowing, prompting patients in In-compliance especially if there should be an occurrence of pediatric and geriatric patients [7].

Tablets and capsules comprise a significant segment of medication that are at present available. In any case like pediatric and geriatric patients who are intellectually hindered, uncooperative, sickened, or on decreased fluid intake have troubles have to swallow these dosage forms [8]. The individuals who are traveling or have little

admittance to water are comparably affected. To satisfy these clinical requirements, drug technologists have built up novel drug delivery systems known as Orodispersible Tablets (ODTs) which break down quickly in saliva, typically in seconds, without the need for water.

Drug disintegration, dissolution as well as the onset of action impact, and medication bioavailability might be fundamentally more significant than those seen from traditional dosage forms When such tablets are set in the oral cavity, salivation rapidly enters into the pores to cause fast tablet disintegration [9].

## Materials and methods
**Materials:** Drug telmisartan was obtained as a gift sample from Psychotropic India Ltd., Agar was obtained from Himedia Pvt.Ltd., Avicel-101 was obtained from Loba Chemie Pvt. Ltd., Mannitol, Magnesium Stearate, and Talc were obtained from CDH Laboratory agent.

## methods
## Pre-formulation parameters
## Precompression studies
## Drug excipients interactions
**FTIR:** IR spectra with pure drug (telmisartan) were taken alone and a peak was determined. Later pure drug with excipients was taken and spectra were determined for stability studies.FTIR used in this research work was labtronics India with KBr pellets[10].
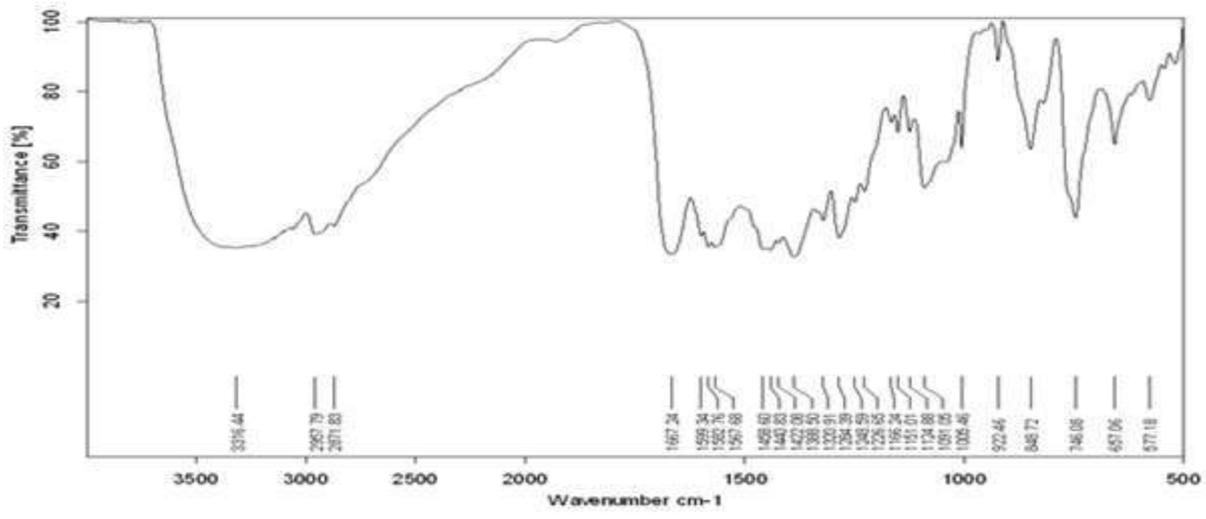


**Figure 6: IR spectrum of the pure drug ( Telmisartan)**
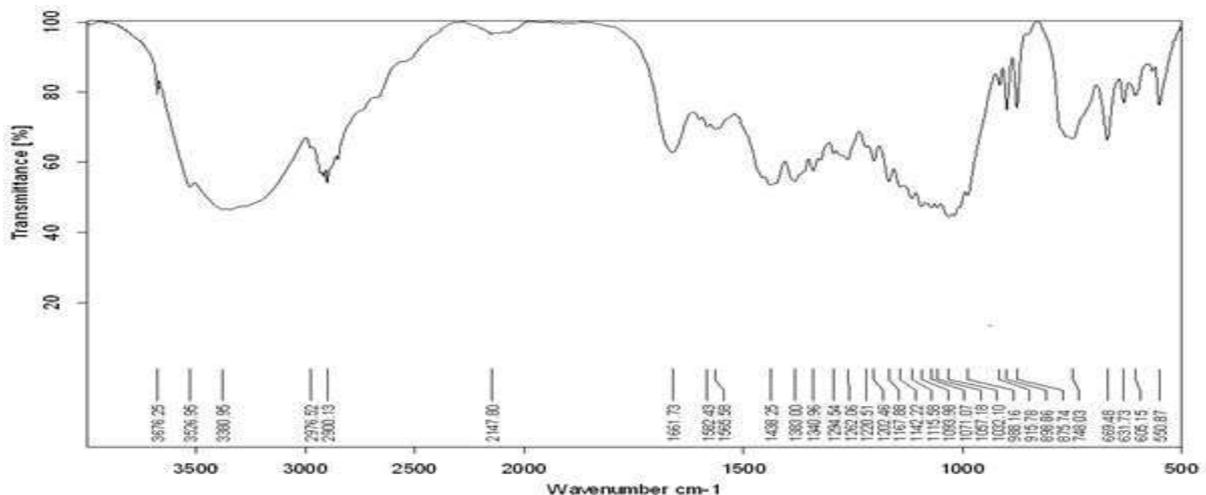


**Figure 7: IR spectrum of formulation F9**

**The angle of repose (θ):** It is defined as the maximum angle possible between the surface of the pile of the powder to the horizontal plane. The angle of repose is the indication of the flow properties of the materials. It depends upon the type of excipients used in the formulation. the angle of repose is good in free-flowing powders [11].

$\tan(\theta)=h/r$,

$\theta = \tan^{-1}(h/r)$, where $\theta$ is the angle of repose

h is the height of pile and,

r is the radius of the pile

**Table 5: Angle of repose with different ranges of flow properties**

| The angle of repose θ | Flow property |
|---|---|
| <25 | Excellent |
| 25=30 | Good |
| 30-40 | Passable |
| >40 | Very poor |

**Method:** A funnel was taken and filled to the brim and the test sample was allowed to pass through the end under gravity. A graph paper sheet was taken to measure the area of the pile thereby, evaluating the flow property. The distance between the funnel and the paper sheet was just 2cm [12].

**Bulk density:** Bulk density is defined as the total mass of the powder divided by the total volume of powder taken. Bulk density mainly depends upon particle shape and particle size distribution.

**Method:** Both bulk density and tapped density are measured by tapped density tester. In this process accurately weighed amount of powder is taken and fill in a 25ml measuring cylinder, initial volume is measured. After that cylinder was allowed to fall from 2cm height with a 2 sec time interval. Taping is continued till there is no change in powder volume [13].

Bulk and tapped density can be calculated as:

Bulk density= weight of powder/ Volume of packing        (a)

Tapped density=weight of powder/ volume of packing        (b)

**Carr's compressibility index:** The compressibility index is the property of powder to be compressed. It's the measure of powder's ability to settle [14]. Grading of compressibility index of powder according to carr's index.

**Table 6: Carr's compressibility parameters according to flow properties**

| Carr's index(compressibility %) | Flow |
|---|---|
| 5-15 | Excellent |
| 12-16 | Good |
| 18-21 | Fair |
| 23-28 | Slightly poor |
| 28-35 | Poor |
| 35-38 | Very poor |
| >40 | Extremely poor |

Carr's index compressibility can be calculated as:

CI %=tapped density-bulk density/tapped density X 100 ...(c)

**Hausner's ratio**: Hausner's ratio is the collectively flow properties of powder and granules. Hausner's ratio is the ratio of tapped density and bulk density [15].

Hausner's ratio= Tapped density/ Bulk density

**Table 7: Grading of Hausner's ratio in flow properties**

| Hausner's ratio | Flow |
|---|---|
| <1.2 | Free-flowing |
| >1.6 | Less free-flowing |

**Formulation of orodispersible tablets:**

Mouth dissolving tablets of telmisartan from batch number 1 to batch number 9 were prepared by direct compression method and the details were assigned in the table-. In each batch, 60 tablets were prepared and analyzed.

**Method of preparation:**

- All the ingredients were collected from different sources.

- Excipients were passed through sieve number 60 separately.

- All the excipients mix in a mortar pestle and uniform mixing is done.

- The drug is added to the excipients and mixed uniformly.

- The mixture of drug and excipient is taken and punched by direct compression machine to get 90mg of tablet.

**Table 8: Formulation of Orodispersible tablets of telmisartan by direct compression method**

| Sl.No. | Ingredients | The quantity used in mg | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 |
| 1. | Telmisartan | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| 2. | Treated Agar | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 3. | Avicel-101 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 |
| 4 | Mg. Stearate | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5. | Talc | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6. | Mannitol | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 7. | Total | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |

**Post compression parameters**

The prepared formulation was evaluated for physical and chemical parameters.

- **Physical parameters**

1. **Color:** Telmisartan fast dissolving tablet is white.

2. **Shape:** Circular in shape.

3. **Size:** The size of the tablet is 6mm in diameter and 3mm in thickness.

**Tablet properties:**

**Hardness:** Tablets require a specific measure of solidarity, or hardness and protection from friability, to withstand the mechanical shock of production, bundling, and transportation. The hardness of the tablets was resolved to utilize the Monsanto Hardness analyzer. It is communicated in Kg/cm2. Three tablets were randomly picked from every batch and the mean and standard deviation were determined[16].

**Friability test:** The Friability of the tablet is determined by using Roche friabilator. It is the process in which tablet surfaces are damaged and additionally exposed to mechanical shock. In this method, ten tablets are initially moved into a friabilator. The tablets were worked at 25rpm for 4 mins or up to 10 rotations. Later tablets were weighed again and friability was determined[17].

Rate of friability was determined using:

F=W(initial) – W(final)/ W(initial) X 100

Less than 1% friability of tablets is accepted.

**Weight variation test**: The tablets were chosen randomly from every batch and gauged exclusively to check for weight variation. The U.S Pharmacopeia permits a little in the hardness of the tablet[18].

**Table 11: Percentage  deviation in weight variation**

| The average weight of the tablet | Percentage deviation |
|---|---|
| 130mg or less | 10 |
| More than 130 mg or less than 324mg | 7.5 |
| 324mg or more | 5 |

**Drug content uniformity**: In the method, twenty tablets were weighed and transferred into the mortar. Tablets were crushed and a powder of tablet containing 100mg of equivalent drug transferred into 100ml of phosphate buffer pH 6.8.

It contains 1000mcg/ml of drug solution. From this 10ml of stock solution taken and diluted to 100ml of phosphate buffer pH6.8, it forms 100 μg/ml.out of this 0.1-0.6ml of stock solution was taken and diluted to 10ml of phosphate buffer. The absorbance was measured at 295nm[19].

**In-vitro disintegration time**: Disintegration is the process in which a tablet is broken down into fragments, this phenomenon is known as disintegration. In-vitro disintegration time is analyzed using various disintegration apparatus according to I.P specifications[20].

According to I.P specifications: place one tablet in each tube of the basket. Add a plate to each cylinder and run the mechanical assembly using phosphate buffer solution pH 6.8 and maintain temperature up to 37°C. The Time taken for complete disintegration of the tablet was recorded[21].

**In-vitro dissolution studies**: In-vitro dissolution studies were examined by USP type-2 apparatus using 900ml of phosphate buffer solution to maintain pH 6.8. in this process, the temperature was maintained up to 37°c. The aliquot solution was withdrawn in 5min intervals and then filtered using filter paper. The absorbance of the filtrate was measured at a maximum wavelength of 295nm. The concentration and absorbance were determined using the standard deviation curve[22].

**Table 12: Details of In-vitro dissolution studies taken**

| Sl. No. | Parameter | Specification |
|---------|-----------|---------------|
| 1. | Apparatus used | Electrolab USP type-2 |
| 2. | Dissolution media | Phosphate buffer pH 6.8 |
| 3. | Dissolution media volume | Up to 900ml |
| 4. | Temperature | 37± 5°C |
| 5. | Rotation speed | 50rpm |
| 6. | Sample withdraw time | 5 min. |
| 7. | Sample withdraw vol. | 5ml |
| 8. | Absorbance measured | 295nm |

The aim and objectives of this present study are to formulate and design mouth dissolving tablets of telmisartan. This novel approach is used for patient compliance, the onset of action, and greater bioavailability.

**Telmisartan granule parameters**

**Table 13: Results of granule parameters**

| Formulation code | Bulk density gm/cc | Angle of repose | Hardness (Kg/cm$^{2)}$ | Friability (%) |
|---|---|---|---|---|
| F1 | 0.54 | 29.08 | 3.25±0.15 | 0.54 |
| F2 | 0.53 | 30.21 | 3.22±0.12 | 0.55 |
| F3 | 0.54 | 28.32 | 3.23±0.15 | 0.56 |
| F4 | 0.52 | 31.15 | 3.33±0.24 | 0.57 |
| F5 | 0.53 | 30.38 | 3.31±0.13 | 0.61 |
| F6 | 0.54 | 31.05 | 3.23±0.14 | 0.57 |
| F7 | 0.53 | 29.56 | 3.25±0.16 | 0.55 |
| F8 | 0.53 | 31.33 | 3.27±0.11 | 0.62 |
| F9 | 0.52 | 30.13 | | 0.55 |

**Weight variation of tablets**

**Table 16: Weight variation of telmisartan tablets (F1-F3)**

| Sl. No. | Formulation Code (F1) in mgs | Wt. Variation ±SD | Formulation Code (F2) in mgs | Wt. Variation ±SD | Formulation Code (F3) in mgs | Wt. Variation ±SD |
|---|---|---|---|---|---|---|
| 1. | 90 | 0.4±0.44 | 88 | 1.4.±1.56 | 90 | 0.1±0.11 |
| 2. | 89 | 0.6±0.66 | 89 | 0.4±0.44 | 91 | 0.98±1.22 |
| 3. | 89 | 0.6±0.66 | 90 | 0.6±0.67 | 89 | 0.9±1.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4. | 90 | 0.4±0.44 | 90 | 0.6±0.67 | 90 | 0.1±0.11 |
| 5. | 90 | 0.4±0.44 | 89 | 0.4±0.44 | 89 | 0.9±1.00 |
| 6. | 90 | 0.4±0.44 | 89 | 0.4±0.44 | 91 | 0.91±1.22 |
| 7. | 89 | 0.6±0.66 | 90 | 0.6±0.67 | 90 | 0.1±0.11 |
| 8. | 90 | 0.4±0.44 | 90 | 0.6±0.67 | 90 | 0.1±0.11 |
| 9. | 90 | 0.4±0.44 | 89 | 0.4±0.44 | 89 | 0.9±1.00 |
| 10. | 89 | 0.6±0.66 | 90 | 0.6±0.67 | 90 | 0.1±0.11 |

**Table 17: Weight variation of telmisartan tablets (F4-F6)**

| Sl .No. | Formulation code (F4) in mgs | Wt. Variation ±SD | Formulation code (F5) in mgs | Wt. Variation ±SD | Formulation code (F6) in mgs | Wt. Variation ±SD |
|---|---|---|---|---|---|---|
| 1. | 90 | 0.1±0.11 | 89 | 0.5±o.55 | 89 | 0.8±0.89 |
| 2. | 91 | 1.1±1.22 | 88 | 1.5±1.67 | 90 | 0.2±0.22 |
| 3. | 90 | 0.1±1.22 | 91 | 1.5±1.67 | 90 | 0.2±0.22 |
| 4. | 89 | 0.9±1.00 | 90 | 0.5±0.55 | 91 | 1.2±1.33 |
| 5. | 91 | 1.1±1.22 | 90 | 0.5±0.55 | 91 | 1.2±1.33 |
| 6. | 89 | 0.9±1.00 | 89 | 0.5±0.55 | 89 | 0.8±0.89 |
| 7. | 90 | 0.1±1.22 | 91 | 1.5±1.67 | 90 | 0.2±0.22 |
| 8. | 90 | 0.1±1.22 | 88 | 1.5±1.67 | 89 | 0.8±0.89 |
| 9. | 89 | 0.9±1.00 | 90 | 0.5±0.55 | 90 | 0.2±0.22 |
| 10. | 90 | 0.1±1.22 | 89 | 0.5±0.55 | 89 | 0.8±0.89 |

**Table 18: Weight variation of telmisartan tablets (F7-F9)**

| Sl No. | Formulation code (F7) in mgs | Wt. Variation ±SD | Formulation code (F8) in mgs | Wt. Variation ±SD | Formulation code(F9) in mgs | Wt. Variation ±SD |
|---|---|---|---|---|---|---|
| 1. | 90 | o.3±o.33 | 90 | 0.2±0.22 | 90 | 0.2±0.22 |
| 2. | 91 | 1.3±1.44 | 90 | 0.2±0.22 | 89 | 0.8±0.89 |
| 3. | 90 | 0.3±0.33 | 89 | 0.8±0.89 | 90 | 0.2±0.22 |
| 4. | 88 | 1.7±1.89 | 89 | 0.8±0.89 | 90 | 0.2±0.22 |
| 5. | 90 | 0.3±0.33 | 90 | 0.2±0.22 | 89 | 0.8±0.89 |
| 6. | 91 | 1.3±1.44 | 88 | 1.8±2.00 | 91 | 1.2±1.33 |
| 7. | 88 | 1.7±1.89 | 90 | 0.2±0.22 | 90 | 0.2±0.22 |
| 8. | 90 | 0.3±0.33 | 91 | 1.2±1.33 | 90 | 0.2±0.22 |
| 9. | 90 | 0.3±0.33 | 91 | 1.2±1.33 | 89 | 0.8±0.89 |
| 10. | 89 | 0.7±0.78 | 90 | 0.2±0.22 | 90 | 0.2±0.22 |

**Drug content of telmisartan tablets**

**Table 19: Drug content of telmisartan mouth dissolving tablets**

| Sl No. | Formulation Code | Absorbance | Concentration | Average drug content ±SD |
|---|---|---|---|---|
| 1. | F1 | 0.996 | 17.2 | 73±0.0116 |
| 2. | F2 | 0.953 | 17.0 | 73±0.106 |
| 3. | F3 | 0.932 | 16.9 | 69±0.102 |
| 4. | F4 | 0.998 | 17.3 | 79±0.119 |
| 5. | F5 | 1.001 | 18.3 | 81±0.121 |
| 6. | F6 | 1.0123 | 18.7 | 87±0.125 |
| 7. | F7 | 1.153 | 19.1 | 94± 0.263 |
| 8. | F8 | 1.198 | 19.0 | 97±0.163 |
| 9. | F9 | 1.201 | 19.8 | 99± 0.173 |

**In-vitro dispersion time**

**Table 20: In-vitro dispersion time of telmisartan tablet**

| Formulation code | Dispersion time±SD |
|---|---|
| F1 | 44.08±1.5 |
| F2 | 41.01±1.7 |
| F3 | 37.02±1.7 |
| F4 | 35.07±1.2 |
| F5 | 16.13±1.23 |
| F6 | 16.0±1.2 |
| F7 | 9.87±1.2 |
| F8 | 7.77±1.0 |
| F9 | 5.13±1.1 |

**CONCLUSION:**

According to this research study it was concluded that the drug telmisartan and its formulation has very good solubility among the solvents and it is very helpful for the treatment of hypertension as well as in kidney diseases. The model drug has optimum solubility, bioavailability, and dissolution.

**Conflict of interest:** Nil

**REFERENCES**

1. Sanjeev Kumar et al, Efficient and improved synthesis of Telmisartan, Journal of Organic Chemistry, Jan-2019.

2. Ramón C. Hermid et al, Influence of Circadian Time of Hypertension Treatment on Cardiovascular Risk, Journal of Biological and Medical Rhythm Science, Vol-27, Issue-8, 2019.

3. S. Yang et al, Association between hypertension and fragility fracture: a longitudinal study, Osteoporosis International, July-2016.

4. Rubin M. Tuder, Pulmonary vascular remodeling in pulmonary hypertension, Cell and Tissue Research, Dec-2016.

5. Suzanne Oparil et al, Hypertension, Nature reviews disease primers, Mar-2018.

6. Kapil Chauhan et al, Formulation and Evaluation of Fast Dissolving Tablets of Telmisartan, International Journal of Pharmaceutical Science and Research, Vol-4, Issue-4, 2018, Pages 1514-1520.

7. Poonam Chaudhari et al, Formulation and Evaluation of Fast Disintegrating Tablet of Telmisartan, International Journal of Pharmaceutical Technology, 2014.

8. Bandameedi Ramu et al, International Journal of Pharmacy Research and Technology, August 2015,8(3):974-4304.

9. Ved Prakash et al, Fast disintegrating tablets: Opportunity in drug delivery system, Journal of Advanced Pharmaceutical Technology and Research, 2014 Oct-Dec; 2(4): 223–235.

10. SamixaDesai et al, Formulation of cyclodextrin inclusion complex-based orally disintegrating tablet of eslicarbazepine acetate for improved oral bioavailability, Materials Science and Engineering, Volume 58, 1 January 2016, Pages 826-834.

11. B. P. Patel et al, Formulation and Evaluation of Mouth Dissolving Tablets of Cinnarizine, Indian Journal of Pharmaceutical Sciences, 2019 Jul-Aug; 72(4): 522–525.

12. R. M. Sarfraz et al, Formulation and Evaluation of Mouth Disintegrating Tablets of Atenolol and Atorvastatin, Indian Journal of Pharmaceutical Science, 2015 Jan-Feb; 77(1): 83–90.

13. R. M. Sarfraz et al, Formulation and Evaluation of Mouth Disintegrating Tablets of Atenolol and Atorvastatin, Indian Journal of Pharmaceutical Sciences,2015 Jan-Feb; 77(1): 83–90.

14. Rebecca et al, Formulation and In-vitro Evaluation of Mouth Dissolving Tablets of Labetalol HCL by Sublimation method, Asian Journal of Pharmacy and Technology, Vol-6, Issue-2, 2016, Pages 60-70.

15. YagmurAkdag et al, Characterization and comparison of deferasirox fast disintegrating tablets prepared by direct compression and lyophilization methods, Journal of Drug Delivery Science and Technology, Volume 57, June 2020, 1017-60.

16. Jaya Malladi et al, Novel platens to measure the hardness of a pentagonal shaped tablet, National Library of Medicines, 2017 Mar;22(2):246-255.

17. Emma Hellberg et al, Evaluation of dissolution techniques for orally disintegrating mini-tablets, Journal of Drug Delivery Science and Technology, Volume 61, February 2021.

18. Santosh Kumar Rada, Fast dissolving tablets: waterless patient compliance dosage forms, Journal of Drug Delivery and Therapeutics, Vol-9, Issue- 1, Jan-Feb 2019.

19. VivekDave et al, Formulation design and optimization of novel fast dissolving tablet of chlorpheniramine maleate by using lyophilization techniques, Bulletin of Faculty of Pharmacy, Volume 55, Issue 1, June 2017, Pages 31-39.

20. Muhammad Irfan et al, Orally disintegrating films: A modern expansion in drug delivery system, Saudi Pharmaceutical Journal, Volume 24, Issue 5, September 2016, Pages 537-546.

21. Arti Mohan et al, *In vitro* and *in vivo* evaluation of fast-dissolving tablets containing solid dispersion of lamotrigine, International Journal of Pharmaceutical Investigation, 2015 Jan-Mar; 5(1): 57–64.

22. Mangesh Machhindranath Satpute et al, Formulation and in vitro evaluation of fast dissolving tablets of metoprolol tartrate, Brazilian Journal of Pharmaceutical Sciences, vol. 21, n. 4, oct./dec, 2017.

## RETRIEVAL OF MEDICAL DATA USING FINGERPRINT TECHNOLOGY WITH SURF FEATURES

**T. R. Thamizhvani[*], R. Chandrasekaran, R. J. Hemalatha, Josephin Arockia Dhivya A**

Department of Biomedical Engineering, Vels Institute of Science, Technology and Advanced Studies, Chennai, India

**ABSTRACT**

*Biometric systems used for the authentication of medical data. Laws, policies and technological standards are developed to maintain the privacy of the individual. In the proposed algorithm, database images of fingerprint are acquired and analyzed using texture, morphological and SURF features for template formation. These features help in recognizing and matching the templates with the input fingerprint data. Database is designed with the local server technique for the storage of the templates and the medical data of the individual through a web application. Template matching is performed with the input fingerprint to retrieve the medical records of the patient or individual. Biometrics enables a high secured authentication system for the storage and retrieval of the medical data. Efficiency of template matching is defined to more effective with the help of the parameters like True acceptance rate and False acceptance rate. Thus an highly secure and improved authentication is emphasized for the medical records with the biometric systems*

*Keywords: Biometric system; Fingerprint technology; Medical record authentication, SURF features; database; Web application.*

## 1. INTRODUCTION

Biometric systems use physiological parameters or factors for authentication of the records, data and other details. There are different types of biometrics like fingerprint, iris, and face. Fingerprint recognition can be stated as the method of recognition using the impressions made by minute ridge formations or patterns described as fingerprints. Fingerprints are unique that is no two people will exactly have the same order of ridge patterns and also the patterns of each and every person remain unchanged throughout the life. Other personal characteristics may change, but fingerprint do not change.

Fingerprint can be recorded in a standard manner using fingerprint card or can be recorded digitally. These can be electronically transmitted. A fingerprint is the representation of the epidermis of a finger. At a macroscopic analysis, a fingerprint is composed of a set of ridge lines which often flow parallel and sometimes produce local macro-singularities called whorl, loop and delta.The number of cores and deltas in a single fingerprint is regulated in nature with help of certain stringent rules. Fingerprints are usually partitioned into five main classes arch, tented arch, left loop, right loop, whorl, according to their macro-singularities. The ridge-line flow can be effectively described by a structure called directional map (or directional image) which is a discrete matrix whose elements denote the orientation of the tangent to the ridge lines. Analogously, the ridge line density can be synthesized by using a density map [1, 2].

At a finer analysis other very important features can be discovered in the fingerprint patterns. These micro-singularities, called minutiae or Galton characteristics, are essentially determined by the termination or the bifurcation of the ridge lines. Minutiae play a primary role for fingerprint matching, since most of the algorithms rely on the coincidence of minutiae to state whether two impressions are of the same finger or not. Minutiae matching, which is essentially a point pattern matching problem, constitutes the basis of most of the automatic algorithms for fingerprint comparison. As advancement in this technology, Frustrated Total Internal Reflection (FTIR) is the most used and mature live-scan sensing technique. The finger is illuminated from one side of a glass prism with a LED, while the other side transmits the image through a lens to a CDD/CMOS sensing element which converts light into digital information. The lack of reflection caused by the presence of water particles where the ridges touch the prism allows ridges to be discriminated from valleys. Authentication of the medical records is necessary to maintain the privacy and rights of the individual patients [3]. Laws and policies state that only authenticated users can study the data or records of the patient. Without authentication, analysis of the data is a crime. For highly secured authentication and protection, fingerprint technology, a biometric type is used in this algorithm [4].

Kardas G (2006) defines a smart card authentication system for the storage and transmission of healthcare information. Healthcare information system (HIS) is operated with this smart card technology which is attached with any external or storage devices [5]. Dharmendra sushil kumar.et.al (2013) describes a system for management of healthcare information. This method incorporates a scanner for recording fingerprint from

which fingerprint data is derived. These data are further transmitted to a hand scan server that analyses and obtains the patient id respectively. This patient id transferred to the healthcare centers to obtain the information regarding the patients. This technique is mainly used at emergency situations which help the doctors or medical specialist to analyse the patient history [6]. In this methodology, SURF features extracted from the fingerprint patterns are used for the identification and template preparation of the patient whose record has to be stored and retrieved during emergency situations. Fingerprint biometric technology for the retrieval of medical data is used in this study with high accuracy rate.

## 2. METHODOLOGY

Fingerprint technology is applied to improve the security of authentication and to eliminate the inconvenience of private key management [7, 8]. Fingerprint patterns are recorded and analyzed to form templates. Based on the features extracted from the fingerprint patterns, template matching is performed to store and retrieve the medical data through an application. This application is designed in such a way that they are interfaced with the database to store all the details of the patient along with the template. As a result, retrieval of medical data is enacted with the help of fingerprint technology. The proposed methodology is defined below in figure 1.
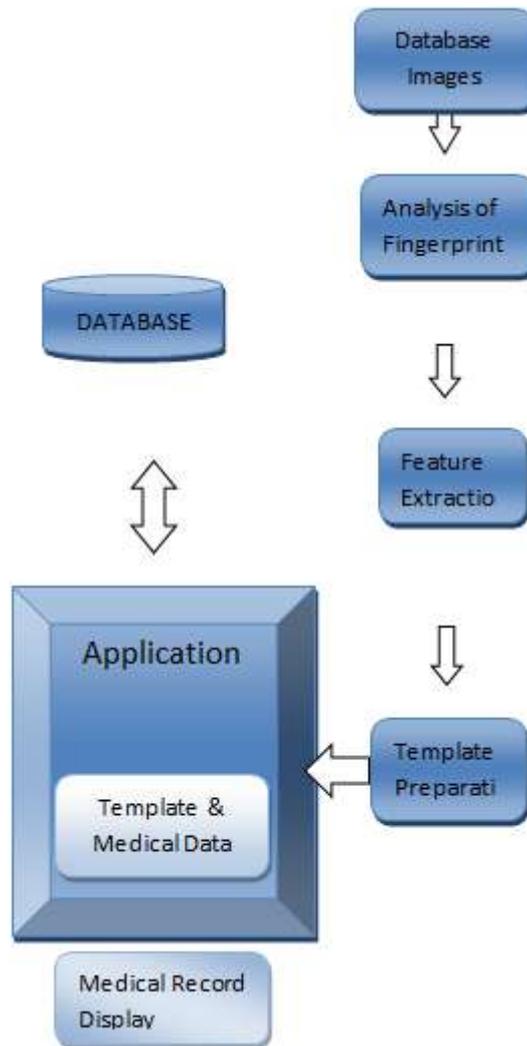
Fingerprint images are derived from the database for analysis. Vahid K. Alilou explained a simple approach or technique for fingerprint matching. This FingerPrint Application developed is demonstrated using the fingerprint images acquired by thumb impressions. These images are described in Math works and free to access. These images are used to illustrate the defined algorithm. From these images SURF features are determined for the process of template formation and matching.

### 2.1. Template Preparation

Database images are used first for the preparation of templates. In which the Speeded Up Robust Features (SURF), feature descriptors are extracted and valid points are defined in the fingerprint images. These descriptor points are further used in template matching. Speeded up robust features are descriptors used in computer technologies for object recognition, identification and detection. These algorithms mainly define the key points

in the corners, edges and blobs of the objects to describe the similar nature [9]. These features possess multiple scale variants.SURF features are approximated mask of second order derivative of Gaussian for an image with variant scales. This technique uses mask along and at 45 degrees to the axis making it more robust when compared with other techniques. These images consists of pixel values at (p, q) which is the summation of values in the rectangle described with the origin and pixel values. Images with any size can be computed easily. Template preparation and matching is performed with these SURF features [10].

### 2.2. Template Matching
Template matching process in which test image is compared with the templates formed. Comparison and matching is performed by the descriptor SURF points. Since fingerprint pattern is unique for each and every individual, range of the descriptor points varies respectively. Template matching is mainly to retrieve the data of the particular individual. The accuracy of template matching of fingerprint images is defined by the True Acceptance Rate and False Acceptance Rate [11, 12]. With these results SURF points described to be efficient.

### 2.3. Database
In this method, database is designed through local server for storage and retrieval of data. Medical records and the template formed are stored in the database through web application. This web application primarily performs the function of storing template which possesses the descriptor points. Medical data in provided are to be patient name, disease condition, age and so on many features can be added. Retrieval of the stored medical data is performed using the descriptor points. The input image is matched with the templates in the database for matching. If the template gets matched, the medical data is retrieved for diagnosis and treatment. Thus the algorithm provides high secured authentication for the medical records that protects the rights of the individuals.

### 3. RESULTS AND DISCUSSIONS
In this method, the fingerprint image and its patterns are defined by SURF feature descriptors. The descriptor and valid points of the fingerprint are extracted for the formation of templates. These templates are matched with the input image through descriptor points. An application is designed to upload the image feature details and the medical records to the database. Images derived from the database are used for the analysis by extracting the features and storing these image details in the database [13]. Further the same algorithm is applied for the real time images. Database images with the derived SURF features are illustrated in the figure 2 below.



Figure 2. Database images with SURF features

Database is designed for the storage of the feature descriptors of the fingerprint and medical data of the individual. This database is interfaced through local server for the transmission of data occurs through web application. Web application developed possesses factors for uploading both templates with descriptor points and medical data. Medical data includes patient id, name, age, gender and other physiological parameters. The web application and the database designed are shown below in figure 3 and figure 4.



**Figure 3. Web application to interlink Database**
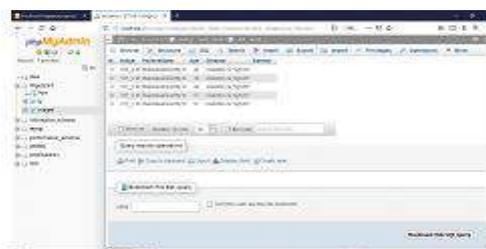


Figure 4. Database for storage and retrieval

Template matching is performed with the help of the SURF features. After the process of matching, the retrieval of data occurs through the web application from the database and displays the details of the individual with the help of the fingerprint technology. Template matching is defined below in the figure. Figure 5(a) illustrates that state when two fingerprints are matched and figure 5(b) represents the unmatched fingerprint images.



**Figure 5(a). Exact matching of the fingerprint templates**



**Figure 5(b). Image of unmatched fingerprint templates**

The rate of determining the true identity of the image is high. The efficiency of the algorithm in template matching is defined in the figure 6. This figure describes the parameters of efficiency for few images derived from the database. Efficiency of the template matching process is defined using parameters like True acceptance rate and false acceptance rate. These parameters define how far the matching is performed and how accurate it is. Since medical data is confidential, the retrieval technique or algorithm has to be high secured. With the results of the defined algorithm using SURF features illustrates that the efficiency of template matching is high and appropriate to identify the absolute user or individual. The proposed algorithm described to be efficient 91.75% of True acceptance rate.
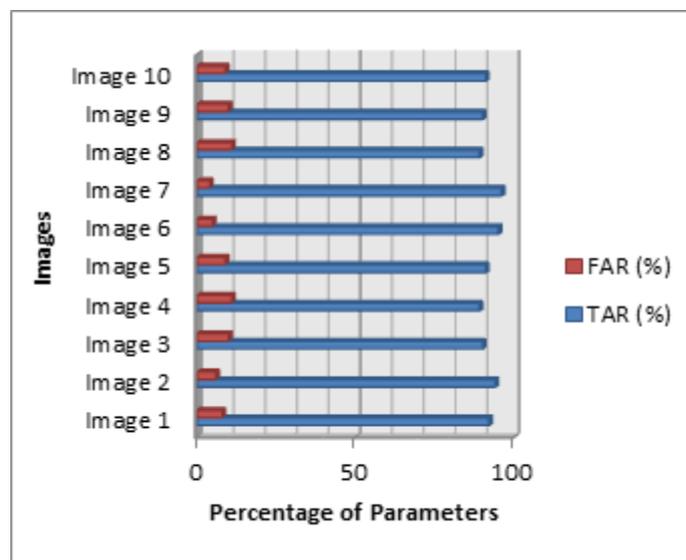


**Figure 6. Efficiency of the proposed algorithm**
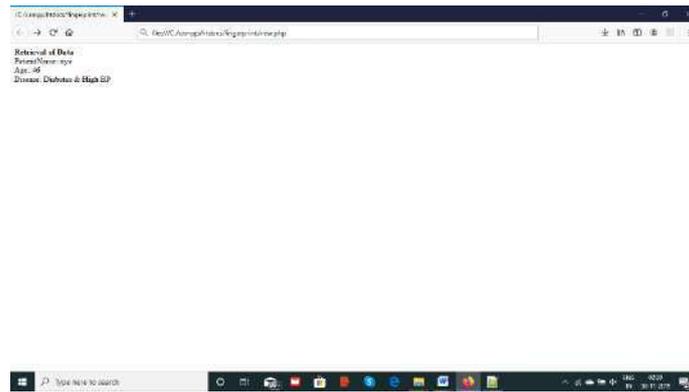
**Figure 7. Retrieval of Medical data**

Figure 7 represents the retrieved medical data which includes name, age and disease condition. Further parameters and criteria's can be added to the database for complete medical description of the patient. Thus the proposed algorithm uses SURF features for template preparation and matching of the fingerprint for the retrieval of the data from the database. The algorithm provides high security to the medical records or data.

## 4. CONCLUSION

Medical record or data authentication and security are necessary according to the laws and policies. The data's has to be secured and should be used by certain set of individuals [14]. Biometric system is effectively used in various fields as an authentication tool. This technology can be used to secure the medical data. Fingerprint technology is commonly used for its unique nature. Templates are formed for the fingerprints acquired from the individual's and stored in the database for further use [15]. Different techniques are applied for the preparation and matching of templates. In this algorithm defined Speeded Up Robust Features are described for the determination of templates. With these descriptor points, the template matching process is performed. Templates along with the medical details are stored in the database through web application with the help of local server process. Matching of the templates is performed using the SURF feature points and the data are retrieved in cases where the history of the patient is necessary. Thus the algorithm define possesses a high true acceptance rate of 91.75% that defines the efficiency of the proposed system. Later, in future real time images are acquired and the defined algorithm is applied for the template matching, data storage and retrieval [16, 17]. Thus this algorithm can be used for the storage and retrieval of medical data with high security.

## REFERENCES

[1] Dhiraj Sunchra, "Fingerprint Based biometric ATM Authentication System", International Journal of Engineering Inventions, vol. 3, no. 11, (2004), pp. 22-28.

[2] Nikhil pati, Girish kulkarini and Dhiraj patil, "Fingerprint Recognization for Library Mangement", (IJCEM) International Journal of computational Engineering & Management, Vol. 16, No. 1,( 2013), pp. 18-21.

[3] Barber B, "Patient data and security: an overview", International Journal of medical informatics, Vol. 49, No. 1, (1998), pp. 19-30.

[4] Hayrinen K, Saranto K and Nykanen P, "Health information system based on electronic medical records", Research Literature, Med Infop, (2008), pp. 291-304.

[5] Kardas G and Tunali ET, "Design and implementation of a smart card based health care information system", Computer methods and programs in Biomedicine, Vol. 81, No.1, (2006), pp. 66-785.

[6] Dharmendra sushil kumar(US2019/0244696) (WO2019150326) medical record management system with annotated patient images for rapid retrieval, (2019).

[7] Kavipriya,S., Renuka, C., Sajitha,V.,and Shalini, R, "Wearable biometric system for patient data acquisition", IJIRAE, Vol. 6, No. 3, (2016), pp. 110-113.

[8] Noah Kasiiti, Judy Wawira, Saptarshi Purkayastha and Martin C. Were, "Comparative Performance Analysis of Different Fingerprint Biometric Scanners for Patient Matching", MEDINFO 2017: Precision Healthcare through Informatics, International Medical Informatics Association (IMIA) and IOS Press, (2017), pp.1053-1057.

[9] Herbert Bay, Andreas Ess, Tinne Tuytelaars and Luc Van Gool, "Speeded-Up Robust Features (SURF)". Computer Vision and Image Understanding, Vol. 110, No. 3, (2008), pp. 346-359.

[10] Richard Guest and Oscar Miguel-Hurtado, "Enhancing static biometric signature verification using Speeded-Up Robust Features", IEEE International Carnahan Conference on Security Technology (ICCST), (2012), pp. 213-217. DOI: 10.1109/CCST.2012.6393561

[11] Ravi J, Raja K B and Venugopal. K. R, "Fingerprint Recognition Using Minutia Score Matching", International Journal of Engineering Science and Technology, Vol. 1, No. 2, (2009), pp. 35-42.

[12] Nathan J. Short, Michael S. Hsiao, A. Lynn Abbott and Edward A. Fox, "Latent Fingerprint Segmentation using Ridge Template Correlation", 4th International Conference on Imaging for Crime Detection and Prevention 2011 (ICDP 2011), (2011), pp.1-6. DOI: 10.1049/ic.2011.0125.

[13] Flores Zuniga, A.E. Win and K.T. Susilo, "Biometrics for Electronic Health Records", Journal of Medical Systems, vol.34, (2010), pp. 975-983.

[14] TR Thamizhvani, R Chandrasekaran, Josephin Arockia Dhivya A, Rithik Jain U, Mukundhan D and H Vasanth Kumar, " A review on biometric technology in healthcare", Indian Journal of Public Health Research & Development, Vol. 10, no.5, (2019), pp. 800-804.

[15] Tang K, Liu A, Wang W, Li P and Chen X, "A Novel Fingerprint Sensing Technology Based on Electrostatic Imaging", Sensors (Basel), Vol. 18, No. 9, (2018), pp. 3050.

[16] Vedanti suhas Mahulkar, Priyanka babu Kachare and Divya Jain, "Fingerprint Based Patient Information System", International Journal of Innovative Science and Research Technology, Vol. 2, No. 12, (2018), pp. 389-392.

[17] Mohsin, A.H., Zaidan, A.A., Zaidan, B.B, A. S. Albahri, O. S. Albahri, M. A. Alsalem and K. I. Mohammed, "Real-Time Remote Health Monitoring Systems Using Body Sensor Information and Finger Vein Biometric Verification: A Multi-Layer Systematic Review," J Med Syst, Vol. 42, (2018), pp. 238. https://doi.org/10.1007/s10916-018-1104-5

## RETINOBLASTOMA: A CHILDHOOD CANCER– A REVIEW

**Abirla M and Sowmya Hari***

Department of Bioengineering, Vels Institute of Science, Technology and Advanced Studies, Chennai, India

**ABSTRACT**

*Retinoblastoma is an ocular cancer which has been very common among children. Retinoblastoma is caused due to mutations in RB and MYCN genes. The mutations in parents are inherited to their children. The mutations can be hereditary and non-hereditary. Retinoblastoma can be in two cases, metastatic and non-metastatic. Metastatic type has been reported in many children. If retinoblastoma untreated it results in loss of vision. The chemotherapeutic drugs like vincristine, carboplatin and etoposide have given better reduction in tumor. When the tumor spreads to other parts like optic nerve, CNS and lymph node it leads to several difficulties in treating the cancer. So, modern therapies have been employed to cure retinoblastoma. RB can be unilateral and bilateral. The drug response of RB is based on its malignancy. The tumor within the eye can be cured and 95% of the patients have recovered. This review focuses in detail about the pathogenesis, symptoms, diagnosis and treatment options available for Retinoblastoma.*

*Keywords: Retinoblastoma, Chemotherapy, Metastasis, RB protein, mutation.*

**INTRODUCTION:**

Retinoblastoma is an eye cancer that develops in the retina. It develops mostly in children and rarer in adults. The age group affected is 0-4 yrs. Retinoblastoma is rare form of cancer that develops in early childhood due to genetic mutations. Retinoblastoma is characterised by abnormal cells in the retina which is a light detecting tissue of an eye (Figure 1). Retinoblastoma occurs in both cases either by hereditary genetic effects or through congenital mutation of chromosome 13 gene q14. Retinoblastoma is caused by to mutational events. In both hereditary and nonhereditary form of mutations from both germinal and somatic cell mutations. Sixty per cent of retinoblastoma is unilateral and most of these forms are not hereditary. Retinoblastoma is bilateral in 40% of cases. All bilateral and multifocal unilateral forms are hereditary (*Aerts I et al.2006*). An intact gene protects against expression of retinoblastoma. It is believed that the gene is a recessive suppressor gene and may play a role in cell growth and development. In order for retinoblastoma to develop, both copies of the gene at the 13q14 locus must be lost, deleted, mutated or inactivated. If either the maternal or paternal copy of the gene that is inherited by an individual is defective, then the individual will be heterozygous for the mutant allele. Tumor formation requires both alleles of the gene to be mutant or inactive. These two mutations correlate to the two hit theory proposed by Knudson.
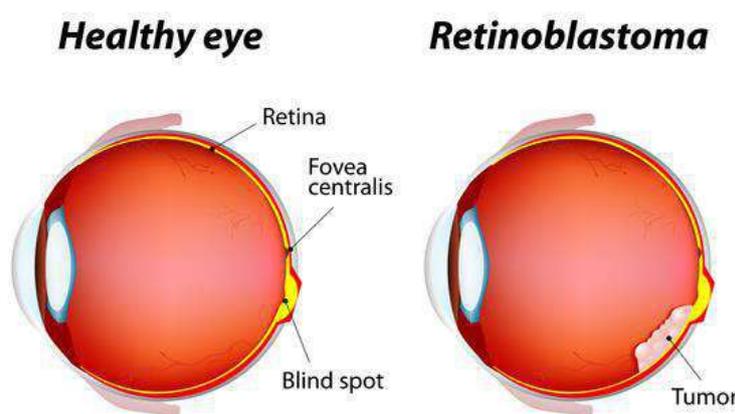


**Figure.1 The difference between healthy eye and affected eye.**

**Image source:https://ghr.nlm.nih.gov/condition/retinoblastoma**

**Retinoblastoma protein:**

The RB protein belongs to a pocket protein family is an oncogenic protein. pRB, the product of the retinoblastoma tumor suppressor gene, actively involved in cell cycle. Its main role is to act as a signal transducer connecting the cell cycle setup with the transcriptional machinery. In this role, pRB allows the entire

cell cycle process to control the expression of several genes that mediate advance of the cell through a critical phase of its growth cycle. Loss of pRB function deprives the cell cycle and the cell of an important mechanism for braking cell proliferation through modulation of gene expression. The RB pathway consists of five families of proteins, CDKN, D-type cyclins, cyclin dependent kinases, RB pocket proteins (RB, p107, and p130), E2F transcription factors. The RB pathway plays a crucial role in cell proliferation and has tumor suppressor activity. The alteration in this pathway will affect the tumor cell response to cytotoxic agents. Some analysis suggests that RB-pathway activation could be used therapeutically (Knudsen ES *et al* 2010). The RB1 was the first tumor suppressor gene discovered. The important role of RB is the regulation of cell cycle. After a cell undergoes mitosis, a phosphatase cleaves RB of additional phosphate groups. This dephosphorylated RB protein interacts with p107 and p130, to repress the promoter regions of genes producing E2F transcription factors. By blocking the E2F, the RB group of proteins inhibits the progression of cell cycle from G1 to S phase, in which the DNA replication occurs. In order for the cell to reach S phase the RB needs to be inactivated. This is done through the progressive phosphorylation of RB via CDK. The phosphorylated RB will not be able to inhibit the E2F, so that the cell can reach the S phase. The loss of RB1 is compensated by increased expression of its related proteins and the activation of multiple pathways leading to apoptosis. In certain susceptible cell lines, such as the cone cell precursors in the retina, these compensator mechanisms do not work effectively (*Shields CL et al.2019*)

**Symptoms:**

Leukocoria and strabismus are the common symptoms of retinoblastoma. Retinoblastoma is classified into familial or sporadic, bilateral or unilateral, heritable or non heritable, and germ line or somatic [2]. The earlier detection of retinoblastoma will provide better treatment for retinoblastoma patients. In advanced stage, loss of vision was the first symptom noticed in children. The present signs include inflammation, pain, discharge, heterochromia iridis (*Wirix M et al. 2000*). Identification of biomarkers has been contributing for retinoblastoma treatment. Knudson described the "two-hit" mechanism for tumorigenesis of retinoblastoma. Two active copies of the retinoblastoma gene are normally carried in human cells. Both copies have to be mutated for the development of retinoblastoma. The initial mutation inactivates one copy of the gene. This mutation may occur in somatic or germline cells. The second mutation occurs in somatic cells mostly due to the loss of heterozygosity. Retinoblastoma can be both intraocular and extraocular. The tumor can be diagnosed at earlier stages through family history. The age of diagnosis for children falls in 11months for bilateral and 5 months for unilateral. Usually retinoblastoma is diagnosed in advanced stage when the tumor spreads into outside the eye (*Abramson DH 1988*). The CT and MRI scan are used in diagnosing which helps to distinguish retinoblastoma from other lesions (*Arrigg PG et al. 1983*)
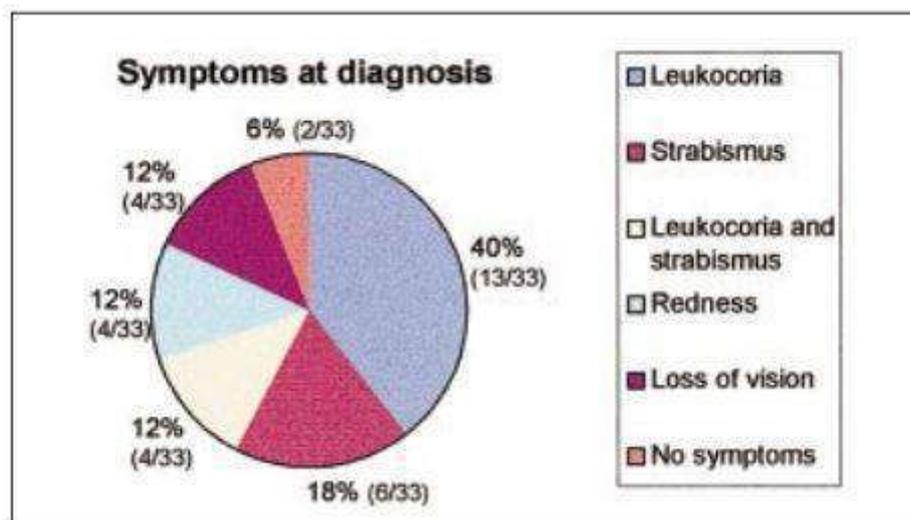


**Figure 2. Symptoms at diagnosis (*Wirix M et al. 2000*)**

**Metatasis of retinoblastoma:**

Retinoblastoma can metastasize into the regional parts of the eye, CNS, lymph nodes, bone and bone marrow (*Hungerford J. 1993*). It spread either by direct growth or through blood. Initially it spreads to vitreous humour, a fluid under retina. Sometimes it may spread through optic nerve and affects the brain. The extraocular retinoblastoma results in spread of cancer into the lymphatic system. Human retinoblastoma has four distinct patterns for its invasion and metastasis. The direct spread along the optic nerve to the brain, orbital tissue and

adjacent bone, the nasopharynx via the sinuses, or the cranium via the foramina is the first pattern. The second pattern was characterised by the Tumor cells that have invaded the optic nerve and leptomeninges and then disperse into the circulating subarachnoid fluid. This may occur even when there is no tumor detected at the cut end of the optic nerve. Through the circulating subarachnoid fluid, tumor cells can also reach the spinal cord, distant sites of brain, and the contralateral optic nerve. The third pattern of metastasis results in widespread of cancer cells into the lungs, bones, brain. The fourth pattern of metastasis, characterized by lymphatic spread, occurs when extraocular tumor invasion has occurred. Only tumors with these characteristics can spread via the lymphatic system, because there are no lymphatic vessels in the eye or orbit. Only the conjunctiva and eyelids have lymphatic drainage (*Ravishankar H et al.2019, MacKay CJ et al.1984, Finger PT et al.2002, Rodriguez-Galindo C et al.2003*). The WERI RB-1 cells are non-metastatic retinoblastoma cells that localize in the retina and conjunctiva. The NCC-Rb-51 is a metastatic retinoblastoma and has higher rates of proliferation and apoptosis and had better invasive ability (*Chan HS et al.2005, Kingston JE et al.1987*)

**Therapy:**
The retinoblastoma can be cured by chemotherapy if detected at earlier stages. Since the malignancy of bilateral retinoblastoma is higher it needs higher treatment like focal therapy, radiation therapy. Multidrug resistance has been common in retinoblastoma. Reports have shown that retinoblastoma has multidrug- resistance phenotype which in turn makes them restricted against the drugs. The multidrug resistance is induced by p-glycoprotein which leads to failure of chemotherapy and results in enucleation of eyes (*Abramson DH et al.1998*). The commonly employed drugs for chemotherapy are vincristine, carboplatin, etoposide, topotecan (*Doz F et al.1995*). Enucleation is the most common treatment for children with advanced retinoblastoma, because this approach prevents metastasis. The retinoblastoma when metastased into the other parts will not respond to the chemotherapeutic agents and bioactive agents. Based upon the RB cells' response to drugs, the chemotherapeutic drugs have been discovered. In progress platinum-DNA adducts were also employed to cure RB tumor (*Murphree AL et al. 1996*). Chemoreduction followed by adjuvant treatment has shown an ultimate control in the size of RB tumor and RB invasions into neighbouring parts of the eye (*Shields CL et al. 1997*). The other advanced therapies are brachytherapy, thermotherapy, cryotherapy, nanoparticulate chemotherapy, etc. The intravitreal and intraarterial chemotherapy approaches have given promising outcome post treatment (*Yanık O et al.2015*). Nano therapy has become a promising treatment in curing retinoblastoma. Several approaches in drug delivery at nano level were succeeded (*Gary-Bobo M et al.2015, Seregard, Arun D. Singh. 2012, Mitra M et al.2011, Bhavsar D et al. 2016*)

**Current status and future viewpoints:**
As of now patients with unilateral and non-metastatic retinoblastoma were cured by enucleation, several sessions of chemotherapy with combination of drugs i.e vincristine and carboplatin. Severe cases were patients with bilateral, extraocular or metastatic retinoblastoma. The drug response of retinoblastoma were low when it metastased into vitreous humor and optic nerve. To minimize these drawbacks advanced therapies have been employed as therapies. In India, about 10% of patients are affected by inherited retinoblastoma from their parents and 52% were affected by nonheritable retinoblastoma (*Dimaras H. 2015*). Retinoblastoma can be cured if it is in any form when diagnosed as earlier. The late diagnosis is due to lack of awareness and healthcare systems (*Rodriguez-Galindo C et al.2008, Madreperla SA et al 1991*). So in coming years the health care units need to be furnished, genetic testing can be done so that RB can be diagnosed as soon as possible and can be given treatment. This can prevent the children from enucleation of eye or loss of vision. At present, the retinoblastoma management have been implemented to provide patients a right treatment at the right period and measures have been taken to resolve the risks in treatment and diagnosis (*Chintagumpala M et al.2007, Rodriguez-Galindo C et al. 2007, Bakhshi S, Bakhshi R. 2007, Chantada GL et al.2007*)   In India the opportunities of research in retinoblastoma were high. The research has been going on in all the aspects to provide the suitable treatment to the children. Based on the strategies involved in treating a cancer, a therapy is designed being tested and implemented (*Kiran VS et al.2003, Singh J et al.2016, Kumar A et al.2013, Ramprasad VL et al. 2007, Rangamani S et al. 2015*). The treatment levels were successful in many developing countries. Cancer care centre implemented were focussed not only to treat the retinoblastoma also provides essential guidance, counselling and deals the problems associated with retinoblastoma (*Reddy VP et al.2007, ElZomor H et al. 2015, Moll AC et al.1997, Lin P, O'Brien JM. 2009*)

**CONCLUSION:**
There were many approaches have been implemented for curing retinoblastoma. Several researches have been carried out to study the entire pattern of this cancer and its treatment. Numerous chemotherapeutic drugs were discovered and being tested *in vitro* and *in silico* and employed for chemotherapeutic intervention. Although radiation therapies, nanoparticles based therapies were given for rare and severe cases. From years RB was

increasing among the population became common among children and people above 60 years. Based on the future perspectives appropriate solution will be found for the complete cure for this eye cancer.

**Conflicts of interests:**

The authors declare that they do not have any Conflicts of Interests.

**REFERENCES:**

1) Aerts I, Lumbroso-Le Rouic L, Gauthier-Villars M, Brisse H, Doz F, Desjardins L. Retinoblastoma. Orphanet journal of rare diseases. 2006 Dec 1;1(1):31.

2) Knudsen ES, Wang JY. Targeting the RB-pathway in cancer therapy. Clinical Cancer Research. 2010 Feb 15;16(4):1094-9.

3) Shields CL, Lally SE. Retinoblastoma. InOcular Oncology 2019 (pp. 91-99). Springer, Singapore.

4) Wirix M, Parys-Vanginderdeuren R, Casteels I, Uyttebrouck A. Delayed diagnosis of retinoblastoma. Bulletin de la Société belge d'ophtalmologie. 2000;278:37-42.

5) Abramson DH. The diagnosis of retinoblastoma. Bulletin of the New York Academy of Medicine. 1988 May;64(4):283.

6) Arrigg PG, Hedges TR, Char DH. Computed tomography in the diagnosis of retinoblastoma. British journal of ophthalmology. 1983 Sep 1;67(9):588-91.

7) Hungerford J. Factors influencing metastasis in retinoblastoma. The British journal of ophthalmology. 1993 Sep;77(9):541.

8) Chévez-Barrios P, Hurwitz MY, Louie K, Marcus KT, Holcombe VN, Schafer P, Aguilar-Cordova CE, Hurwitz RL. Metastatic and nonmetastatic models of retinoblastoma. The American journal of pathology. 2000 Oct 1;157(4):1405-12.

9) Ravishankar H, Mangani AS, Shankar MB, Joshi M, Devasena T, Parameswaran S, Subramaniam K. Characterization of NCC-RbC-51, an RB cell line isolated from a metastatic site. Histochemistry and cell biology. 2019 Nov 28:1-9.

10) MacKay CJ, Abramson DH, Ellsworth RM. Metastatic patterns of retinoblastoma. Archives of ophthalmology. 1984 Mar 1;102(3):391-6.

11) Finger PT, Harbour JW, Karcioglu ZA. Risk factors for metastasis in retinoblastoma. Survey of ophthalmology. 2002 Jan 1;47(1):1-6.

12) Rodriguez-Galindo C, Wilson MW, Haik BG, Lipson MJ, Cain A, Merchant TE, Kaste S, Pratt CB. Treatment of metastatic retinoblastoma. Ophthalmology. 2003 Jun 1;110(6):1237-40.

13) Chan HS, Gallie BL, Munier FL, Beck MP. Chemotherapy for retinoblastoma. Ophthalmology clinics of North America. 2005 Mar;18(1):55-63.

14) Kingston JE, Hungerford JL, Plowman PN. Chemotherapy in metastatic retinoblastoma. Ophthalmic paediatrics and genetics. 1987 Jan 1;8(1):69-72.

15) Abramson DH, Frank CM, Susman M, Whalen MP, Dunkel IJ, Boyd III NW. Presenting signs of retinoblastoma. The Journal of pediatrics. 1998 Mar 1;132(3):505-8.

16) Doz F, Neuenschwander S, Plantaz D, Courbon B, Gentet JC, Bouffet E, Mosseri V, Vannier JP, Mechinaud F, Desjardins L. Etoposide and carboplatin in extraocular retinoblastoma: a study by the Société Française d'Oncologie Pédiatrique. Journal of clinical oncology. 1995 Apr;13(4):902-9.

17) Murphree AL, Villablanca JG, Deegan WF, Sato JK, Malogolowkin M, Fisher A, Parker R, Reed E, Gomer CJ. Chemotherapy plus local treatment in the management of intraocular retinoblastoma. Archives of ophthalmology. 1996 Nov 1;114(11):1348-56.

18) Shields CL, Shields JA, Needle M, De Potter P, Kheterpal S, Hamada A, Meadows AT. Combined chemoreduction and adjuvant treatment for intraocular retinoblastoma. Ophthalmology. 1997 Dec 1;104(12):2101-11.

19) Yanık Ö, Gündüz K, Yavuz K, Taçyıldız N, Ünal E. Chemotherapy in retinoblastoma: current approaches. Turkish journal of ophthalmology. 2015 Dec;45(6):259.

20) Gary-Bobo M, Mir Y, Rouxel C, Brevet D, Hocine O, Maynadier M, Gallud A, Da Silva A, Mongin O, Blanchard-Desce M, Richeter S. Multifunctionalized mesoporous silica nanoparticles for the in vitro treatment of retinoblastoma: drug delivery, one and two-photon photodynamic therapy. International journal of pharmaceutics. 2012 Aug 1;432(1-2):99-104.

21) Seregard, Stefan, and Arun D. Singh. "Retinoblastoma: direct chemotherapeutic drug delivery into the vitreous cavity." (2012): 473-474.

22) Mitra M, Dilnawaz F, Misra R, Harilal A, Verma RS, Sahoo SK, Krishnakumar S. Toxicogenomics of nanoparticulate delivery of etoposide: potential impact on nanotechnology in retinoblastoma therapy. Cancer nanotechnology. 2011 Dec 1;2(1-6):21-36.

23) Bhavsar D, Subramanian K, Sethuraman S, Krishnan UM. Management of retinoblastoma: opportunities and challenges. Drug delivery. 2016 Sep 1;23(7):2488-96..

24) Dimaras H. Retinoblastoma genetics in India: From research to implementation. Indian journal of ophthalmology. 2015 Mar;63(3):219.

25) Rodriguez-Galindo C, Wilson MW, Chantada G, Fu L, Qaddoumi I, Antoneli C, Leal-Leal C, Sharma T, Barnoya M, Epelman S, Pizzarello L. Retinoblastoma: one world, one vision. Pediatrics. 2008 Sep 1;122(3):e763-70.

26) Madreperla SA, Whittum-Hudson JA, Prendergast RA, Chen PL, Lee WH. Intraocular tumor suppression of retinoblastoma gene-reconstituted retinoblastoma cells. Cancer research. 1991 Dec 1;51(23 Part 1):6381-4.

27) Chintagumpala M, Chevez-Barrios P, Paysse EA, Plon SE, Hurwitza R. Retinoblastoma: review of current management. Oncologist. 2007 Oct 1;12(10).

28) Rodriguez-Galindo C, Chantada GL, Haik BG, Wilson MW. Treatment of retinoblastoma: current status and future perspectives. Current treatment options in neurology. 2007 Jul 1;9(4):294.

29) Bakhshi S, Bakhshi R. Genetics and management of retinoblastoma. Journal of Indian Association of Pediatric Surgeons. 2007 Jul 1;12(3):109.

30) Chantada GL, Qaddoumi I, Canturk S, Khetan V, Ma Z, Kimani K, Yeniad B, Sultan I, Sitorus RS, Tacyildiz N, Abramson DH. Strategies to manage retinoblastoma in developing countries. Pediatric blood & cancer. 2011 Mar;56(3):341-8.

31) Kiran VS, Kannabiran C, Chakravarthi K, Vemuganti GK, Honavar SG. Mutational screening of the RB1 gene in Indian patients with retinoblastoma reveals eight novel and several recurrent mutations. Human mutation. 2003 Oct;22(4):339-.

32) Singh J, Mishra A, Pandian AJ, Mallipatna AC, Khetan V, Sripriya S, Kapoor S, Agarwal S, Sankaran S, Katragadda S, Veeramachaneni V. Next-generation sequencing-based method shows increased mutation detection sensitivity in an Indian retinoblastoma cohort. Molecular vision. 2016;22:1036.

33) Kumar A, Moulik NR, Mishra RK, Kumar D. Causes, outcome and prevention of abandonment in retinoblastoma in India. Pediatric blood & cancer. 2013 May;60(5):771-5.

34) Ramprasad VL, Madhavan J, Murugan S, Sujatha J, Suresh S, Sharma T, Kumaramanickavel G. Retinoblastoma in India. Molecular diagnosis & therapy. 2007 Jan 1;11(1):63-70.

35) Rangamani S, SathishKumar K, Manoharan N, Julka PK, Rath GK, Shanta V, Swaminathan R, Rama R, Datta K, Mandal S, Koyande S. Paediatric retinoblastoma in India: evidence from the national cancer registry programme. Asian Pac J Cancer Prev. 2015;16:4193-8.

36) Reddy VP, Honavar SG, Shome D, Shah K, Naik MN, Rao R. Demographics, clinical profile, management, and outcome of retinoblastoma in a tertiary care center in southern India. Journal of clinical oncology. 2007 Jun 20;25(18_suppl):20011-.

37) ElZomor H, Taha H, Aleieldin A, Nour R, Zaghloul MS, Fawzi M, Kamel A, Alfaar AS. High risk retinoblastoma: prevalence and success of treatment in developing countries. Ophthalmic genetics. 2015 Jul 3;36(3):287-9.

38) Moll AC, Imhof SM, Bleeker-Wagemakers EM, Ottera WD, Bouter LM, Koten JW, Tan KE. Prevalence of mental retardation in patients with hereditary retinoblastoma. Ophthalmic genetics. 1997 Jan 1;18(4):217-20.

39) Lin P, O'Brien JM. Frontiers in the management of retinoblastoma. American journal of ophthalmology. 2009 Aug 1;148(2):192-8.

## CELLULOSIC-ACRYLIC POLYMER BLEND IN DRUG DELIVERY ACROSS SKIN

**Saumyajyoti Das\*, Prasenjit Sarkar and Sutapa Biswas Majee**

Division of Pharmaceutics, Department of Pharmaceutical Technology, NSHM Knowledge Campus, Kolkata-Group of Institutions, 124 BL Saha Road, Kolkata 700 053, West Bengal, India

## ABSTRACT

*Delivery of drugs through the skin has been always a challenging area for research due to barrier properties exhibited by the outermost layer of skin. One of the most popular strategy to overcome the barrier property of skin is termed as Transdermal drug delivery system(TDDS). These drug delivery systems in the form of transdermal patches have been designed as an alternative route for drug delivery directly into blood stream. The drug delivery through skin holds several advantages such as maintenance of constant drug level in blood thereby minimizing side effects, improvement of extent of absorption of drug into blood stream by circumventing hepatic first pass metabolism and minimizing wastage of drugs. Polymers play a crucial role in modulating the drug release from transdermal patches. It has been observed that a single polymer is not capable of controlling the rate of release of drug from patch for a prolonged period of time. Polymer blends enable effective and desired modulation of drug release from patches. Polymers employed in fabrication of TDDS can be either Natural, synthetic or Semi-synthetic. The outlook for continued growth of the TDDS market is very optimistic. It is essential to have sufficient knowledge on the properties of the different polymers so as to select the ideal combination of polymers for the design and development of transdermal patches. The present article assembles the comprehensive information on various types of polymers being used for the development of transdermal patches, rational behind the use of combination of polymers with a special emphasis on cellulosic-acrylic polymer blend for the development of transdermal patches.*

*Keywords : Drug, Polymer, Polymer blend, transdermal patch, cellulosic-acrylic polymer blend.*

## INTRODUCTION

Drug is a chemical entity that is used or intended to be used to modify or explore physiological system or pathological states for the benefit of the patient. There are several routes of drug administration, oral route being the most common one. Among various routes, drug delivery across the skin is very unique and it offers several advantages over other routes of drug administration. There is a phenomenon called hepatic first pass metabolism in which drugs administered by oral route undergo extensive metabolism in liver before reaching into systemic circulation, thereby producing sub-optimal therapeutic effects. In this context, drug delivery across skin offers several advantages which include avoidance of hepatic first pass metabolism, maintenance of drug in blood at constant levels for longer period of time which in turn can reduce the frequency and number of doses to be administered[1-3]. Moreover, drug delivery across skin also enables decreased gastro-intestinal side effects, increased patient compliance providing greater advantage in patients who are nauseated or unconscious. Relatively larger surface area of skin provides better absorption of drug into systemic circulation as compared to buccal or nasal cavity. These features of drug delivery across skin also minimize drug wastage in comparison to oral route. Additional advantages of this particular route of drug administration include self-administration and painless mode of drug delivery. This strategy or technology which is implemented to facilitate the drug delivery across skin is termed as " Transdermal drug delivery system"(TDDS)[4]. In 1979, the US Food and Drug Administration (FDA) approved the first transdermal patch for scopolamine in treatment of motion sickness. One of the most common examples of such system is Nicotine patch (Habitrol®, manufactured by Dr. Reddy's Laboratories, dose delivered is 5-22 mg in 16-24 h) which is very effective for smoking cessation. Nicotine patches act as a replacement for cigarettes, cigar and other nicotine containing products. They act by slowly releasing small amounts of nicotine to curb cravings. Transdermal therapy is a preferred alternative where long-term treatment is required, such as in chronic pain treatment, hormone replacement therapy, management of hypertension, Parkinsonism, Alzheimers's disease etc.

The transdermal drug delivery system market was valued at US\$ 6,063.85 million in 2019 and is projected to reach US\$ 8,415.04 million by 2027[5,6]. The expansion of transdermal drug delivery market is mainly attributed to factors such as the increasing prevalence of chronic diseases, growing demand for non-invasive drug delivery devices and high demand for self- administration of drugs. All the above mentioned demands can be successfully fulfilled through continuous improvement of the transdermal drug delivery technique. The present article aims to enrich the readers with knowledge about a specific group of polymer blends used for delivery of drug across skin.

## Basic components of transdermal patch

The basic components of transdermal patches include backing layer, adhesive, drug, polymer, solvents, penetration enhancer and plasticizer[2,3]. Drug is entrapped in the polymer, which controls the release rate of drug. Penetration enhancers are incorporated to increase drug transport through skin. Plasticizers are added to provide flexibility[4]. Polymers are the back bone of the transdermal patches and play a very crucial role in controlling drug release from the transdermal patch. Polymers enable the slow release of drug for a prolonged period of time. This prolonged release of drug from the patch leads to the slow or prolonged absorption of drug through the skin barrier into systemic circulation[7]. In this manner, the transdermal patches can elicit the therapeutic action for longer period of time. So the common tendency of missing of doses by mistake can be minimized. Some of the commercially available popular transdermal patches, drug incorporated therein, doses and clinical indication have been listed in Table 1.

### TABLE 1 : Various transdermal patches approved by US FDA[8]

| Drug incorporated | Brand name | Dose delivered | Clinical indication |
|---|---|---|---|
| Clonidine | Catapres-TTS® | 0.7-2.1 mg in 7 days | Hypertension |
| Scopolamine | Transderm -Scop® | 1.0 mg in 3 days | Motion sickness |
| Ethinyl oestradiol(EO) + Norelgestromin(N) | Ortho-Evra® | 0.14 mg EO and 1.05 mg N in 7 days | Contraceptive |
| Fentanyl | Duragesic® | 1.8-7.2 mg in 3 days | Analgesia |
| Lidocaine | Lidoderm® | 10-32 mg in 12 hrs. | Post-hepatic neuralgia |
| Nitroglycerine | Nitro-Dur®, Transderm-Nitro® | 1.2-11.2 mg in 12-14 hrs | Angina |
| Oestradiol (O)+ Norethindrone (N) | Combipatch® | 0.15-0.20 mg O and 0.42-1.0 mg N in 3-4 days | Hormone replacement therapy |

## Polymers used in development of transdermal patches

A wide range of polymer can be used for the fabrication of transdermal patches. These polymers can be categorized into three groups based on their nature of origin viz., Natural polymers, Synthetic polymers and Semi-synthetic polymers. Examples of Natural polymers include xanthan gum, sodium alginate, chitosan, mucilage of *Ficus carica* fruit etc[10-12]. These natural polymers are found to be suitable in the development of transdermal patches owing to their non- irritating and non-toxic properties and its compatibility with skin. Increased popularity of chitosan as natural polymer in the field of transdermal drug delivery may be attributed to its exceptional properties including non-cytotoxicity, biocompatibility, non-allergenic behavior and the film forming ability. Examples of Synthetic polymers include polyvinyl alcohol, polyvinylpyrrolidone, polymethylmethacrylate etc. Examples of Semi-synthetic polymers include hydroxy propyl methyl cellulose (HPMC), ethyl cellulose (EC), etc[1-4].

## Rationale behind the use of polymer blend

It is evident that the use of blend of polymer leads to the creation of several diffusion pathways to achieve desired slow and steady drug release from patches as compared to the use of single polymer. In case of patches containing only hydrophilic polymer, there may be rapid release of high percentage of drug (burst effect) which hinders controlling the rate of release of drug over prolonged duration[13,14]. This rapid and sudden release of drug within a very short duration results in unwanted accumulation of drug in systemic circulation there by leading to toxic effects which sometimes becomes fatal and difficult to tackle. Alternatively, the use of only hydrophobic polymer leads to insufficient drug release from patch. It is quite obvious that if the drug release is not sufficient enough from the patches containing only hydrophobic polymer, the absorption of the drug through skin will also be insufficient leading to sub-optimal therapeutic effect. Therefore, it is evident that a balance between hydrophilicity and hydrophobicity of polymer is essential for effective modulation of drug release from patches and thus an optimum combination of hydrophilic and hydrophobic polymer is required[14].

The various polymer blends that have been employed to fabricate transdermal patches include HPMC-EC, HPMC-Eudragit, EC-PVP, Chitosan-alginate, Eudragit RL100-Eudragit RS100, Eudragit-PVP, etc[15-27].

## Cellulosic-acrylic polymer blends in drug delivery across skin

Among various cellulosic polymers, HPMC is widely used to fabricate transdermal patches because of its film forming ability. Synthesis of HPMC comprises the following steps. The first step is termed as "Independent alkalization" which involves the addition of 7-8 parts of caustic soda flakes into a diluting agent system in an alkalization kettle; followed by heating at 70-80 ºC and then lowering temperature to 10-25ºC; and finally 8-9

parts of refined cotton is added into the alkalization kettle and keeping the temperature constant at 10-25ºC for 2-3 hours; Finally acetic acid is added into a reactor for neutralization to obtain the HPMC. HPMC is a hydrophilic polymer and has been shown to yield clear films because of the adequate solubility of polar drug in the polymer. HPMC can be hydrated easily, it also exhibits swelling property that favors the fast release of the drug from the patch. Drug release occurs via the process of diffusion in case of transdermal patches. Diffusion is naturally a probabilistic process described by the random walk of molecules. The polymeric structure has a strong influence on the diffusivity as the motion of a small molecule is restricted by the three dimensional network of polymer chains. When the patch comes into contact with skin fluid, the fluid is absorbed into the polymeric structure and swelling occurs due to hydrophilic nature of HPMC. This initiates HPMC polymeric chain relaxation process. Relaxation involves two distinguishable steps. The first step involves changes in entanglement of individual polymer chains that depends on the rate of hydration. The second step involves the diffusion of drug molecules through the disentangled polymeric structure into the blood stream thereby crossing the skin barriers[22].

Different grades of HPMC are available such as HPMC K4M, HPMC K15M, HPMC K 100M, HPMC E15 LV etc. and they differ on the basis of their molecular weight and viscosity range. K indicates gelling temperature which is found to be in the range of 70-90℃. The viscosity in case of HPMC K4M is found to be 4000 cps. Among these, HPMC K4M and K15M have been studied in development of transdermal patches[23]. HPMC K100M is generally not preferred because of its inability to form suitable transparent durable film. Films made up of HPMC K 100M are found to be brittle, fragile, translucent and do not possess sufficient mechanical strength suitable for fabrication into patch. The most commonly available brand for HPMC is METHOCEL® manufactured by "The Dow Chemical Company".

Acrylic acid polymers that are commonly investigated for their suitability in drug delivery across skin include Eudragits. Eudragits are copolymers of methacrylic acid which can be either water-soluble such as Eudragit L,S, FS , and E and insoluble ones like Eudragit RS, RL. Eudragit RL 100, Eudragit RS 100, S100 etc. have been used to formulate transdermal patches[24].

Eudragit polymers are cationic, anionic or non-ionic polymers of dimethyl aminoethyl methacrylates, methacrylic acid, and methacrylic acid esters in varying ratios. The films produced by Eudragit polymers are elastic, self-adhesive, transparent, and flexible in nature. They have the potential to form wrinkle-free transparent films with good adhesion to skin. Release of drug from Eudragit-based patches occurs via erosion. Moreover, Eudragit polymers possess an inherent feature to delay the drug release profile thereby, controlling the rate of drug release for prolonged period of time. Due to these above mentioned inherent physicochemical properties as well as influence on drug release profile from patches, Eudragit polymers are used to fabricate transdermal patches. Eudragit RL100 has been reported to facilitate drug release from patches compared to ERS 100. ERL 100 contains higher proportion of hydrophilic quaternary ammonium group which is responsible for the swelling of the film and the generation of high ionic repulsive force with the incorporated ionized drug molecule thereby, enhancing the diffusivity and the corresponding release profile of drug from patches. In this context, combination of cellulosic-acrylic polymer has been found to be very effective to modulate the drug release in slow and steady manner[24].

The most commonly employed method of transdermal patch formulation is solvent evaporation method[25]. In this method the backing membrane is prepared by pouring PVA solution on mould followed by drying. Then the drug-polymer dispersion containing plasticizer and permeation enhancer is poured and cast on to the PVA backing membrane followed by drying to form the film or patch. The prepared patches are stored in desiccator until further use. Various evaluation tests such as moisture content, moisture uptake, folding endurance, percentage flatness, in vitro drug permeation, in vitro drug release are carried out to check the critical quality attributes of transdermal patches[25-27].

Vijaya et al. (2012) formulated amitriptyline hydrochloride matrix patches involving Eudragit RL100 and HPMC polymers. Dibutyl phthalate was used as a plasticizer. The data obtained from in vitro drug release study revealed that the patch containing Eudragit RL 100 and HPMC at ratio of 2:1 produced highest drug release of 98 ±1.03% in 24 h. Drug release followed Higuchi model which means the percentage cumulative of drug release is directly proportional to square root of time[20]. Thenge et al. (2010) formulated matrix type transdermal patch of lercanidipine using Eudragit RS 100 – HPMC and Eudragit RS 100 – EC. In this study, propylene glycol was used as penetration enhancer and di butyl phthalate was used as plasticizer. Eudragit RS 100 – HPMC (at a ratio of 3:7) patches released 96.23 % of drug over a period of 24 hours following zero order kinetics[28]. Gannu et al. (2007) formulated nitrendipine matrix patches composed of blend of Eudragit RL 100 and hydroxypropyl methyl cellulose in the ratios of 5:0, 4:1, 3:2, 2:3, 1:4 and blend of Eudragit RS 100 and

hydroxypropyl methyl cellulose in the same ratios. All formulations contained 6 % v/w of carvone as penetration enhancer and 15% v/w of propylene glycol as plasticizer. The formulation containing ERL100 : HPMC at a ratio of 2:3 exhibited highest cumulative drug permeation of 2300 µg/cm$^2$ in 24 hrs. Moreover, the in vitro drug release study revealed highest cumulative percentage of drug release of 89.29% in 24 h[29]. Shafique *et al.* (2021) attempted to develop a transdermal drug delivery system (TDDS) containing ketoprofen (KTF) and pregabalin (PGB). In this study, hydrophilic polymer (HPMC) and hydrophobic polymers (Eudragit L-100 and ethyl cellulose) were employed for the formulation of transdermal patches. Propylene glycol and oleic acid were used as permeation enhancer and PEG-400 was employed as a plasticizer. In vitro drug permeation studies exhibited more than 97% and 95% release of PGB and KTF, respectively. Moreover, this study also revealed that in case of pregabalin patches containing HPMC and EC, higher permeation was observed when the proportion of HPMC was kept higher than the EC. Similarly, the patches containing HPMC and Eudragit L-100 exhibited higher permeation when the proportion of Eudragit L-100 was kept lower as compared to that of HPMC. Similar pattern was observed with release of ketoprofen from the two types of patches [30]. Kusum devi *et al.* (2003) formulated transdermal patches of verapamil by employing ERL100 and HPMC at various ratios. Dibutyl phthalate was used as plasticizer. It was observed that patch containing ERL 100 : HPMC at 8:2 exhibited highest drug release of 94.02 % in 24 h[31]. Joshi *et al.* (2021) formulated flurbiprofen transdermal patches by employing different ratio of HPMC K15M and ERL100. Di butyl phthalate was used as plasticizer and d-limonene was used as penetration enhancer. Drug permeation study revealed that patch containing HPMC K15M: ERL100 in the ratio of 3:1 exhibited highest cumulative amount of drug permeation (468.97 µg/cm$^2$ ) in 24 h[32].

## CONCLUSION

Polymers play an important role in development of transdermal patches in delivery of drug across skin. However, one factor that has to be kept in mind while formulating the patches is that one of the polymer in the polymeric blend should be of hydrophilic in nature and the other one should be hydrophobic for effective control on the rate of drug release for a prolonged period of time. An optimum combination of cellulosic(HPMC)-acrylic(Eudragit) polymeric blend has been reported to achieve satisfactory control on the rate of drug release.

## REFERENCES

1.  Tanwar H, Sachdeva R. Transdermal drug delivery system : A review. Int J Pharm Sci Res. 2016;7(6):2276-2278

2.  Alkilani Z, Maeliosa TC, Donnelly R *et al*. Transdermal drug delivery: Innovative pharmaceutical developments based on disruption of the barrier properties of the stratum corneum. MDPI Pharmaceutics . 2015;7(6) : 439-441.

3.  Alexandar A, Dwivedi S, Giri  T *et al*. Approaches for breaking the barriers of drug permeation through transdermal drug delivery . J Contr Rel. 2012;7(3):29-33.

4.  Aulton ME. Aulton's Pharmaceutics: The Design and Manufacture of Medicines.3$^{rd}$ ed. London, UK K. Taylor;2007.

5.  Brown MB, Martin GP, Jones SA, Akomeah FK. Dermal and transdermal drug delivery systems: Current and future prospects of drug delivery. Drug Delivery. 2006;13(3)3:175-187.

6.  Guy RH. Current status and future prospects of transdermal drug delivery. Pharm Res. 1996;13(12):1765-1769.

7.  Amnuaikit C, Ikeuchi I, Ogawara K, *et al*. Skin permeation of propranolol from polymeric film containing terpene enhancers for transdermal use. Int J Pharm. 2005;289:167-178.

8.  Y.W. Chien, "Transdermal Therapeutic Systems," in Controlled Drug Delivery: Fundamentals and Applications.2$^{nd}$ ed. New York J.R. Robinson and V.H.L. Lee;1987.

9.  Davis SS, Illum L. Drug delivery systems for challenging molecules. Int J Pharm.1998;176: 1–8.

10. Ahad  HA, Kumar CS, Ravindra BV, *et al*. Characterization and permeation studies of diltiazem hydrochloride- *Ficus reticuleta* fruit mucilage transdermal patches. Int J Pharm Sci Rev Res. 2010;1:32-37.

11. Abdul AH, Suresh KC, Kumar BA *et al*. Permeation studies of diclofenac sodium from *Ficus carica* fruit mucilage matrices for transdermal delivery. Int J Chem Tech Res. 2010; 2(2): 937–941.

12. Rana Abu-Huwaij, Rana M. *et al.* Formulation and in vitro evaluation of xanthan gum or Carbopol 934-based mucoadhesive patches, loaded with nicotine. AAPS Pharm SciTech. 2011;12(1):21-27.

13. Gorle AP, Pawara IT, Achaliya AP. Design, development and evaluation of transdermal drug delivery system of antipyretic agent. Int J Pharm Res Heal Sci. 2017;5(4):1743-1749.

14. Pathan S, Sahoo K, Khatri K. *et al.* Development, characterization, in vitro and ex vivo evaluation of antiemetic transdermal patches of ondansetron hydrochloride and dexamethasone. GSC Biol Pharm Sci. 2021;14(3):68–70.

15. Takmaz EA, Inal O. *et al.* Studies on transdermal delivery enhancement of zidovudine. AAPS Pharm SciTech. 2009;10(1):88-96.

16. Parthasarathy G, Reddy KB. *et al.* Formulation and characterization of transdermal patches of naproxen with various polymers. Int J Comprehensive Pharm. 2011;6(7):1-3.

17. Ramadan E, Borg T. Design and in vivo pharmacokinetic study of a newly developed lamivudine transdermal patch. Future J Pharm Sci. 2018;11:1-4.

18. Prabhakara P, Koland M *et al.* Preparation and evaluation of transdermal patches of papaverine hydrochloride. Int J Res Pharm Sci. 2010;1(3):259-266.

19. Vijayan V, Sumanth MH. *et al.* Development and physiochemical, in-vitro evaluation of antihypertensive transdermal patches. J Pharm Sci Res. 2010;2(3):171-177.

20. Vijaya R, Sureshkumar S. *et al.* Preparation of amitriptyline hydrochloride films using Eudragit RL 100 and hydroxy propyl methyl cellulose polymers and their in-vitro evaluation for effective transdermal delivery. Int J Life Sci Pharm Res. 2012;2(2):7-14.

21. Guyot M, Fawaz F. Design and In vitro evaluation of adhesive matrix for transdermal delivery of propranolol. Int J Pharm. 2000;204:171–182.

22. Akhtar N, Singh V, Khan R. *et al.* Non-invasive drug delivery technology: Development and current status of transdermal drug delivery devices, techniques and biomedical applications. Biomed Engg Biomed Technol. 2020;65(3):245–248.

23. Patel T, Gupta K, Khan S. *et al.* Formulation and evaluation of transdermal patch of repaglinide. Int J Pharm Sci Res. 2017;7(6):45-55.

24. Chandak A, Verma P. Eudragit- based transdermal delivery system of pentazocine: Physico-chemical , in vitro and in vivo evaluations. Int J Pharm Sci. 2015;6(2):10-12.

25. Arora P, Mukherjee B. Design, development, physicochemical, and in vitro and in vivo evaluation of transdermal patches containing diclofenac diethyl ammonium salt. J Pharm Sci. 2015;91(9):2081-2088.

26. Mukherjee B, Mahapatra S, Gupta R. *et al.* A comparison between povidone-ethyl cellulose and povidone-Eudragit transdermal dexamethasone matrix patches based on in vitro skin permeation. Eur J Pharm Biopharm. 2005;59(2):478-483.

27. Yousuf M, Ahmad M, Naeem M. *et al.* Development and in vitro evaluation of polymeric responsive release matrix type transdermal patches of anti-asthmatic drugs. Iran J Sci Technol. 2020;10(2):5-8 .

28. Thenge R, Mahajan K, Sawarkar G. *et al.* Formulation and evaluation of transdermal drug delivery system of lercanidipine hydrochloride. Int J Pharm Tech Res 2010;2(1):256-258.

29. Gannu R, Vishnu VY. *et al.* Development of nitrendipine transdermal patches: In vitro and ex vivo characterization. Curr Drug Deliv. 2007;4:69-76.

30. Shafique N, Siddiqui T. *et al.* Transdermal patch, co-loaded with pregabalin and ketoprofen for improved bioavailability;In vitro studies. Polymer Polymer Composites. 2021;10:1-13.

31. Kusum Devi V, Saisivam S *et al.* Design and evaluation of matrix diffusion controlled transdermal patches of verapamil hydrochloride. Drug Dev Ind Pharm. 2003;29(5):495–503.

32. Joshi R, Garud N. Development, optimization and characterization of flurbiprofen matrix transdermal drug delivery system using Box–Behnken statistical design. Future J Pharm Sci. 2021;7:2-18.

## A REVIEW ON ESSENTIAL OILS FOR PAIN MANAGEMENT AND ITS APPLICATION ON TEXTILE MATERIALS

**Shivangi Agarwal[1] and Dr. Shalini Juneja[2]**

[1]Research Scholar and [2]Associate Professor, Department of Home Science, Banasthali Vidyapith, Rajasthan, India

**ABSTRACT**

*Muscular pain is a recognized medicinal problem resulting in further non-communicable disease which is widely increasing throughout the world. Muscle soreness may emerge due to infections of the soft tissues, overexertion, inflammatory conditions or injury. There are wide varieties of medicinal plants which help in combating muscular pain. The medicinal plants are used in the form of plant extract or essential oils. Camphor, eucalyptus, lemongrass, clary sage, peppermint, etc. are some essential oils used for relieving muscular pain. Essential oils are used in aromatherapy as a main therapeutic agent. Aromatherapy is derived from the word aroma and therapy which means smell or fragrance and healing of person's soul, body and mind respectively. In addition, essential oils have antibiotic, antiviral and antibacterial properties in it. The usefulness and scope of biomedical-engineered goods have expanded immensely in recent years and textile material offers an outstanding intermediate to bring these biomedical-engineered goods for human's welfare and health. Aroma-therapeutic textiles are value-added functional textiles for the comfort of humans along with their well-being. The aroma-therapeutic textiles influence our olfactory senses and also offer healing assistances to the wearer.*

*Keywords: muscular pain, medicinal plants, aroma-therapeutic textile, essential oils.*

## INTRODUCTION

Pain is an unpleasant sensory or emotional experience associated with actual or potential tissue damage. Muscular pain is prevalent among all age groups at present. There are many reasons which cause muscle pain such as excessive use of muscles, improper use of muscles, exercises and many times stress and anxiety also result in muscle pain. Pain is a multi-dimensional experience that does not only impact individual physically but also mentally, socially, spiritually and emotionally. Man has used many forms of therapy for relieving pain throughout the history, like hot and cold pack, exercise, therapeutic massage, drugs, compression garments etc. In present time, many patients take synthetic medicinal drugs for the treatment of muscular soreness which may cause an adverse effect on the gastrointestinal tract and they are analgesic and anti-inflammatory in nature. Therefore, many healthcare providers and sufferers are interested in using essential oils for relieving muscular pains because of its minimal side effects, along with its aiding properties which promote allover strength and good health. The use of whole plant or part of plant for medical purpose is known as phytotherapy. A part of phytotherapy is aromatherapy in which the essential oils are used as major component. Aromatherapy came into light after scientists untangled the skin permeability and antiseptic properties of essential oils. In aromatherapy, essential oils are penetrated in the human skin surface through bath, local application and inhalation.

The United States Food and Drug Administration (FDA) currently recognized essential oil as safe for medicinal use. In some cases, essential oils can cause minor skin irritation at the applied site. Essential oils are usually used with carrier oil for external application or for massage [1] and essential oils can also be applied to the textile materials. The application of essential oils on textile materials allows a controlled release of the active substance and antimicrobial effect. Most preferred textile materials are made of cellulose fibres, the resulting products being used as bandages, wound dressing, absorbent items, hygiene products, etc. Textile materials when treated with essential oils get valuable specialities such as the feeling of well-being, therapeutic effects and freshness in the wearer.

### Essential oils

The term essential oil is sometimes used as a blanket term to include all aromatic, volatile, natural, plant oil including $CO_2S$ and absolutes [2]. The plant extracted volatile oil is used in oils, ointments and lotions for the treatment of miscellaneous ailments such as arthritis, muscle pain, gout, neuralgia, wound and also for the stimulation of hair bulbs by rubbing into hairs to prevent premature baldness [3]. Essential oils are natural oils, obtained from distillation of plant materials such as buds, leaves, flowers, seeds, barks, twigs, herbs, fruits, roots and wood. The essential oils are known for its multiple benefits such as antiseptic, virucidal, fungicidal, bactericidal, antioxidant, insecticidal, antiparasitic, radical-scavenging properties, anti-inflammatory, emollient and healing effects. Some studies have shown the essential oils preferred for muscular pain and inflammation are eucalyptus, camphor, clary sage, rosemary, citrus, pine, black cumin, lavender, sweet marjoram, peppermint etc [4].

Essential oils are the blends of hydrocarbons, saturated and unsaturated alcohol, ethers, esters, aldehydes, terpenes, ketones and oxide phenols [5]. Essential oils are fat-soluble in nature, therefore, they are able to penetrate in the skin membrane and drained into the systematic circulation. Essential oils are evaluated as the "vital force" of the plant, these oils in plants play the similar role as blood in the human body and the structure of fat-soluble oil is alike to the structure of tissues and cells in the human anatomy. This makes them harmonious with human protein and allows them to uncomplicatedly accepted by the human body [6].

**Chemical composition of essential oils preferred for muscular pain tropically:**
The chemical composition of essential oils for muscular pain, identified by GC- mass spectrometry (GC-MS) and gas chromatography (GC), is shown in **Table 1.**

**Table 1:** Essential oils for muscular pain

| Essential oil | Scientific name | Family | Chemical composition | Reference |
|---|---|---|---|---|
| Camphor | *Cinnamomum camphor L.* | Lauraceae | Camphor, linalool, cineol, safrole, p-cymene, eugenol, limonene, β-myrecene, α-humulene, Nerolidol. | [7] |
| Clary sage | *Salvia sclarea L.* | Lamiaceae | Linalool, linalyl acetate, α-,β-pinene, Camphene, Myrcene, γ-,α-terpinene, Camphor, cis-thujone, trans-thujone, ρ-cymene, Caryophyllene, α-humulune, Terpineol, Caryophyllene, oxide. | [8] |
| Clove | *Syzygium aromaticum* | Myrtaceae | 2-pinene, methyl salicylate, chavicol, 4-allylanisole, Anethol, α-pinene, α-murolene, α-copaene, α-,βcaryophyllene, α-,β-selinene, Eucalyptol, Valencene, eugenyl acetate, eugenol, -(-)b-cadinene, Caryophyllene, oxide, Jasmine ledol, Globulol, Cedrene. | [9] |
| Eucalyptus | *Eucalyptus globules* | Myrtaceae | 1,8-cineole, Aromadendrene, α-gurjunene, Globulol, Pipertone, β-pinene, allo-aromadendrene, α-,β-,γ-terpinen-4-ol. | [10] |
| Geranium | *Perlargonium graveolens L.* | Geraniaceae | Citronellol, trans-geraniol, lo-epi-γ-eudesmol, isomemthone, linalool, geranyl acetate, γ-cadinene, geranyl butyrate, gernacrene D, geranyltiglate. | [11] |
| Lemon grass | *Cymbopogon citrates* | Poaceae | Myrcene, Limonene, E,E-cosmene, Z-β-ocimene, E-β-ocimene, α-terpinolene, Citronellal, cis-verbenol, linalool, cis-carvenol, atrimesol, nerol, neral, geranoil, geranial, carveol, geranyl acetate, caryophyllene. | [12] |
| Peppermint | *Menthe piperita L.* | Lamiaceae | Cineole, Limonene, Menthone, Isomenthone, Menthofluran, Menthyl, Acetate, Isopulegol, Pulegon, Menthol, Carvone. | [13] |
| Pine | *Pinus sylvestris* | Pinaceae | α-pinene, β-pinene, Camphene, β-phyllandrene, $\Delta^3$-carene, Limonene. | [14] |
| Sweet marjoram | *Origanum majorana* | Lamiaceae | Hydrate, terpinen-4-ol, cymene, cis-sabinene, α-terpineol, Thymol, | [15] |

| | | | Carvacrol. | |
|---|---|---|---|---|
| Wintergreen | *Gaulteria fragantissima Wall.* | Ericaceous | methyl salicylate, α-pinene, Tannin, Resin, Δ-cardinene, Myrcene, Δ³-carene, 3,7-guaidiene. | [16] |
| Yarrow | *Achillea millefolium L.* | Asteraaceae | Camphene, yomogi alcohol, α-terpineol, Limonene, cis-p-menth-2-en-l-ol, 1,8-cineole, α-terpinene, chrysanthenone, camphor, Linalool, γ-terpinene, terpinen-4-ol, α-phellandrene, cis-chrysanthenyl, acetae, spathulenol, ρ-cymene, Caryophyllene, oxide, Globulol. | [17] |

## APPLICATION OF ESSENTIAL OILS ON TEXTILE MATERIALS

The essential oils are used in the textile field for bringing life balance and for imparting restorative and distressing properties to the textiles that pamper and energize [18]. The essential oil treated textiles are used in home textiles, cosmetic products, household cleaning, medical and alternative healing textiles and body care textiles. Essential oils from the textile material are absorbed by the skin through control release mechanism [6]. The essential oils are applied to the textile materials by various techniques such as:

**Padding mangle:** Padding mangle applies finish to an open width fabric in a uniform manner. The mangle consists of two cylindrical rubber bowls with a stainless steel mandrel. The padding operation consists of two steps. Firstly, the impregnation is achieved by immersing the fabric in the dye liquor and then secondly, the fabric is passed through a pair of rollers to extrude air and to incorporate dye liquor into the fabric. The surplus dye liquor is sent back along with the fabric. The first step is known as 'dip' and the second step is known as 'nip' [19]. After padding the water must be removed from the fabric i.e., drying followed by curing of fabric i.e., heat is given to the fabric which results in a chemical reaction, this whole process of finish application is usually cited as pad-dry-cure [20].

**Microencapsulation:** Microencapsulation is a promptly emergent technique that has used for miscellaneous applications. In microencapsulation, microcapsules are formulated. These microcapsules consist of two parts shell and core. Shell is a continuous film of the polymeric material containing tiny solid or liquid droplets of active agents known as core. Under the programmed conditions microcapsules release the active agents to attain precise performance. The mechanism of releasing active agents depends on the thickness of the shell (wall material) and the quantity of core material. The mechanism of releasing active agents from microcapsules may involve diffusion through the wall, bursting of a shell, dissolution of polymeric wall material, biodegradation, and change in pressure or friction or temperature etc. [21]

**Chemical Vapour Deposition (CVD):** In Chemical Vapour Deposition the coating or finish comply with the shape of the substance surface. In this process, the film of solid material from a gaseous phase is deposited on the surface of the substrate. To deposit a film on substrate's surface the chemicals in vapour form are reacted thermally at low pressure. The porous of textile material can be coated without jamming the pores and the thickness of film deposition can be controlled by pressure, temperature, speed and gas flow. The different types of effects such as conductivity, super hydrophobicity, antimicrobial properties on textile materials are obtained by CVD process [22].

**Sol-gel technology:** Sol-gel method is one of the most effective and simple methods for developing various nano-composites among all other fabricating techniques of nano-coating [21]. In sol-gel technology, metallic salts and metal oxides are used as pioneers as they cause condensation and hydrolysis reactions through acid or alkali catalytic effects [23]. The entrapment of the biocidal agent with an inorganic matrix depends upon the extent of control on various stages of sol-gel processes. On the fabric surface, these sol-gels can perfectly deposit *via* electro-spinning, dip coating, spray coating, spinning coating and pad-dry-cure method. The room temperature is requiring for sol-gel reactions as gel cures at a moderate temperature. This application technique shows good efficacy and wash durability [21]. The sol-gel technology is used in the textile industry for anti-mosquito, anti-bacterial finish, flame retardant, water or oil repellent, anti-crease or anti-wrinkle, easy-care or durable press effect, soil repellent, ultraviolet (UV) protection, abrasion-resistant etc. [23].

## RELATED STUDIES:

- Meenapriya and Priya [24] studied the effect of lemongrass oil on 30 patients suffering from rheumatoid arthritis. The patients were given lemongrass oil to apply for 30 days and every 2 to 3 days pain scale was noted. The results showed the mild change in the pain level of the patients. They concluded that further application of lemongrass oil would significantly show a great decrease in the pain level of the patients.

- Lakhan *et al.* [1] studied the medicinal uses of essential oils immersed through the olfactory system. They examined 12 studies for relieving pain using aromatherapy through an electronic database search. The result shows the positive effect of essential oils for reducing pain. The analysis results that the aromatherapy is more reliable for treating acute pain and nociceptive as compared to chronic pain and inflammation respectively. The study indicates that the aromatherapy can effectively treat the pain along with the conventional treatment.

- Chauhan *et al.* [25] formulated two herbal pain relief oils and evaluated its parameters. The $F_1$ and $F_2$ two oils were prepared, where $F_1$ consists of aqueous extract of Curcuma longa (rhizomes), Vitex negundo (leaves) and sesam oil as base oil and $F_2$ comprised of an extract of Curcuma longa, Vitex negundo, sesam oil as base oil along with essential oil. They had acid value ranging from 19.34-19.45, Saponification value ranging from 115.24-194.33 and refractive index ranging from 1.456-1.468 respectively. The results show that $F_2$ formulated oil possess better skin penetration and less greasy because of essential oil, as essential oil contains volatile oil and the extract of Curcuma longa, Vitex negunda act as antiseptic, anti-inflammatory and pain reliever.

- Chandrasekaran *et al.* [26] studied 16 medicinal herbs such as holy basil, neem, turmeric, sandal wood, etc. for treating 7 different illnesses such as psoriasis, joint pain, allergic dermatitis, asthma, liver disorders, sinus trouble/ cold and headache. Seven different types of therapeutic clothes (aleo vera T-shirt, neem-portia T-shirt, holy basil T-shirt, turmo- neem T-shirt, Eucalyptus head band, sandal handkerchief and balloon joint pain band) were developed using 100% cotton woven and knitted fabrics. The herbs are applied using pad-dry-cure method on the fabric. The developed fabrics were tested for the antimicrobial activity using agar diffusion test method and challenge test method. The curative performances of the garments were found to be significant in all cases. The herbal treated curative garments were lasted up to 10-15 washes.

## CONCLUSION

This review paper has shed some light on the therapeutic ability of essential oils having muscle pain-relieving property. The use of essential oils are not a modernistic therapeutic technique, its origin can be traced back in ancient time. The application of essential oil has blowout steadily through the entire world as well as its exploration, gave rise to a remarkable increment in the yield and the quality of oil production. In the field of health, essential oils are mostly preferred for reveling muscular pain. It should be noted that essential oils should not be adulterated and it should be applied according to the instructions of qualified aroma-therapists. The aromatherapy can be boon not only to the patients but also to the common man, if the essential oils are properly explored to their full potential.

## REFERENCES

1. Lakhan, S.E., Sheafer, H. and Tepper, D. (2016). The effectiveness of aromatherapy in reducing pain: A systematic review and meta- analysis. *Pain Research and Treatment*, 1-13. Retrieved from: http://dx.dio.org/10.1155/2016/8158693.

2. Shah, Y.R., Sen, D.J., Patel, R.N., Patel, J.S., Patel, A.D. and Prajapati, P.M. (2011). Aromatherapy: The doctor of natural harmony of body and mind. *International Journal of Drug Development and Research*, 3(1), 286-294. Retrieved from: http://www.ijddr.in/drug-development/aromatherapy-the-doctor-of-natural-harmony-of-body--mind.pdf.

3. Miraj, S. (2016). An evidence- based review on herbal remedies of *Rosmariun officinalis*. *Der Pharmacia Lettre*, 8(19), 426-436. Retrieved from: https://core.ac.uk/download/pdf/143840598.pdf.

4. Hangratanaworakit, T., Soontornmanokul, S. and Wongareesanti, P. (2018). Development of aroma massage oil for relieving muscle pain and satisfaction evaluation in human. *Journal of Applied Pharmaceutical Science*, 8(4), 126-130. DOI: 10.7324/JAPS.2018.8418.

5. Ali, B., Al-Wabel, N.A., Shams, S., Ahamad, A., Khan, S.A. and Anwar, F. (2015). Essentail oils used in aromatherapy: A systemic review. *Asian Pacific Journal of Tropical Bioemedicine*, 5(8), 601-611. Retrieved from: http://creativecommons.org/licenses/by-nc-nd/4.0.

6. Cerempei, A. (2017). Aromtherapeutic textiles. *Active Ingredients from Aromatic and Medicinal Plants*, Intechopen, 87-106. DOI: 10.5772/66510.

7. Hamidpour, R., Hamidpour, S., Hamidpour, M. and Shahlari, M. (2013). Camphor (*Cinnamoum camphor*), a traditional remedy with the history of treating several diseases. *International Journal of Case Reports and Images*, 4(2), 86-89. DOI: 10.5348/ijcri-2013-02-267-RA-1.

8. Bayadar, H., Sangun, M.K., Erbas, S. and Kara, N. (2013). Comparison of aroma compounds in distilled and extracted products of sage (*Salvia officinalis L.*). *Journal of Essential Oil Bearing Plants*, 16(1), 39-44. DOI: 10.1080/0972060x.2013.764175.

9. Xu, J.G., Liu, T., Hu, Q.P. and Cao, X.M. (2016). Chemical composition, antibacterial properties and mechanism of action of essential oil from clove buds against *Staphyloccocus aureus*. *Molecules*, 21(1194), 1-13. DOI: 10.3390/molecules21091194.

10. Vecchio, M.G., Loganes, C. and Minto, C. (2016). Beneficial and healthy properties of eucalyptus plants: A great potential use. *The Open Agriculture Journal*, 10(1), 52-57. DOI: 10.2174/1874331501610010052.

11. Asgarpanah, J. and Ramezanloo, F. (2015). An overview on phytopharmacology of *Pelargonium graveolens L. Indian Journal of Traditional Knowledge*, 14(4), 558-563. Retrieved from: https://www.researchgate.net/publication/283051914_An_overview_ on_phytopharmacology_of_Pelargonium_graveolens_L/link/5673a50408aee7a427449aec/download.

12. Mohamed-Hanaa, A.R., Sallam, Y.I., El-Leithy, A.S. and Aly, S.E. (2012). Lemongrass (*Cymbopogon citratus*) essential oil as affected by drying method. *Annals of Agricultural Science*, 57(2), 113-116. DOI: 10.1016/j.aoas.2012.08.004.

13. Loolaie, M., Moasefi, N., Rasouli, H. and Adibi, H. (2017). Peppermint and its functionality: A Review. *Archives of Clinical Microbiology*, 8(4:54), 1-16. DOI: 10.4172/1989-8436.100053.

14. Wyk, B.K. and Wink, M. (2004). Medicinal plants of the World: An illustrated scientific guide to important medicinal plants and their uses. Singapore: Times editions, 242.

15. Tripathy, B., Satyanarayan, S., Khan, K.A. and Raja, K. (2017). An updated review on traditional uses, taxonomy, phytochemistry, pharmacology and toxicology of *Origanum majorana. Inernation Journal of Pharma Research and Health Sciences*, 5(4), 1717-1723. DOI: 10.21276/ijprhs.2017.04.01.

16. Menon, R.S.R. (2015). Pharmacological aspects of essential oil- Wintergreen oil. *International Journal of Science and Research*, 6(7), 1539-1541. Retrieved from: https://www.ijsr.net/archive/v6i7/ART20175161.pdf.

17. Mirahmadi, S.F., Sefidkon, F., Hassandokht, M.R. and Hassani, M.E. (2012). Essential oil content and composition of *Achillea biebesteinii Afan*. in different plant parts and phonological stages. *Journal of Essential Oil Research*, 24(1), 25-19. DOI: 10.1080/10412905.2012.645636.

18. West, A.J. and Annett- Hitchcock, K.E. (2014). A critical review of aroma therapeutic application for textiles. *Journal of Textile and Apparel, Technology and Management,* 9(1), 1-13. Retrieved from: https://ojs.cnr.ncsu.edu/index.php/JTATM/article/viewFile/5734/3273.

19. Purushothama, B. (2017). Handbook of value addition processes for fabrics. India: Woodhead Publishing India Pvt. Ltd., 71-72.

20. Choudhary A.K.R. (2017). Principles of Textile Finishing. India: Woodhead Publishing, 7.

21. Naveed, M. (2018) Potential application techniques for antimicrobial textile finishes, *Trends in Textile Engineering and Fashion Technology,* 3(4), 366-373. DOI: 10.31031/TTEFT.2018.03.000570.

22. Gulrajani, M.L. and Gupta, D. (2011). Emerging techniques for functional finishing of textiles. *Indian Journal and Fiber and Textile Research*, 388-397. Retrieved from: http://nopr.niscair.res.in/bitstream/123456789/13233/1/IJFTR%2036%284%29%20388-397.pdf.

23. Camlibel, N.O. and Arik, B. (2017). Sol-gel applications in textile finishing processes. Intechopen, 253-281. DOI: 10.5772/67686.

24. Meenapriya, M. and Priya, J. (2017). Effect of lemongrass oil on rheumatoid arthritis. *Journal of Pharmaceutical Sciences and Research*, 9(2), 237-239. Retrieved from: http://jpsr.pharmainfo.in/Documents/Volumes/vol9Issue02/jpsr09021734.pdf.

25. Chauhan, V., Kaushik, A. and Sudha. (2016). Formulation and Evaluation of herbal pain relief oil. *European Journal of Pharmaceutical and Medical Research*, 3(4), 515-520. Retrieved from: http://www.ejpmr.com/admin/assets/article_issue/1459944179.pdf.

26. Chandrasekharan, K., Ramachandran, T. and Virneswaran, C. (2012). Effect of medicinal herb extracts treated garments on selected disease. *Indian Journal of Traditional Knowledge*, 11(3), 493-498. Retrieved from: http://nopr.niscair.res.in/bitstream/123456789/14391/1/IJTK%2011%283%29%20493-498.pdf.

## MACHINE LEARNING BASED ANALYSIS OF THERMAL IMAGES AT ELECTRICAL INSTALLATIONS

**Dr. S. M. Bakre[1], Mrs. S.M. Shaikh[2,] Dr. Mrs. A. D. Shiralkar[3] and Ms. Suchita Ingle[4]**

[1]Associate Professor, [2]Assistant Professor, [3]Head of Department and [4]Research Scholar, Electrical Engineering Department, AISSMS IOIT, Pune, India

**ABSTRACT**

*The evolution of thermograph technology has been quite beneficial to the power system engineers working at electrical installations, substations and overhead lines. About 20-25% faults are taking place due to loose connections developed at joints at electrical installations. The loose connections are developed at clamps, connectors, spacers, T joints etc. because of factors such as wind pressure, lack of routine maintenance and incidental defect in hardware. In rainy season, the water gets accumulated inside the gap formed by theseloose connection. This may cause undesired events such as sparking, flashover and breakdown. This may lead to consumer dissatisfaction due to interruptions, loss of revenue, fatal/ nonfatal accidents and system degradation. Such loose connections are identified well in advance using thermal scanning and the unforeseen event can be avoided. The joint is said to be converted to hot spot above the temperature of $50^0$ C. Conventionally the analysis of thermal images is conducted with respect to present value of temperature of the joint. The future values of temperature cannot be predicted by the conventional analysis. This paper proposes a novice method of forecasting temperature using linear regression analysis. Using the proposed method, the hot spots being developed in future can be anticipated. The other parameters such as $R^2$method and p-value are also put up. The Python language can be used as an effective programming tool for conducting computational analysis. The proposed method is cost effective and easy for implementation.*

*Keywords: Thermal imaging, Thermograph, Linear Regression*

## 1   THERMOGRAPHY OF ELECTRICAL INSTALLATIONS

There are number of connections in form of joints at electrical installations through which the system current flows. For instance, the overhead lines are connected to substation equipment's such as Transformers, Circuit breakers, Isolators, Lightning Arrestors and Instrument Transformers. This connection from line to equipment is made through the conductors called jumpers. The jumper is connected to overhead line at the joint called T connector. The other end of equipment is connected to equipment at a metallic or bi-metallic clamp. Usually, the clamps and connectors are made up of Aluminum alloy. The bi-metallic clamps are of Aluminum-Copper Alloy. The two conductors are connected to each other using metallic sleeve made up of Aluminum alloy. Underground cables also have joints for connections at electrical installations. The twin or quadruple conductors of overhead lines are separated by a hardware called spacers. Because of factors such as wind pressure, lack of routine maintenance and defect in hardware, the joints get loosened. Particularly the nut-bolts of the bolted type clamps become loose. This results in formation of air gap in joints. In a normal practice the temperature of the joint should be below $50^0$ C. Because of air gap, the temperature rises above $50^0$ C. The location at which the temperature is above $50^0$ C is termed as hot spot [1]. The hot spot is attended by tightening nut-bolts or replacing hardware as the case may be. Mostly the hot spot is abolished by tightening fasteners. In case the hot spot is ignored, the hot spot may be converted to red hot. Red hot is the situation where the temperature of joint rises above $100^0$ C. This may cause sparking, flashover and breakdown followed by interruption of supply, damage to the equipment and fatal or nonfatal accident.In rainy season, the water gets accumulated inside the gap formed by loose connection. As water is semiconductor of electricity, serious consequences may take place. Hot spots may also be developed at indoor locations such as metering installations and control & relay panels [2].

About 20-25% faults are taking place due hot spots developed at joints at electrical installations. In order to avoid this situation, it is essential to detect hot spot at early stage and attend it on priority. Such hot spots can be detected by thermal scanning of various joints at electrical installations. In this way, the thermography has proved to be quite useful in condition monitoring and diagnostic testing of electrical equipment and lines. Prior to arrival of this technology, the power system engineers would find it difficult to detect hotspot in its initial stage [3].

## 2   REVIEW OF THERMOGRAPHY

The basic principle of thermography is based on the fact that any object above absolute zero temperature emits electromagnetic radiation. If the intensity of an electromagnetic radiation is measured, the temperature of the object can be determined without having physical contact with the object. Based on this principle the equipment

is developed called Thermovision camera or thermal scanning camera or thermal imaging camera [4]. Figure 1 illustrates the functional block diagram of Thermovision camera.
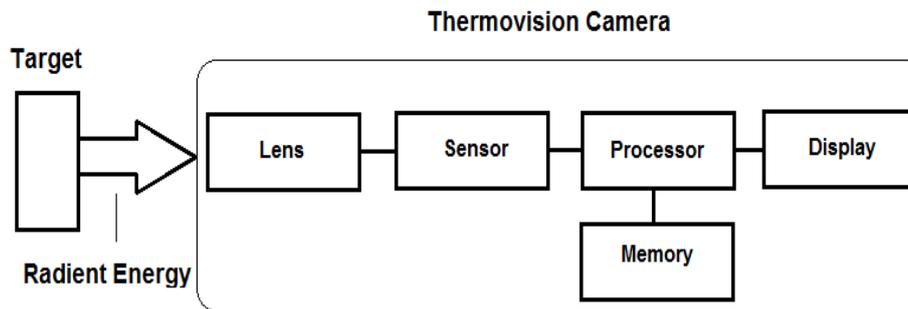


**Fig.1.** Functional Block Diagram of Thermovision Camera

The target object emitting radiant energy is focused by the Thermovision camera. The particular joint to be scanned is spotted by a laser beam emitted by the camera. The camera can be located upto 10 meters from the target object without touching it. The radiant wave is focused by the lens. The sensor converts radiant energy into electrical signal. This signal is there in analog form. It is converted to digital form by the inbuilt Analog to Digital Converter (not shown in Figure). These signals are processed by the processor to determine temperature of joint and other parameters. The observations are stored in the read write memory and also indicated on the display.

## 3    OBSERVATIONS AND CONVENTIONAL ANALYSIS

The thermal imaging can be conducted at any time in the day (day and night) without availing any outage or isolation. However, in order to have realistic results, the thermography is recommended at system peak hours [5]. Some cases of analyzing thermograph are discussed below.



a. Overhead Joint        b. Isolator Jaw Contacts        c. Terminal joint of CT
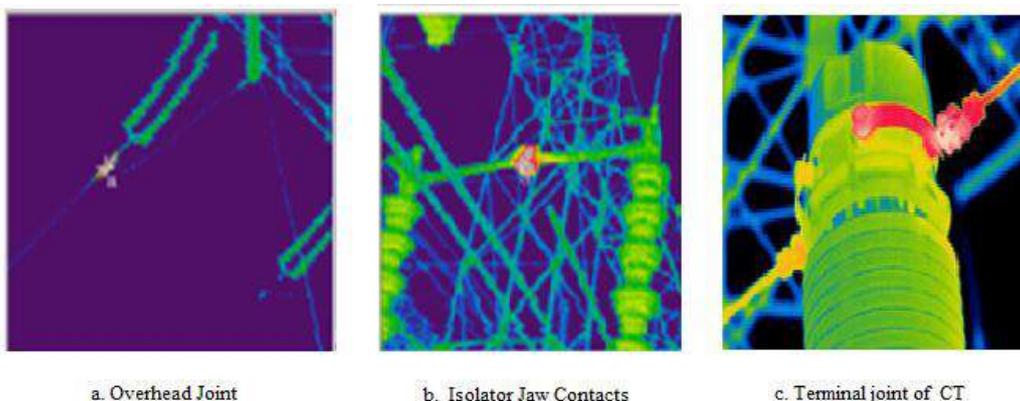
**Fig.2.** Thermograph of lines and Equipment

Fig 2 depicts thermograph of lines and substation equipment. Fig 2 (a) shows hot spot developed near the clamp of the overhead transmission line. If the hot spot is not attended in time, the conductor may fall down on equipment and lines and cause detrimental effects. Fig 2(b) shows hot spot developed because the isolator jaws are not closed properly. It is necessary to undergo proper alignment of isolator blades ensuring proper closing of contacts. The operation staff should to instructed to check whether the contacts are closed properly. Fig 2(c) shows the hot spot developed at terminal joint of the Current Transformer (CT). The CT is a live tank type CT where the oil tank is provided at the top side. The CT clamp gets heated due to hot spot which causes heating of oil tank of the CT. This results in boiling of the oil inside the tank. This phenomenon may lead to serious consequences such as blasting of oil tank. The hot boiled oil comes out of CT with tremendous force causing fire hazards. Further, thismay result in blasting the CT. In the event of blasting of CT, the pieces of insulators are scattered with a great force in the switchyard thereby causing damage to other equipment nearby and fatal/ nonfatal accident. Such undesired events can be avoided by conducting regular thermal scanning and attending hot spots.

After taking snapshots of thermal images, the analysisobservations recorded by the Thermovision camera are carried out. The normal joints having temperature below $50^0$C are ignored. Immediate action should be taken in case of red hot. Table 1 shows various temperature ranges for joints and action to be taken to abolish hot spot.

**Table 2.** Temperature ranges and action to be taken

| Temperature | Status | Action to be taken |
|---|---|---|
| Below $50^0$ C | Normal | Routine checkup. |
| Between $50^0$ C to $60^0$ C | Hot spot – initial stage | Continuous monitoring. To be attended on staggering day. |
| Between $60^0$ C to $80^0$ C | Hot spot – developing stage | Rigorous monitoring. To be attended as early as possible. |
| Between $80^0$ C to $100^0$ C | Hot spot – developed stage | Red alert. To be attended on top priority. |
| Above $100^0$ C | Red Hot | Instant shut down to be taken and to be attended quickly. |

## 4    MACHINE LEARNING BASED ANALYSIS

Machine learning is the method of data analysis that automates analytical model building. It is the branch of Artificial Intelligence based on idea that systems can learn from data, identify patterns and performs the role of decision making with minimal human intervention. Regression is one of the tools used in machine learning which shows relationship between dependent and independent variables. Mainly,there are two types of regressions – Linear and Logistic. Linear regression is the technique of establishing linear relationship between two variables where the data is modeled in a straight line. Using linear regression, it is possible to determine the values of dependent variable(y), error ($R^2$) and p value.

In the proposed model, there are two variables x and y. Variable x indicates a day count for certain joint such as day1, day2, day3 and so on. Five days have been considered as a sample model to discuss use case having five data points. The other variable y indicates temperature of the joint in degree centigrade. The five points are plotted to get a scattered plot as shown in Fig 3. The mean of variables x and y is denoted as X and Y. The computations required for regression analysis are furnished in Table 2. These computations are performed using Python language as a back-endprogramming tool. Python is a general purpose, platform independent, object oriented, open-source programming language which is quite suitable for developing machine learning source codes [6]. The results obtained from Table 2 are plotted on Cartesian coordinate plane as shown in Fig 3. The scattered Plot is drawn using matplotlib pyplot library of Python. The sample source code is given below for drawing scattered plot and line graph.

After finding mean values X and Y, these are subtracted from variables x and y to get x-X and y-Y respectively. Further the term (x-X) is squared and summed. Later, the terms (x-X) and (y-Y) are multiplied and added as shown in table 2. The slope m of the proposed regression line can be found out using following formula.

$$m = \frac{\sum(x - X)(y - Y)}{\sum(x - X)^2}$$

The slope comes out to be (40/10=) 4 as referred from Table 2. Now the intercept on Y axis can be found out from coordinates (3,36) taken as a mean and slope having value 4. Therefore, equation of line   $y=mx + c$can be expressed as $36=4.3x + c$yielding $c=24$. Hencethe generalized equation for this context becomes $y=4x + 24$. This line is called a regression line. The goal is to get a best fit line. It is possible to determine the future temperature from this generalized equation. For instance, the temperature of joint on $10^{th}$ day would be $y=4(10) + 24$i.e., $64^0$C. This gives a sort of alarm to the power system engineers working there. The conventional thermograph analysis is not capable of finding such future temperature.

Substituting values of x, we get corresponding values of variable y (termed as Yp) in linear relationship with x as shown in Table 2.

**Table 2.** Linear regression computation

| x | y | x-X | y-Y | Sqr(x-X) | (x-X)*(y-Y) | Yp | Yp-y | sqr (Yp-y) | sqr(y-Y) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 30 | -2 | -6 | 4 | 12 | 28 | -8 | 64 | 36 |
| 2 | 40 | -1 | 4 | 1 | -4 | 32 | -4 | 16 | 16 |
| 3 | 20 | 0 | -16 | 0 | 0 | 36 | 0 | 0 | 256 |
| 4 | 40 | 1 | 4 | 1 | 4 | 40 | 4 | 16 | 16 |
| 5 | 50 | 2 | 14 | 4 | 28 | 44 | 8 | 64 | 196 |
| 3 | 36 | | | 10 | 40 | 36 | | 160 | 520 |
| X | Y | | | | | | | Sum | Sum |

The value of $R^2$ is obtained from formula given below.

$$R^2 = \frac{\sum(Yp - y)^2}{\sum(y - Y)^2}$$

Therefore, the value of $R^2$ comes out to be (160/520=) 0.30. This is not a good fit value as it indicates deviation between actual and predicted values. The value of $R^2$ can be improved by going through number of iterations. The analysis shown in Table 2 can be conducted using Python program. Using matplotlib library, the graphical functions such as scatter plot and line can be explored as shown in Fig 3. The part of Python source code to draw scatter plot and line is given below. Initially the matplotlib library having pyplot utility is imported. Then the values of x and y coordinates and Yp computed by Python code and furnished in Table 2 earlier are called. Using xlabel and ylabel commands the captions to x and y axes are given respectively. Title to the graph is given by giving the title command [6].

```python
import matplotlib.pyplot as plt
x=[1,2,3,4,5]
y=[30,40,20,40,50]
yp=[28,32,36,40,44]
plt.xlabel('Day count')
plt.ylabel('Joint temperature')
plt.scatter(x,y)
plt.plot(x,yp)
plt.title('Linear Regression model')
plt.show()
```

After execution of the above code, the graphical output is obtained as shown in Fig. 3. The output comprises of scatter plot and regression line.
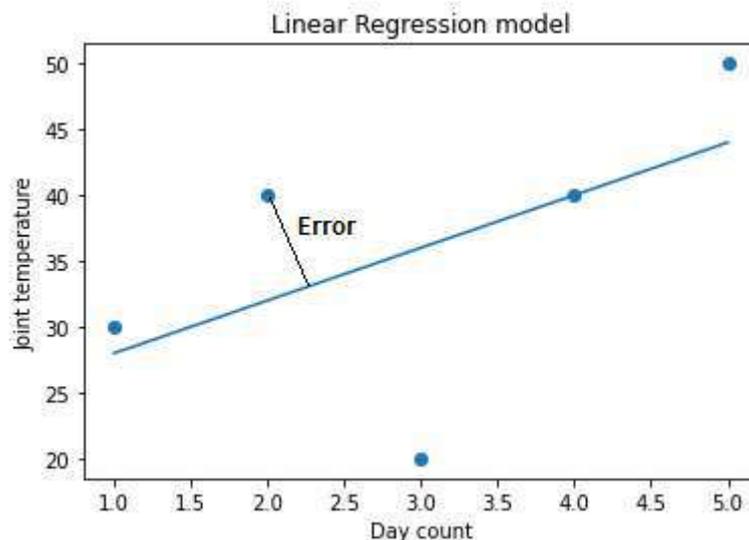


**Fig.**3**.** Thermograph of lines and Equipment

The plot comprises of scatter points which are plated as per actual data. The line is drawn from the generalized line equation. The deviation between scattered point and line is called as an error. For successful implementation, efforts should be taken to minimize error. For this purpose, number of iterations are executed having various values of slope m. The line having minimum error between predicted and actual value is selected as a best fit line. The $R^2$ method is implemented to check the goodness of fit.

## 5. CONCLUSION

The thermal imaging technology (Thermography) has proved itself to be a significant diagnostic tool for condition monitoring and diagnostic testing to the operation and maintenance engineers working at electrical installations. The use of thermographs for conducting proactive maintenance has been discussed in this paper. Different ranges of temperatures required for taking corrective action are also discussed. However, the conventional methods are not equipped to forecast the future position of a hot spot. In this context, a novice

method of forecasting the temperature parameter of hot spot based on machine learning is suggested. The linear regression algorithm has been implemented for this purpose. Python language is used as a backend software tool for conducting regression analysis. The values of $R^2$, p value (Predicted value, Yp)and future temperature (y) parameter are computed and found to be appropriate. The proposed method is found to be cost effective and easy for implementation.

## REFERENCES

1. **M**ohammedhusen H Manekiya; P. Arulmozhivarman,"Leakage detection and estimation using IR thermography", 2016 IEEE International conference on Communication and Signal Processing (ICCSP)

2. Niancang Hou, "The infrared thermography diagnostic technique of high voltage electrical equipment with the internal faults", IEEE Powercon '98. 1998 International conference on Power System Technology proceedings.

3. Gurmeet Singh;T. C. Anil Kumar;V.N.A. Naikan,"Fault diagnosis of induction motor cooling system using infrared thermography".

4. F.H.Y. Chan;A.T.P. So, "Application of thermography in monitoring major consumer electricity consumption patterns", 1993 2nd International conference on Advances in Power System Control, Operation and Management- APSCOM-93.

5. Jing Wang; Chunhui Zhao,"Broad Learning System based visual fault diagnosis for electrical equipment thermography images", 2018 Chinese Automation Congress (CAC).

6. Dr SM Bakre, Dr. Mrs. P.N. Gokhale, "Python Programming in easy steps", KDP Amazon Publishing, 2020

## MACHINE LEARNING METHODS TO DETECT PNEUMONIA OF LUNGS IN CORONA: A SURVEY

**[1]Shimja M and [2]Dr. Kartheeban K**
[1]Research Scholar and [2]Professor & Head, [1,2]Department of Computer Applications, Kalasilingam Academy of Research and Education, Srivilliputhurr

**ABSTRACT**
*The number of patients in world is increasing exponentially day by day due to corona.They have symptoms like fever ,cough, shortness of breath and in these patients CT shows lighter coloured or gray patchers which is patch ground glass opacity in medical terms.This may lead t0 Pneumonia and finally results in death.So early detection of Pneumonia is important .The early diagonosis will help to reduce the mortality rate to a great extent.There are several methods to diagonise early.Machine learning and deep learning play an important role in determining the severity of Pneumonia using various datasets like chest X-Rays,CTscans and Lus images.Deep learning method consists of three steps for the detection of Pneumonia.The steps are 1.Detection, 2.Segmentation 3.Classification.*

*Keywords:groung glass opacity,grey patchers*

## INTRODUCTION

Pneumonia,is an infection that mostly inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty breathing. A variety of organisms, including bacteria, viruses and fungi, can cause pneumonia.In this pandemic period the major cause of death across the world is due to pneumonia which is occurring during Covid. Research shows major reason for death rate of Corona occurred with Pneumonia. So early detection of Pneumonia is very important to overcome the death than treating the patient at advanced stage . However, the pneumonia could be cured effectively with great chance if it is diagnosed at an early stage rather than at an advanced stage The early diagnosis of Pneumonia, mainly rely on the detection of so many factors.at the early stage.

Medical Image Processing encompasses the use and exploration of 3D image datsets of the human body,obtainedfromCT,X-ray,ultrasound images.It plays an important role in detection of organs abnormalities and early detection of diseases.It play an important role in maintaining the mortality rate of a country.The major sources of Medical images are

1.Radiography

2.MRI

3.Nuclear medicine

4.Ultra sound

5.Tomography

6.Elastography

7.Echocardiography

There are many methods to diagonise Pneumonia and lung abnormalities.The major sources commonly used are X-Rays,CTScans,and Lus images.Chest X-rays are non invasive can spot or identify abnormalities.Portability,accessibility and sterilization procedure may hinder the process greatly in pandemic period.Computer Assisted Tomography is noninvasive ,painless procedure that uses low dose X-rays to screen lungs.It can provide greater details than traditional X-rays.It is used to examine abnormalities found on conventional chest X-Rays .Lung Ultrasound are easily available at bedside,free of radiation hazard and is in real time.It is useful for diagonising pleural and lung pathologies.A high frequecy linear probe is useful in assessment of soft tissues,pleura and lung sliding.Lus is portable, easy to disinfect and low cost .

CT scans are used more and more broadly by the radiologists nowadays. However, screening CT images manually is a very time-consuming job for radiologists, for there are hundreds of slices in one scan. The accuracy of diagnosis will be improved by improving the radiologist's efficiency.

Nowadays machine learning techniques have been used widely in many areas such as pattern recognition,natural language processing and computational learning.Deep learning is a subset

A deep neural network is an artificial neural network with multiple layers between input and output layers.Three types of deep neural networks are populary used today.1.Multilayer Perceptrons(MLP) 2.Convolutional Neural Networks(CNN)3.Recurrent Neural Networks

Overview of deep learning techniques

In this section, the deep learning technique is introduced, especially deep CNN. Generally, deep learning provides the potential to automate and merge the extraction of relevant features with the classification procedure . Recently, CNN has been shown to be very powerful in computer vision application and keep breaking the performance records in challenges . CNNs compose of many layers that transform their input with weights by convolutional operation.

. Nowadays in computer vision, CNNs has become the first choice, even in many clinical applications.

**Deep learning in finding severity of Pneumonia**
Generally, there are three main steps in detecting the severity of Pneumonia : Detection, segmentation and classification. The detection aims to predict the presence of ground glass opacities in lung. . The segmentation module aims to predict which area,left or right is prone to Pneumonia.And the classification steps could predict the exact type of Pneumonia.

**Detection with Deep Learning**
As pointed by [1] that several features has to be considered for predicting the severity of Pneumonia of lungs due to pandemic.Mainly CT scans were obtained using two scanners .Evaluators read CT feature using axial or multiplanar reconstructed images either in lung and mediastinal window settings.Each scan is evaluated for 1.ground glass opacities2.presence of consolidation 3.number of pulmonary lobes4.presence of predominantly nodular pattern e) crazy paving pattern.f)presence of cavitation g)presence of pleural effusion (h) presence of mediastinal or lymphnode >10mm i)presence of underlying lung disease (j) presence of linear opacities resembling patterns of organizing pneumonia such as band like opacities(h)airspace opacification distribution pattern (i)presence of the halosign.The number of involved pulmonary blobs ranged from 1 to 5 with lingual counting as part of left upper lobe.Ground opacification distribution pattern was defined as peripheral if it is involved the outer of the lung on axial slices,as central if involved only two inner thirds or as mixed if no predominances was observed.We can divided the ling in 6 zones,upper,mid and lower zones (both right and left) using the carina and rifght inferior pulmonary vein as landmarks.A four point scale of lung parenchyma disease was manipulated by CTscore and points were summed for total score which ranged from 0 t0 72.Involvement of each lung zone was then categorized according to the extent of disease.0-Normal1-<25% involvement ,2- 25-50% involvement,3-25-50% involvement ,4 as >75% involvement.

As pointed in [2],evaluation of chest CT and clinical features of Covid 19 patients were analyzed and summarized.Here ,it is aimed to analyse the image features and to obtain relationship between clinical features andv radiological findings.Here two CT signs of each patient is evaluated.1.Ground glass opacity(GGO)2.Consolidation.3.number of lobes involved by GGO or consolidation 4.Other abnormality such as cavitation ,nodules, pleural effusion,thoracic ,lymphadenopathy,potential lung disease such as emphysema ,fibrosis etc.Here Covid 19 patients were divided into 2 groups based on initial chest imaging-positive radiological finding and negative radiological group.Positive radiological finding was defined as the presence of GGO and or consolidation in the initial chest CT scan.Negative was the absence of GGO or consolidation .Here two chest CT were interpreted with CT severity score.

As in [3],too also predominant imaging pattern of covid -19 is ground glass opacity (GGO) intuing periphery with occasional consolidation on CT.GGO are frequently observed and present in 77%-100% of confirmed covid 19 cases.Here radiomics analysis are performed in GGO signs.Here datas are collected,counter of region of interest is selectd,feature is extracted and selected .Then model is constructed and accuracy is measured.

As in [4] ,CT imaging can help in predicting severity of Covid 19 diseases.A severity score based on CXR is noted.

As in [5] chest radiography is readily available modally for the detection of lung abnormalities in many centers.Compared to CT,chest radiography are cheap.So chest radiographs can be performed in patients with moderate to severe symptoms to diagonise complications.If clinical symptoms is progressive ,can go to

CT.The patients with RT-PCR confirmed covid 19 and moderate or severe symptoms ,imaging can be used for risk identification.

As in [6],it is the first ever experience for deep learning for identification of lung abnormalities in covid 19 patients.Due to rapidly increase in the number of patients ,it is very difficult to get a medical aid first.So efforts have been made to implement deep learning concepts into medical health.During deep learning process,a neural network is trained on a dataset.It will help in automatic recognition and segmentation of pathology making diagonosis much speeder.In this method ,software automatically segments the lungs and lung lobes on a 3D chest CT dataset.Relevant landmarks are used to identify lung and generate lung and lobe segmentation with network.Robustness can be increased considering ground glass opacities consolidations,pleural effusions.The software detect percentage of opacity.It also detect a 5 point infection score.Correlation of CT with clinical parameters can be evaluated.

As in [7],datamining is an advanced artificial intelligence technique that is used for discovering novel ,useful and valid hidden patterns or knowledge from dataset.The technique reveals relationships and knowledge or patterns among the dataset in several or single datasets.It is used for prognosis and diagonosis of many disease including Severe Acute Respiratory Syndrome Corona virus (SARS-COV) and Middle east Respiratory Syndrome Corona Virus (MERS-CoV).Several data mining models for the prediction of CoV infected patients recovery.The models predict when covid 19 infected patients would be recovered and released from isolation centres as well as patients not be recovered and lost their lives Covid 19 Pandemic.Datamining algorithms like decision tree,support vector machine,naïve Bayes and K-nearest neighbour algorithms are used.

In [8] deep learning for classification and localization of covid 19 markers in point of care ultra sound is used.Deep learning have proven to be successful from object recognition and detection to semantic segmentation.Deep learning can lead toassistance and automation of preliminary diagonosis.Here how specific imaging biomarkers inLUS can be used for management of Covid 19 pandemic situation.Here it is presenting a scenario where frames are provided with pixel level annotation and segmentation .Here 3 types of prediction mainly frame based score prediction,video –level score aggregation,semantic segmentation .Here it is using STN network .In segmentation model it is to segment and discriminate between areas in B-mode Lus images ,Pixel accuracy of 96%.

In [9] discuss deep learning application to combat novel corona virus covid 19 pandemic.Deep learning is a subset of artificial intelligence that contain multiple layers to anlyse data.Data are filtered through several layers where each successive layer using the ouput of the previous one to produce its output.It can be used to understand the protein structure of coronas virus to discover drugs for potential treatment.

In [10],deep learning is the most successful technique of machine learning which provides useful analysis to study a large amount of chest X-Ray images.Here augmentation is applied in the dataset.Then it is used to train propose model.Here InceptionNetV3 is a convolutional neural network used for classification .XceptionNet,ResNext is alos used .Precision,Sensitivity,specificity and score can be find out.

As in [11],developed a rapid accurate and automatic tool for severity screening.The timely diagonosis,accurate assessment with symptomatic treatment is very important to improve prognosis and to reduce the morality.Here different classifiers are used.Linear discriminate ,Linear SVM,cubic SVM,K-nearest neighbour ,decision trees.Here 80% of deep features were randomnly selected as training dataset and remaining 20 % for testing.Here tenfold cross validation is also performed to validate the performance of severity classification for four deep learning models.

As in [12] a deep convolutional neural network(CNN) is the most widely used among machine learning methods.It is the most widely used among machine learning methods.It is one of the first preferred neural networks expecially in image based problems since it contains both feature extraction and classification stages and produce very effective results.In image-based covid19 researches,the CNN model or different models produced from CNN is encountered.In it,a generally hold out method and few K-fold cross validation is used during training phase.In hold out method ,training is done by dividing the data into two parts as test and train in 10 fold cross validation ,a data is divided into k folds,then folds are trained k times.It is used as a better method for model evaluation.The extracted features were trained using six machine learning algorithms namely decision trees,random forest,XG Boost,Ada Boost.

In [13],[14],proposed a method consisted of preprocessing,CT image segmentation using ResNet18 and classification of CTscans performed by adding location that provides relative location of information of the

patch on the pulmonary image.Overall accuracy rate is 86-87%.DEnsenet 21-fdn was implemented for lung segmentation.

In [15]Automatic and unsupervised method for detection and localization of pleural line in Lus data based on hidden Markov model and Viterbi algorithm. Pleural line localization is followed by supervised classification procedure based on Support vector machine. Classifier evaluates healthiness level of patient and if present severity of the pathology ie score value for each image of a given lung acquisition.Presence of air complicates ultrasound propagation. High mismatch between acoustic impedence of intercostals tissues and air contained in lungs creates an acoustic interface(pleural line) whose reflection coefficient tends to 1. .So alternative method needed. Novel method for automatic estimation of COVID19 severity in LUS data.The proposed system consists of two parts. The first method is unsupervised method for automatic detection and characterisation of pleural line. It is used to extract pleural line and intensity characteristics using HMM and viterbi algorithm.Second methiod is supervised classification based on score of each image of LUS video.Svm(support vector machine) classifier that performs automatic scoring of each lus image

In[16] Uses an efficient method to diagonise covid cases from normal cases.Deep learning chest radiograph classification method..AI BASED SMART chest radiography.It consists of data augmentation of radiograph images ansd convolutional neural network model. The majority of these approaches can only recognize two classes (e.g., COVID-19 vs. nor-mal). However, there is a need for well-developed models that can classify a wider range of CXR images belonging to the COVID-19 class itself such as the bacterial pneumonia, the non-COVID-19 viral pneumonia, and the normal CXR scans.

The work in [17] proposes the use of a deep learning approach based on pretrained AlexNet model for the classification of COVID-19, non-COVID-19 viral pneumonia, bacterial pneumonia, and normal CXR scans obtained from different public databases. The model was trained to perform two-way classification (i.e., COVID-19 vs. normal, bacterial pneumonia vs. normal, non-COVID-19 viral pneumonia vs. normal, and COVID-19 vs. bacterial pneumonia), three-way classification (i.e., COVID-19 vs. bacterial pneumonia vs. normal), and four-way classification (i.e., COVID-19 vs. bacterial pneumonia vs. non-COVID-19 viral pneumonia vs. normal). For non-COVID -19 viral pneumonia and normal (healthy) CXR images, the proposed model achieved 94.43% accuracy, 98.19% sensitivity, and 95.78% specificity. For bacterial pneumonia and normal CXR images, the model achieved 91.43% accuracy, 91.94% sensitivity, and 100% specificity. For COVID-19 pneumonia and normal CXR images, the model achieved 99.16% accuracy, 97.44% sensitivity, and 100% specificity. For classification CXR images of COVID -19 pneumonia and non-COVID-19 viral pneumonia, the model achieved 99.62% accuracy, 90.63% sensitivity, and 99.89% specificity. For the three-way classification, the model achieved 94.00% accuracy, 91.30% sensitivity, and 84.78%. Finally, for the four-way classification, the model achieved an accuracy of 93.42%, sensitivity of 89.18%, and specificity of 98.92%.

..As in [18], it propose a two-route convolutional neural network (CNN) by extracting global and local features for detecting and classifying COVID-19 infection from CT images. Each pixel from the image is classified into the normal and infected tissues. For improving the classification accuracy, we used two different strategies including fuzzy $c$-means clustering and local directional pattern (LDN) encoding methods to represent the input image differently. This allows us to find more complex pattern from the image. To overcome the overfitting problems due to small samples, an augmentation approach is utilized. The results demonstrated that the proposed framework achieved precision 96%, recall 97%, $F$ score, average surface distance (ASD) of $2:8 \pm 0:3$ mm, and volume overlap error (VOE) of $5:6 \pm 1:2\%$. aim of our study is to develop a deep learning model for automatic diagnosis of regions of the lungs infected with the COVID-19 virus using chest CT volumes. the $Z$ score normalization technique is repre-sented. In the fuzzy clustering method is described. A local directional number patterns (LDN) encoding approach is proposed. The architecture of the convolutional neural network (CNN) is demonstrated. CNN pipeline is represented.

Automatic Analysis of the lung CT images is needed to increase the diagonostic efficiency, as in [19]here a self supervised two stage learning model to segment Covid 19 lesions(GGO and consolidation) from chest CT images is used.The proposed self supervised learning is with 3 major components-data augmentation,representation learning and few shot classification.Here it proposes an advanced deep learning model called Self Supervised InfNet as a backbone ,optimizer techniques to improve lung lesion segmentation performance.It split the dataset into training set and test set.Self-Supervised InfNet which is liken Sinfnet include two parts-Single SSinfnet and Multi SSInfNet.To utilize the ability of a self-supervised method for the SifNets Segmentation,a mask is generatedAfter learning the self supervised features for InfNet,the training continues as normal ,similar to SinfNet5 algorithmThe training starts with the weights trained using

self-supervised inpainting method.The last layer is changed to its original layer instead of replaced convolutional layer.

As in [20], the proposed method relies in supervised machine learning and it is composed by two main phases:.training, The training phase is aimed to build a model for discriminating between x-rays images *COVID-19* related and images related to *other* pathologies.. As required by supervised classification, we need a label (i.e., a diagnosis): for this reason the proposed method requires the domain experts (i.e., radiologists) to assign to each training chest X-rays a label (i.e, COVID-19 or other). In particular in the *other* category following pulmonary diseases are considered: *Streptococcus*, *SARS*, *ARDS* (Acute respiratory distress syndrome) and *Pneumocystis* .To obtain numerical values from medical images, we consider a set of color layout descriptor (CLD) features. CDL features are designed to capture the spatial distribution of color in an image . The feature extraction process consists of two parts: grid based representative color selection and discrete cosine transform with quantization . Clearly, color is the most basic quality of the visual contents, therefore it is possible to use colors to describe and represent an image. The MPEG-7 standard has tested the most efficient procedure to describe the color and has selected those that have provided more satisfactory results. This standard proposes different methods to obtain these descriptors, and one method defined to describe the color is the CLD, that permit to describe the color relation between sequences or group of images, for this reason this standard is chosen in this paper to extract meaningful numeric features from x-ray i.MPEG-7 visual descriptors include the color, texture and shape descriptor for efficient content-based image retrieval.Basically, an x-ray image is divided into 64 equal blocks and we compute the average color for each block, and then features are calculated from the averages : this is resulting in 64 different features (one feature for each block in which we divide the x-ray image). We apply a feature selection algorithm i.e., the CfsSubsetEval : the final feature set is composed from a total of 33 CLD features that are included in this study.The feature set is obtained from each chest X-ray and, with the associated label, it represents the input for the supervised machine learning algorithm, that will output the model.The effectiveness of the proposed feature set in discriminating between *COVID-19* and *other* disease is organised in descriptive statistics i.e., boxplot analysis and the evaluation of the model obtained as output from the machine learning classifier.

As in[21],here chest X-Ray  images are used to separate 2-4 classes  in 7 different and functional scenarios according to healthy ,viral ,bacterial and Covid -19 classes.In the proposed architecture,Generative Adversarial Networkks (GAN) are  used together with a fusion of deep transfer learning and LSTM Networks without involving  feature extraction/selection  for classification of Pneumonia.Here 99 %  accuracy  is attained.Here chest  X-Rays databases are used.Datasets consists of  posterior and anterior chest images of patients with Pneumonia.LSTM  has four layers of neural networks.Here  samples from each group  of the X-Ray images are balanced usin GAN.Then used a  fusion of deep transfer learning and LSTM  to automatrically classify Pneumonia from chest X-Ray images.Here DNN model which is a mixture of GAN ,LSTM and CNN.Higest accuracy  of 99.5 % is attained

As in [22]Convolutional neural network  is used.Here  high resolution CT images is used.Here DenseNet is used.Densely Connected Convolutional networks is used.

As in [23],a transfer learning  model to accelerate  prediction processes and to assist medical professionals is proposed.Automatic diagonosis  of covid 19 using  Haralick texture features  is focused on segmented Lung images.A fully convolutional Densenet for segmentation and  residual network for classification is used.Transfer learning architecture  consists of segmentation network,classification,Haralick texture features extractions  are used,. Here  CXR and CT  images  from Kaggle data set is used.

As in [24],it includes  three parts:automatic  lung segmentation,non –lung area supression, and Covid 19 diagonostic and prognostic analysis.Here two DL networks  were involved

As in [25], Pneumonia is an infection  of the lungs caused by virus or bacteria..Here CNN model consists of five layers –input layer,convolutional layers,pooling layers,full connected layers and output layers.Here the dataset used is X-Ray images.

As in[26], Rapid and cost effective screening in place where traditional testing is not feasible.Here classification metrics such as precision,Recall and  F1 score can be find out.Inception V3 network  achieved best average accuracy (89.1%)

As in [27], here the dataset  used is portable  chest  X-Ray.It employed  deep learning convolutional neural networks to classify  covid 19 lung infections on PCXR and other infection.Here data source is from Kaggle repository.

## CONCLUSIONS

This paper presented a survey of automatic detection of severity of Pneumonia .Various souces of images such as chest Xray,CT scans,LUS images  datasets are used..Each has its own advantages and disadvantages.Automatic detection using Lus images  provide  a way of accuracy of prediction.

## REFERENCES

1. "Chest ct imaging features of Covid-19 Pneumonia:First radiological  insights  from  Porto,Portugal"A Carvalho,R.Cunha,B.A Lima,J.M Periera,A.J.Madureira European Journal  of Radiology  Open 7(2020) 100294  https://doi.org/10.1016/j.ejro.2020.100294

2. "Evaluation of chest CT and clinical features of Covid -19 patient in Macao"Chon Man Ieong,Xi Xu,Soi Chau Kong,Liang ping Luo European   Journal  of Radiology Open 7(2020) 100275 https://doi.org/10.016/j.ejro.2020.100275

3. "Discrimination of pulmonary groung glass opacity changes in Covid 19 and non-covid  19 patients using CT  radiomics analysis"-Chenyi Xe,Ming-Yen Ng,Jie Ding,Siu Ting Leung,Christine Shing Yen Lo,Ho Yuen Frank Wang ,Varut Vardhanabhuti,European Journal  of Radiology   Open7(2020)100271 httpas://doi.org/10.1016/j.ejro.2020.100271

4. "Review of chest CT  manifestations of  Covid 19  infection"Maria El Homsi,Michael Chung,Aldam Bernheum,Adam Jacobi,Michael J.King,Sara Lewis,Bachir Taouli,European Journal of Radiology Open 7(2020)100239,https://doi.org/10.1016/j.ejro.2020.100239

5. " Imaging  in  Covid Virus  Disease 2019 (Covid -19)–A scopic  review"-Ankush Jajodia,Lukas Ebner,Benedikt Heidinger,Arvind Chaturvedi,Helmut Prosch European  Journal  of  Radiology Open 7(2020)100237,https://doi.org/10.1016/j.ejro.2020.10023

6. " Deep learning   for automatic quantification of Lung abnormalities  in Covid 19  patients:First experience and correlation   with clinical parameters"Victor  Mergen ,Adrian Kobe,Christian Bluthgen,Andre Euler,Thomas Flohr,Thomas Frauenfelder Hatem Alkadu,Matthias Eberbard,European Journal   of Radiology Open 7(2020) 100272 https://doi.org/10.1016/j.ejro.2020.100272

7. "Predictive Data mining   models for Novel Corona virus(Covid 19) infected Patients recovery"L.J Muhammed,MD Milon Islam,Sani Sharif Usman,Safial Islam Ayon,SNComputer Science (2020)1:206 https:/doi.org/10.1007/s42979.00216.

8. "Deep Learning  for Classification and Localisation  of Covid 19 Markers in  Point-of-Care Lung Ultra sound"Subhankar Roy.Wili Menapace,Sebastian Oei ,IEEE Transactions  on  Medical  Imaging,vol 39,August 2020 pp 2676-2687

9. Deep learning based detection and analysis of Covid 19 on chest X-ray images.

10. "Dee p learning   Applications to combat Novel Corona Virus(Covid -19 ) Pandemic",Amanullah Asraf,Md.Zabirul Islam,Md.Rezwanul Haque,Md.Milon Islam.SN Computer Science 2020:1(16):363 Nov 3 2020 https://doi:10.007/s42979-020-00383

11. "Rapid Identification of Covid -19 severity in CT Scans through   classification of deep features"Zekuan.Xiahu Li.Haitao Sun,Jian Wang,Biomedical Eng Online (2020)19:63 http://doi.org/10.1186/s12938-020-00807-x

12. "Review on diagonosis of covid 19 from chest  CT images using Artificial intelligence",Ilker Ozsahin,Boran Sekeroghu,Computational and  Mathematical Methods  in Medicine,volume 2020,Article ID9756518,https:/doi.org/10.1155/2020/9756518

13. ".Artificial intelligence Applied to chest X-ray  images for the automatic detection of covid 19:A thoughtful Approach",Julian D ARIAS Londono,Jorge A Gomez Garcia,IEEE Access 2020  3044858 volume 8 ,2020

15. "Automatic Pleural Line Extraction and COVID-19 Scoring From Lung Ultrasound Data"Leonardo Carrer,Elena Domini,Daniele  Marinelli,IEEE Transactions on  Ultrasonics ,Ferroelectronics and Frequency Control,vol 67 No:1,November 2020,pp 2207-2217

16. "DL-CRC:Deeplearning based chest Radiograph  classification for Covid 19  detection:A Novel Approach",Sadman Sakih,Tahrat Tazrib,Mostafa M Fouda,IEEE Access 2020

17 "Deep learning in classification of Covid 19 Corona virus ,Pneumonia and Healthy lungs on CXR and CT images"Mihaela –Ruxandra Lascu,Journal of Medical and Biological Engineering https://doi.org/10.1007/s40846-021-00630-2

18. "Machine learning for corona virus covid 19 detection from chest x.rays"Luca Brunese,Fabio Martinelli,Procedia Comput Science ,doi:10.1016/j.procs.2020.09.258

19 "..Lung infection segmentation for covid 19 pneumonia based on cascade convolution network from ct images." https://doi.org/10.1155/2021/5544742

20 ",Artificaial intelligence applied to chest X\ray images for the automatic detection of covid 19-AThoughtful Evaluation Approach", https://doi.org/10.1109/access.2020.3044858

21. "Developing an efficient deep neural network for automatic detection of Covid 19 using chest X-ray images",Sobhan Sheykhivand,Zohreh Mousavi ,Alexandrai Engineering Journal(2021),Elsevier,60,2885-2903

22 "Deep learning for detecting corona virus disease 2019(covid -19) on high –resolution computed tomography:a pilot study",ShuyI Yang,Longquan Jiang,Annals of Translational medicine;8(7)

23 "Deep Learning in Classification of Covid -19 Coronavirus,Pneumonia,and Healthy Lungs on CXR and CT images",Mihaela –Ruxandra Lascu,Journal of Medical and Biological Engineering,https://doi.org/10.1007/s40846-021-00630-2

24 "A fully Automatic deep learning system for Covid 19 diagnostic and prognostic analysis",Shuo Wang, of Medical and Biological Engineering,https://doi.org/10.1007/s40846-021-00630-2

25 "Automated Methods for detection and classification Pneumonia based on X-Ray Images using deep learning",Chawki Youness,Research gate,March 2020

26 "Deep learning based detection of covid 19 using lung ultrasoung imagery",Julia Diaz Escobar,htps://Doi.org/10.1371/journal.pone.0255886,Aug 13,2021

27. "Deep –learning convolutional neural networks with transfer learning accurately classify Covid -19 lung infection on portable chest radiographs",Shreeja Kikkisetti,PeerJ 8:e10309 Doi 10.7717/peerj.10309

## TO EVALUATE THE RELATIONSHIP BETWEEN LUMBAR LORDOSIS ANDFORWARD NECK POSTURE USING RADIATION – FREE MEASUREMENT TOOL

**Nithyanisha R, Monica S and Jaya Bharathi C**

Dr. MGR Educational and Research Institute, Deemed To Be University, Chennai, Tamilnadu, India

**ABSTRACT**

*OBJECTIVE OF THE STUDY:*

*The purpose of the study is evaluate the relationship between lumbar lordosis and forwardneck posture using radiation – free measurement tool.*

*BACKGROUND OF THE STUDY:*

*Forward neck posture is the upper extension of the upper cervical vertebrae and forward translation of the cervical vertebrae. It increases compressive loading on tissues in the cervical spine, particularly the facet joints and ligaments. Lumbar lordosis is the inward curveof the lumbar spine. Lordosis can affect the lower back and neck. This can lead to excess pressure on the spine causing pain and discomfort. It can affect the ability to move if it's severe and left untreated. Hence the study was made to corelate the relationship between forward neck posture and lumbar lordosis.*

*METHODOLOGY:*

*STUDY DESIGN: Observational study*

*STUDY SETTING: Physiotherapy students in DR.MGR EDUCATIONAL AND RESEARCH INSTITUTE UNIVERSITY.*

*SAMPLE SIZE: 100 subjects*

*STUDY SAMPLE METHOD: Simple random sampling methodSTUDY DURATION: 4 weeks of duration*

*INCLUSION CRITERIA*

- *Both men and women*

- *Age above 18 years*

- *Age below 40 years*

- *Subjects with musculoskeletal disorder*

*EXCLUSION CRITERIA:*

- *Subjects with structural deformity*

- *Subjects with general systemic disease*

- *Subjects with chronic respiratory disease*

- *Tmj dysfunction*

- *Torticollis*

- *Balance disorder*

- *Pregnant women*

- *Recent surgery*

*PROCEDURE:*

*100 subjects were randomly selected based on inclusion and exclusion criteria.*

*The cranio vertebral angle and lumbar lordosis for all the subjects were measured using radiation – free measurement tool. The angles were recorded.*

*KEY WORDS: Digital pelvic inclinometer, pelvic tilt, forward neck posture, lumbar lordosis, radiation – free measurement tool, posture*

## INTRODUCTION

Lumbar lordosis refers to the natural inward curve of lower back. It's a key element of posture, whether good or bad. When the angle of this curve is too extreme, often called a sway back, it can cause a lot of problems—including misalignment and pain. The same goes for too shallow an angle. However, determining a "normal" angle is more difficult than you might expect. Common causes of lumbar lordosis are Discitis Obesity Kyphosis Osteoporosis and Spondylolisthesis. Causes of lumbar lordosis in children are Bad posture, Previous spine surgery, Pelvis or hip injury, Congenital, Genetics, Dwarfism and Other spine disorders.

Lumbar lordosis in pregnancy is due to the spine adjusting itself to the center of gravity as the pregnancy weight gain causes abdominal enlargement. It may shift again after the woman delivers the baby.

Forward neck posture is a poor habitual neck posture. It is defined by hyper extension of the upper cervical vertebrae and forward translation of the cervical vertebrae. Causes of forward neck posture are Occupational posture: forward or backward leaning of head for long duration, slouched or relaxed sitting, faulty sitting posture while using computer or screen, Effect of gravity: slouching, poor ergonomic alignment, Other faulty postures like pelvic and lumber spine posture, Sleeping with head elevated too high, Poor posture maintained for long duration, and Lack of development of back muscle strength.

An inclinometer is a sensor used to measure the magnitude of the inclination angle or deformation of any structure. The bent is either depicted in percentage or degrees concerning gravity.

A digital inclinometer system is composed of Inclinometer probe, Inclinometer cable reel (marked at every 0.5 m / 1 m ), Android Mobile Readout Unit, Accessories: Cable Reel battery, Battery Charger, Mobile battery, Mobile Charger. The digital inclinometer system is the most commonly used one

Being exposed to raditation can be dangerous to our cells and tissues. According to scientists, exposure to X-ray can easily damage our delicate cells and tissues. This means the more you expose yourself to X-rays, the more you endanger your cells and tissues. It can lead to cancer. This is one of the biggest dangers of X-rays. Scientists say that constantly exposing yourself to X-rays can easily cause you to suffer from cancer. This is possible because of the fact that X-rays are basically powerful beams of radiation. And as we might all know, constant exposure to radiation will destroy our cells and tissues, and that action alone increases our risk of developing cancer. The more you expose yourself to radiation, the more you harm yourself and increase your risk of getting cancer.

## PROCEDURE

STUDY DESIGN: Observational study

STUDY SETTING: Physiotherapy students in DR.MGR EDUCATIONAL AND RESEARCH INSTITUTE UNIVERSITY.

SAMPLE SIZE: 100 subjects

STUDY SAMPLE METHOD: Simple random sampling method STUDY DURATION: 4 weeks of duration

## INCLUSION CRITERIA

- Both men and women

- Age above 18 years

- Age below 40 years

- Subjects with musculoskeletal disorder

## EXCLUSION CRITERIA:

- Subjects with structural deformity

- Subjects with general systemic disease

- Subjects with chronic respiratory disease

- Tmj dysfunction

- Torticollis

- Balance disorder

- Pregnant women

- Recent surgery

## OUT COME MEASURE

- Cranio vertebral angle

- Lumbar lordotic angle

## MEASUREMENT:

To measure cranio vertebral angle, the base of the C2 and C7 spinous processes were identified. The inclinometer was positioned in the sagittal plane with the center of the base over the C2 spinous process. The inclinometer was set to zero in the C2 position and was thenmoved over the C7 spinous process. The number of degrees were read and recorded in the C7position for the cranio vertebral angle.

To measure the lumbar lordosis, the person is asked to stand erect. The spinous process of S1was palpated and marked. The tip of the pelvic inclinometer placed at S1 and set at zero and moved to T12 spinous process. The number of degrees were read and recorded for the lumbarlordosis.

<center>NORMAL CRANIOVERTEBRAL ANGLE > 49.9<br>DEGREE<br>NORMAL LUMBAR LORDOTIC ANGLE = 20 - 45<br>DEGREE</center>

## DATA ANALYSIS

The collected were tabulated and analyzed using descriptive and inferential statistics. Mean was used to assess all the parameters of the data using statistical package for socialscience (SPSS)for the individuals.

| S.NO | NAME | AGE | GENDER | CVA | CVA RANGE | LLA | LLA RANGE |
|------|------|-----|--------|-----|-----------|-----|-----------|
| 1 | Sivaraman | 20 | MALE | 45 | ABNORMAL | 47 | ABNORMAL |
| 2 | Rajesh | 25 | MALE | 43 | ABNORMAL | 48 | ABNORMAL |
| 3 | Murugaesan | 29 | MALE | 42 | ABNORMAL | 49 | ABNORMAL |
| 4 | Senthil | 30 | MALE | 46 | ABNORMAL | 52 | ABNORMAL |
| 5 | Shanmugam | 32 | MALE | 32 | ABNORMAL | 53 | ABNORMAL |
| 6 | Saraswathi | 35 | FEMALE | 39 | ABNORMAL | 55 | ABNORMAL |
| 7 | Jayanthi | 40 | FEMALE | 37 | ABNORMAL | 56 | ABNORMAL |
| 8 | Saranya | 29 | FEMALE | 35 | ABNORMAL | 48 | ABNORMAL |
| 9 | Rohith | 22 | MALE | 36 | ABNORMAL | 46 | ABNORMAL |
| 10 | Shriram | 22 | MALE | 33 | ABNORMAL | 46 | ABNORMAL |
| 11 | Jothi | 40 | FEMALE | 35 | ABNORMAL | 50 | ABNORMAL |
| 12 | Jeevitha | 26 | FEMALE | 39 | ABNORMAL | 52 | ABNORMAL |
| 13 | Murali | 27 | MALE | 45 | ABNORMAL | 53 | ABNORMAL |
| 14 | Shankar | 35 | MALE | 44 | ABNORMAL | 54 | ABNORMAL |
| 15 | Sundar | 38 | MALE | 47 | ABNORMAL | 54 | ABNORMAL |
| 16 | Sivashankari | 37 | MALE | 44 | ABNORMAL | 56 | ABNORMAL |
| 17 | Lavanya | 25 | FEMALE | 45 | ABNORMAL | 56 | ABNORMAL |
| 18 | Nandhini | 29 | FEMALE | 34 | ABNORMAL | 48 | ABNORMAL |
| 19 | Pavithra | 34 | FEMALE | 36 | ABNORMAL | 48 | ABNORMAL |
| 20 | Preethi | 25 | FEMALE | 30 | ABNORMAL | 50 | ABNORMAL |
| 21 | Keerthi | 36 | FEMALE | 33 | ABNORMAL | 55 | ABNORMAL |
| 22 | Kirthika | 34 | FEMALE | 32 | ABNORMAL | 58 | ABNORMAL |
| 23 | Sangeetha | 35 | FEMALE | 36 | ABNORMAL | 56 | ABNORMAL |
| 24 | Sharmila | 39 | FEMALE | 39 | ABNORMAL | 55 | ABNORMAL |
| 25 | Anandhan | 34 | MALE | 34 | ABNORMAL | 54 | ABNORMAL |
| 26 | Nirmala | 32 | FEMALE | 35 | ABNORMAL | 53 | ABNORMAL |
| 27 | Venkatesan | 31 | MALE | 31 | ABNORMAL | 52 | ABNORMAL |
| 28 | Sasikala | 30 | FEMALE | 30 | ABNORMAL | 50 | ABNORMAL |
| 29 | Aruna | 36 | FEMALE | 33 | ABNORMAL | 49 | ABNORMAL |
| 30 | Kayalvizhi | 26 | FEMALE | 35 | ABNORMAL | 48 | ABNORMAL |
| 31 | Meena | 24 | FEMALE | 41 | ABNORMAL | 47 | ABNORMAL |

| 32 | Gopal | 23 | MALE | 42 | ABNORMAL | 49 | ABNORMAL |
|----|-------|----|------|----|----------|----|----------|
| 33 | Kirshnaveni | 22 | FEMALE | 47 | ABNORMAL | 50 | ABNORMAL |
| 34 | Shankari | 21 | FEMALE | 33 | ABNORMAL | 52 | ABNORMAL |
| 35 | Praveena | 19 | FEMALE | 32 | ABNORMAL | 52 | ABNORMAL |
| 36 | Jayabharathi | 22 | FEMALE | 35 | ABNORMAL | 53 | ABNORMAL |
| 37 | Monisha | 28 | FEMALE | 36 | ABNORMAL | 56 | ABNORMAL |
| 38 | Narayani | 29 | FEMALE | 35 | ABNORMAL | 58 | ABNORMAL |
| 39 | Thara | 35 | FEMALE | 34 | ABNORMAL | 57 | ABNORMAL |
| 40 | Sunil | 32 | MALE | 38 | ABNORMAL | 56 | ABNORMAL |
| 41 | Yuvaraj | 22 | MALE | 39 | ABNORMAL | 54 | ABNORMAL |
| 42 | Ajith | 33 | MALE | 41 | ABNORMAL | 53 | ABNORMAL |
| 43 | Maha lakshmi | 35 | FEMALE | 29 | ABNORMAL | 48 | ABNORMAL |
| 44 | Swetha | 34 | FEMALE | 30 | ABNORMAL | 49 | ABNORMAL |
| 45 | Sundari | 39 | FEMALE | 31 | ABNORMAL | 52 | ABNORMAL |
| 46 | Vidhya | 40 | FEMALE | 33 | ABNORMAL | 52 | ABNORMAL |
| 47 | Latha | 36 | FEMALE | 35 | ABNORMAL | 53 | ABNORMAL |
| 48 | Jaya lakshmi | 40 | FEMALE | 36 | ABNORMAL | 57 | ABNORMAL |
| 49 | Jeevitha | 40 | FEMALE | 39 | ABNORMAL | 56 | ABNORMAL |
| 50 | Soundarya | 38 | FEMALE | 39 | ABNORMAL | 57 | ABNORMAL |
| 51 | Nithish kumar | 39 | MALE | 40 | ABNORMAL | 56 | ABNORMAL |
| 52 | Vignesh | 37 | MALE | 35 | ABNORMAL | 54 | ABNORMAL |
| 53 | Sabari | 36 | MALE | 33 | ABNORMAL | 55 | ABNORMAL |
| 54 | Santhosh | 40 | MALE | 32 | ABNORMAL | 48 | ABNORMAL |
| 55 | Saravanan | 35 | MALE | 36 | ABNORMAL | 47 | ABNORMAL |
| 56 | Naresh | 36 | MALE | 39 | ABNORMAL | 48 | ABNORMAL |
| 57 | Muthu kumar | 37 | MALE | 35 | ABNORMAL | 49 | ABNORMAL |
| 58 | Yuvashree | 25 | FEMALE | 36 | ABNORMAL | 52 | ABNORMAL |
| 59 | Vishal | 26 | MALE | 37 | ABNORMAL | 56 | ABNORMAL |
| 60 | Rekka | 24 | FEMALE | 34 | ABNORMAL | 54 | ABNORMAL |
| 61 | Kavitha | 22 | FEMALE | 32 | ABNORMAL | 57 | ABNORMAL |
| 62 | Revathi | 27 | FEMALE | 30 | ABNORMAL | 55 | ABNORMAL |
| 63 | Sumathi | 29 | FEMALE | 34 | ABNORMAL | 56 | ABNORMAL |
| 64 | Bhavani | 27 | FEMALE | 36 | ABNORMAL | 54 | ABNORMAL |
| 65 | Bhuvaneshwari | 25 | FEMALE | 39 | ABNORMAL | 54 | ABNORMAL |
| 66 | Vijay | 25 | MALE | 37 | ABNORMAL | 55 | ABNORMAL |
| 67 | Bala | 29 | MALE | 35 | ABNORMAL | 56 | ABNORMAL |
| 68 | Gokul | 30 | MALE | 32 | ABNORMAL | 57 | ABNORMAL |
| 69 | Ruban | 35 | MALE | 30 | ABNORMAL | 55 | ABNORMAL |
| 70 | Balaji | 32 | MALE | 31 | ABNORMAL | 55 | ABNORMAL |
| 71 | Durai | 34 | MALE | 36 | ABNORMAL | 46 | ABNORMAL |
| 72 | Arumugam | 36 | MALE | 39 | ABNORMAL | 48 | ABNORMAL |
| 73 | Vignesh | 25 | MALE | 40 | ABNORMAL | 47 | ABNORMAL |
| 74 | Karthick | 24 | MALE | 41 | ABNORMAL | 49 | ABNORMAL |
| 75 | Arul kumar | 22 | MALE | 42 | ABNORMAL | 50 | ABNORMAL |
| 76 | Sathish | 23 | MALE | 42 | ABNORMAL | 53 | ABNORMAL |
| 77 | Vishal | 26 | MALE | 38 | ABNORMAL | 57 | ABNORMAL |
| 78 | Vincent | 24 | MALE | 39 | ABNORMAL | 56 | ABNORMAL |
| 79 | Hemanth | 25 | MALE | 33 | ABNORMAL | 54 | ABNORMAL |
| 80 | Naveen | 27 | MALE | 39 | ABNORMAL | 52 | ABNORMAL |
| 81 | Lokesh | 28 | MALE | 34 | ABNORMAL | 50 | ABNORMAL |
| 82 | Pradeep | 29 | MALE | 38 | ABNORMAL | 52 | ABNORMAL |
| 83 | Jitendar | 32 | MALE | 39 | ABNORMAL | 56 | ABNORMAL |
| 84 | Subash | 37 | MALE | 38 | ABNORMAL | 54 | ABNORMAL |
| 85 | Naresh | 36 | MALE | 36 | ABNORMAL | 55 | ABNORMAL |
| 86 | Sarath | 34 | MALE | 34 | ABNORMAL | 57 | ABNORMAL |

| 87 | Faiyaz | 37 | MALE | 30 | ABNORMAL | 58 | ABNORMAL |
|---|---|---|---|---|---|---|---|
| 88 | Kishore | 39 | MALE | 35 | ABNORMAL | 56 | ABNORMAL |
| 89 | Shankar | 35 | MALE | 36 | ABNORMAL | 60 | ABNORMAL |
| 90 | Sunil kumar | 36 | MALE | 33 | ABNORMAL | 52 | ABNORMAL |
| 91 | Santhosh | 32 | MALE | 31 | ABNORMAL | 56 | ABNORMAL |
| 92 | Prakash | 33 | MALE | 37 | ABNORMAL | 57 | ABNORMAL |
| 93 | Vinothini | 35 | MALE | 39 | ABNORMAL | 51 | ABNORMAL |
| 94 | Geetha | 36 | FEMALE | 35 | ABNORMAL | 52 | ABNORMAL |
| 95 | Renuka | 40 | FEMALE | 35 | ABNORMAL | 58 | ABNORMAL |
| 96 | Priya | 40 | FEMALE | 36 | ABNORMAL | 59 | ABNORMAL |
| 97 | Shemba | 35 | FEMALE | 36 | ABNORMAL | 56 | ABNORMAL |
| 98 | Yamini | 36 | FEMALE | 37 | ABNORMAL | 54 | ABNORMAL |
| 99 | Saleena | 25 | FEMALE | 39 | ABNORMAL | 55 | ABNORMAL |
| 100 | Shanmugapriya | 27 | FEMALE | 40 | ABNORMAL | 46 | ABNORMAL |
| | | | MEAN | 36.26961479 | | 52.79078567 | |

| RANGE | CVA | LLA |
|---|---|---|
| NORMAL | 0% | 0% |
| ABNORMAL | 100% | 100% |

| | MEAN |
|---|---|
| CVA | 36.27 |
| LLA | 52.79 |



COMPARISON OF CVA VS LLA



MEAN OF CVA & LLA
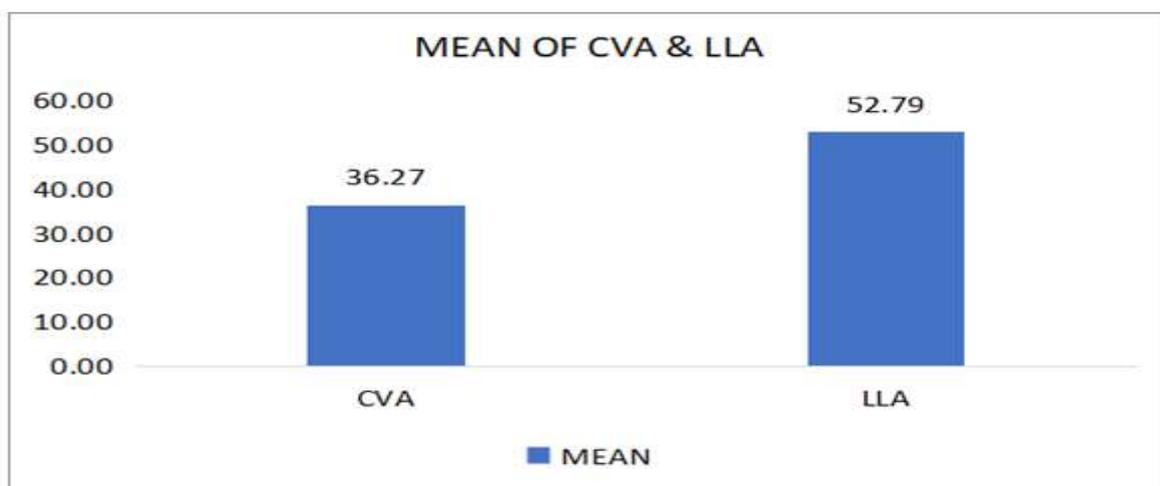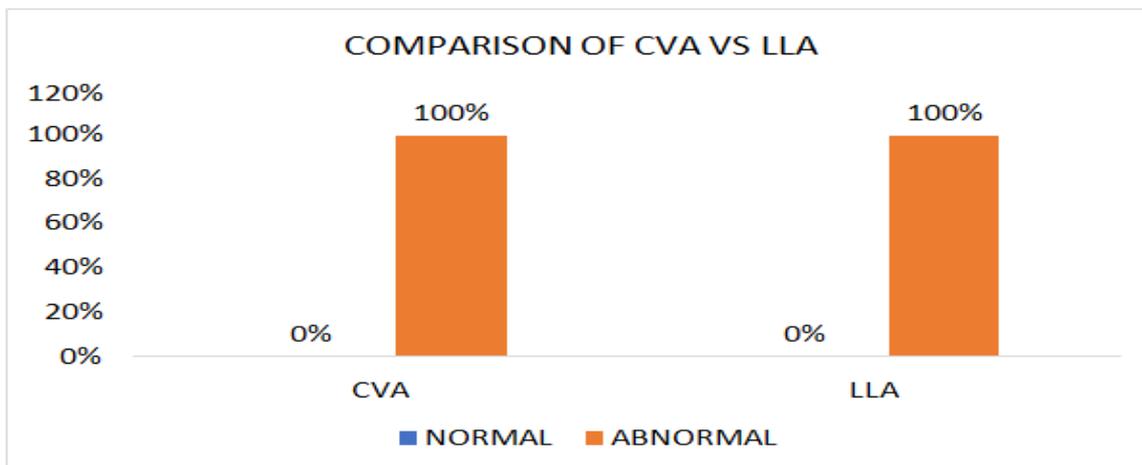
**RESULT:**

From the statistical analysis, subjects with decreased cranio vertebral angle had a increased lumbar lordosis angle. Hence the study reveals that subjects with forward neck posture shows a increased lumbar lordosis.

**DISCUSSION:**

Forward neck posture is a common condition results from prolonged bending toward a computer screen or hunching over a laptop or cell phone. It is also associated with the loss of muscle strength in the aging process.

Lordosis is an excessive inward curvature of the spine. Certain disease processes can adversely affect the structural integrity of the spine and contribute to lordosis. Some common causes include discitis, obesity, osteoporosis and spondylolisthesis.

100 subjects were randomly selected based on the inclusion and exclusion criteria. The most numerous group of patients included in the study comprised the age between 18 to 45 years. The cranio vertebral angle and lumbar lordotic angle were measured using digital pelvic inclinometer for all the subjects. The angles were noted.

The recorded angles correlated statistically. The obtained mean values for cranio vertebral angle and lumbar lordotic angle were 36.27 and 52.79. From these values it was concluded that decreased cranio vertebral angle increases the lumbar lordotic angle.

## CONCLUSION:

The study reveals that the subject with decreased cranio vertebral angle will have increased lumbar lordotic angle.

## REFERENCES:

1. Mahmoud NF, Hassan KA, Abdelmajeed SF, Moustafa IM, Silva AG. The relationship between forward head posture and neck pain: a systematic review and meta-analysis. Current reviews in musculoskeletal medicine. 2019 Dec;12(4):562-77.

2. Burt HA, Effects of faulty posture; President's Address. Proc R Soc Med. 1950; 43(3):187–194. Accessed 26 February 2019.

3. Kim DH, Kim CJ, Son SM. Neck pain in adults with forward head posture: effects of craniovertebral angle and cervical range of motion. Osong public health and research perspectives. 2018 Dec;9(6):309.

4. Salahzadeh Z, Maroufi N, Ahmadi A, Behtash H, Razmjoo A, Gohari M, Parnianpour M. Assessment of forward head posture in females: observational and photogrammetry methods. Journal of back and musculoskeletal rehabilitation. 2014 Jan 1;27(2):131-9.

5. Czaprowski D, Stoliński Ł, Tyrakowski M, Kozinoga M, Kotwicki T. Non- structural misalignments of body posture in the sagittal plane. Scoliosis and spinal disorders. 2018 Dec 1;13(1):

6. Been, Ella, and Leonid Kalichman. "Lumbar lordosis." The Spine Journal 2014;14.1: 87-97. (evidence level: 2A)

7. Bogduk, Nikolai. "Clinical anatomy of the lumbar spine and sacrum". Elsevier Health Sciences, 2005

8. Polly Jr, David W., et al. "Measurement of lumbar lordosis: evaluation of intraobserver, interobserver, and technique variability." Spine 21.13 (1996):1530-1535. (evidence level: 1B)

9. Laird, Robert A., et al. "Comparing lumbo-pelvic kinematics in people with and without back pain: a systematic review and meta-analysis." BMC musculoskeletal disorders 15.1 (2014): 1. (evidence level: 1A)

10. Physiotherapy and recovery Lumbar Lordosis. Available from: https://beyutza.wordpress.com/2014/02/16/lumbar-lordosis/ (last accessed 12.12.2019)

11. Xu-hui Z, Jia-hu F, Lian-shun J, Zhi-yong C, Young Z, Xiongsheng C, Wei-ping W. Clinical significance of cervical vertebral flflexion and extension spatial alignment changes. Spine 2009; 34(1): E21-E26.

12. McAviney J, Schulz D, Bock R, Harrison DE, Holland B. Determining the relationship between cervical lordosis and neck complaints. J Manipulative PhysiolTher 2005; 28(3): 187- 193.

13. Ng JK, Kippers V, Richardson CA, Parnianpour M. Range of motion and lordosis of the lumbar spine: reliability of measurement and normative values. Spine (Phila Pa 1976) 2001; 26(1): 53-60.

14. Saur PM, Ensink FB, Frese K, Seeger D, Hildebrandt J. Lumbar range of motion: reliability and validity of the inclinometer technique in the clinical measurement of trunk flflexibility. Spine (Phila Pa 1976) 1996; 21(11): 1332-1338.

15. Yip CH, Chiu TT, Poon AT. The relationship between head posture and severity and disability of patients with neck pain. Man Ther 2008; 13(2): 148-154.

## SYNTHESIS AND CHARACTERIZATION OF CARBAZOLE CONTAINING PYRIDOPYRIMIDINE-SUBSTITUTED SULFONAMIDE DERIVATIVES

**Fatjonë Krasniqi[1], Arleta Rifati-Nixha[2]\*, Mustafa Arslan[3] and Avni Berisha[4]**

[1,2,4]Chemistry Department, Faculty of Mathematical & Natural Sciences, University of Prishtina, Prishtina, 10000, Republic of Kosova

[3]Chemistry Department, Faculty of Art and Sciences, Sakarya University, Sakarya, 54147, Turkey

**ABSTRACT**

*Heterocyclic compounds are biologically active molecules in the development of new medicinal agents due to their essential roles in vitamins, enzymes, and nucleic acids. The synthesis and characterization of carbazole containing pyridopyrimidine-substituted sulfonamide derivatives (3a-c) were studied. The obtained structures are confirmed based on IR, $^1H$ NMR and $^{13}C$ NMR spectra and the results obtained from the elemental analysis have been consistent with the composition of the newly synthesized compounds.*

*Keywords: carbazole, sulfonamide, pyridopyrimidine*

## A CRITICAL EXAMINATION OF EFFICIENCY NATIONAL HEALTH MISSION IN CHHATTISGARH

[1]Girish Kumar Kurre and [2]Dr. Richa Yadav
[1]Scholar, Social Work, Dr. C. V. Raman University, Bilaspur
[2]Head, Department of Social Works, Dr. C. V. Raman University, Bilaspur

**ABSTRACT**

*The National Health Mission (NHM) was launched by the government of India in 2013 subsuming the National Rural Health Mission and National Urban Health Mission. National Health Mission (NHM) has several components to engage the community, such as Mitanin (ASHA) for improving health seeking behavior of the women and Jeevan Deep Samiti (JDS) commonly known as the Rogi Kalyan Samitis (RKS) to increase public participation in the management of public sector facilities. Village Health Sanitation and Nutrition Committees (VHSNC) in the rural areas and Mahila Arogya Samiti (MAS) in the urban slum areas are also formed for encouraging involvement of the community in identifying health problems and facilitating the implementation of various health programmes. This paper examines the efficiency of NHM in chhattisgarh.*

*Key Words:     National Health Mission, Community, Chhattisgarh*

## A SURVEY ON LEPROSY ELIMINATION PROGRAM IN CHHATTISGARH

**[1]Girish Kumar Kurre and [2]Dr. Richa Yadav**
[1]Scholar, Social Work, Dr. C. V. Raman University, Bilaspur
[2]Head, Department of Social Works, Dr. C. V. Raman University, Bilaspur

**ABSTRACT:**
*Leprosy is a disease, which still strikes fear in the societies as a mutilating, disfiguring, contagious and incurable disease. Because of the horrifying nature of the physical disfigurement and since no cure was discovered until the 20th century, leprosy has, for centuries, been a highly stigmatizing disease. Though leprosy is not a disease of the poor, yet it affects poor to a much greater extent because of their social and economic vulnerability. The stigma attached to leprosy has been the major cause of hiding or late reporting resulted in high basilie load in the community and high prevalence of MB cases. When leprosy is completely curable with MDT (multi drug therapy), still then Chhattisgarh have highest prevalence of leprosy in the country, Chhattisgarh is the only state which has not achieved elimination stage. This study shows the prevailing condition of Leprosy elimination in Chhattisgarh.*

*Key Words: Leprosy, Elimination, Disease*

## IN VITRO PROPAGATION OF AN ENDANGERED ORCHID DENDROBIUM BARBATULUM LINDL THROUGH STEM NODAL SEGMENTS

**Ashok N. Pyati**

Plant Tissue Culture Laboratory, PG Department of Botany, Maharani's Science College for Women, Mysore, Karnataka, India

**ABSTRACT**

*Dendrobium barbatulum Lindl. is belonging to the family orchidaceae. This species is highly valued in the floriculture industry. However, this orchid species is getting depleted from its natural habitat due to over collection and habitat destruction. Therefore, an efficient propagation protocol from stem nodal segment culture system was established from One year old in vitro grown seedlings. The frequency of shoot regeneration and the number of adventitious buds produced from the stem nodal explants significantly relied on the concentration of plant growth regulators. Half strength Murashige and Skoog (MS) medium supplemented with different concentrations of α- Naphthalene acetic acid (NAA), 6-Benzyl amino purine (BAP) and Thidiazuron (TDZ), separately and in combinations. The synergistic action between NAA and BAP enhanced the proliferation and elongation of shoots from the nodal segments. The highest number of shoots per explants (12.13±0.14) was obtained in half MS medium supplemented with 5.38 µM NAA and 16.15 µM BAP. Among the different phytohormones tested for rooting, the addition of 2.69 µM NAA shows highest frequency of root induction. More than 90% In vitro plants survived during acclimatization under ex vitro conditions. The protocol developed will not only help to alleviate the pressure on the natural population under stress, but will also help in meeting its demands in ornamental industry and also form the basis of conservation.*

*Key words: In vitro, Conservation, Plant growth regulators, acclimatization*

## EVALUATION OF ECONOMIC ASPECTS OF MITANIN PROGRAMME IN DISTRICT JANJGIR-CHAMPA

### [1]Kumud Singh and [2]Dr. Pratima Bais

[1]Research Scholar and [2]HOD and Assistant Professor, Department of Economics, Dr. C.V. Raman University, Kargi Road, Kota, Bilaspur (C.G.)

**ABSTRACT**

*In Chhattisgarh, Mitanin is a government community health worker (CHW). There are nearly 65,520 mitanins in 28 districts of Chhattisgarh who reach around people across villages and urban slums. They provide health education, link communities with formal government healthcare services, and mobilize community action for health rights. Mitanin are the backbone of the health system of Chattisgarh state and are meant to be selected by and be accountable to the community. Recognized as Mitanin in the District Janjgir – Champa, is the social health activist and a voluntary community health worker moreover an important human resource for public health system. Their inspiration to become a community health worker and constant efforts is a combination of monetary and non-monetary factors. This kind of motivation to work arises relatively from desire to work for the community and esteem, but is fostered by the financial benefit. This study has been undertaken with the objective to study the economic status of Mitanins in District Janjgir – Champa, and their contribution to household income and the role played by monetary incentives in their work. This study was conducted among 50 Mitanins of the District who were interviewed using pre-piloted structured questionnaire through which. their economic status was assessed. The results of the study reveal that the majority of Mitanins are earning between Rs. 3000 to Rs. 5000. The major findings of the study disclose that most Mitanins belong to poor socio-economic background, thus financial incentive was an important motivating factor with associated concerns about delay in payments even then contribute in a major way to their household income.*

*Keywords: Government community health worker, Esteem, Incentive, Motivation.*

.

## THE ROLE OF MITANINS IN ADDRESSING HEALTH RELATED ISSUES IN JANJGIR – CHAMPA

**[1]Kumud Singh and [2]Dr. Pratima Bais**

[1]Research Scholar and [2]HOD and Assistant Professor, Department of Economics, Dr. C.V. Raman University, Kargi Road, Kota, Bilaspur (C.G.)

**ABSTRACT**

*The study is focused to describe the role of Mitanins in addressing health related social issues in District Janjgir – Champa, with an idea to recognize the ways for strengthening and making recommendations on the working of Mitanins in Mitanin Programme and future Community Health Work programmes. For the purpose of the study, a case study design with qualitative research methods is adopted, with the sample comprising of action on social factors by the Community Health Workers. This case study describes successful action undertaken by Mitanins on nutrition or violence against women in the village or cluster of villages in the District Janjgir – Champa. Data collection was undertaken through In-depth Individual Interviews and Group Interviews with Mitanins, community members and programme staff that participated with the Mitanins in, and also benefitted from, their action on health related social issues. The conceptual framework of the factors facilitating and constraining the action of Mitanins on health related social issues, along with the pathways for action on social determinants by the Community Health Workers (CHWs), and their role, was developed at the start of the research. The analysis was done using this conceptual framework, which was refined during analysis, resulting in an explanatory framework. The study provides us with the resulting that, the Mitanins in the District Janjgir – Champa had effectively and successfully addressed the nutrition and other health related social issues, as imagined in the initial programme documents. Regardless of threats to the sovereignty of the programme, pressures to formalise the Mitanin's role, and reaction from assigned interests, such action keep on constant, since the start of the Mitanin programme.*

*Keywords: Mitanin, CHW, Cluster, Health, Nutrition, Community.*

## TEACHING: AN OVERVIEW

**Dr. Debabrata Bhattacharjee**

Post Graduate Teacher (Education), District Institute of Education and Training, Gomati, Tripura, India & Department of Secondary Education, Govt. of Tripura, India

**ABSTRACT**

*Teaching is a very specified activity where general and behavioural objectives are pre-determined and the entire teaching phases have their context specific correlation as pre-active phase, inter-active phase and post-active phases are very closely inter-related. Hence, the success or failure of teaching in terms of attainment of educational objective is solely relies upon teaching and for that aspect effectiveness in teaching is needed and it requires competent teachers who can well organize and manage the entire phase of teaching. The paper focuses on various core and peripheral issues of teaching so that the pertinent issues related with teaching can be comprehended. Since, teaching is a very specified activity and learning outcomes of the learners are depended on teaching, so teaching should be very scientific and learning objective oriented so that the qualitative outcome of learning can become possible.*

*Keywords: teaching, learner, competency, perception, learning-outcome*

तृतीय लिंग समुदाय और सामाजिक भेदभावः छ.ग. प्रदेष के संदर्भ में विवेचनात्मक अवलोकन

अरूण कुमार सिंह

षोधार्थी, समाजषास्त्र, डॉ सी वी रमन विष्वविद्यालय, बिलासपुर

डॉ ऋचा यादव

विभागाध्यक्ष, समाजषास्त्र, डॉ सी वी रमन विष्वविद्यालय, बिलासपुर

षोध सारांष

तृतीय लिंग समुदाय को बचपन में परिवार से बहिश्कार, फिर षिक्षा केंद्र में भेदभाव, फिर रहने वाले स्थानों में भेदभाव, कार्यस्थल पर भेदभाव इत्यादि को झेलना पड़ता है। समाज का यह व्यवहार समुदाय के लोगों को मानसिक रूप से इतना प्रभावित करता है कि यह उनके जीवन के हर पहलु में दिखाई देता है। प्रस्तुत षोध में इन्हीं तथ्यों की पड़ताल करने के लिए तृतीय लिंग के व्यक्तियों से सर्वे के माध्यम से जानकारी एकत्र कर के निश्कर्श निकाला गया है। षोध में यह पाया गया है कि किन्नर लोग भारतीय समाज में किनारे पर जीवन यापन कर रहे हैं। वे कभी भी सम्माननीय जीवन नहीं व्यतीत कर पाते। किन्नर लोग अनेकों प्रकार की असमानताओं का षिकार होते हैं जो कि सामाजिक कलंक के रुप में उनसे जुड़ी रहती हैं तथा इसी कारण नागरिक और मानव अधिकारों को प्राप्त करने में भेदभाव का षिकार होते हैं। किन्नर लोगों के साथ भेदभाव की दर उच्च स्तर पर है, जो कि दुर्व्यवहार और आत्महत्या का कारण बनती है।

कीवर्डः तृतीय लिंग, भेदभाव, सर्वे

भारतीय परिदृष्य में तृतीय लिंग वर्ग की दषाः एक विष्लेशण

अरूण कुमार सिंह

षोधार्थी, समाजषास्त्र, डॉ सी वी रमन विष्वविद्यालय, बिलासपुर

डॉ ऋचा यादव

विभागाध्यक्ष, समाजषास्त्र, डॉ सी वी रमन विष्वविद्यालय, बिलासपुर

**षोध सारांष**

समाज में फैली अदूरदर्शी या पक्षपातपूर्ण विचारधारा और तृतीय लिंग समुदाय के बहिष्कार के लिए काफी हद तक संसद के नुमाइंदे व न्याय के ठेकेदार जिम्मेदार हैं जो कि इन्हें एक अति पिछड़े समुदाय के रुप में जकड़े रखते हैं। किन्नरों के लिए असम्मान की भावना समाज की विभिन्न संरचनाओं जैसे— परिवार, शैक्षिक संस्थाओं आदि में पायी जाती है। आवश्यक शैक्षिक व स्वास्थ्य सुविधाओं से बहिष्कार की शुरुआत तब होती है जब ये लोग घर छोड़ने का फैसला करते हैं या घर छोड़ देते हैं। शिक्षा और आय के स्रोतों के अभाव में काफी बड़ी मात्रा में ये वेश्यावृत्ति की ओर खिंचे चले जाते हैं और गम्भीर संक्रमणीय बीमारियों जैसे—एच. आई. वी. का शिकार हो जाते हैं। सम्पूर्ण मानव अधिकारों का अभाव, असम्मान, तीखी आलोचना, संघ बनाने विशेषाधिकारों व अभिव्यक्ति की आजादी का हनन, लैंगिक स्वायत्तता की अनुपस्थिति आदि बहिष्कार के बिन्दु हैं जिसके कारण ये लोग हॉसिये पर खड़े हैं। मीडिया के द्वारा इनकी छवि का गलत ढ़ग से वर्णन किया जाता है।

**कीवर्डः** तृतीय लिंग, असम्मान, लैंगिक स्वायत्तता

## छ.ग. राज्य में आदिवासियों की जीवन षैलीः कोरवा जनजाति के विषेश संदर्भ में

संध्या षुक्ल

षोधार्थी, समाजषास्त्र, डॉ सीवी रमन विष्वविद्यालय, बिलासपुर

डॉ रीना तिवारी

सहायक प्राध्यापक, समाजषास्त्र, डॉ सीवी रमन विष्वविद्यालय, बिलासपुर

**षोध सारांष**

छ.ग. में आदिवासी प्राचीन समय से दुर्गम भागों मे निवासरत् है। इन्हें यहाँ के षहरों के समान सुख सुविधाएँ उपलब्ध नहीं है। मुख्यतः प्राकृतिक संसाधनों पर निर्भर इन लोगों को अपने पूरे जीवनकाल में अनेक प्रकार की चुनौतीयों का सामना करना पड़ता है। प्रकृति के करीब रहने के कारण अन्य जीव–जन्तुओं का भय, भरण पोशण के लिए वनोपज और प्राकृतिक चीजों की निर्भरता, षिक्षा का अभाव, स्वास्थ्य सुविधाओं का अभाव और उसमें भी जड़ी बुटीयों पर निर्भरता इत्यादि कुछ ऐसे कारण है जो एक आम आदमी को इन स्थानों में जाने और वहाँ जीवन यापन करने से कोसों दूर कर देते है। इन परिस्थितियों में आदिवासी किस प्रकार की जीवन षैली से रहते है और अपनी अगली पीढ़ी को खड़ा करते है? इसी बातों की पड़ताल करते हुए यह षोध किया गया है।

**कीवर्ड :** पहाड़ी कोरवा, जीवन षैली, संघर्श

छग राज्य में कोरवा जनजाति की सामाजिक और आर्थिक स्थिति की विवेचना

संध्या षुक्ल

षोधार्थी, समाजषास्त्र, डॉ सीवी रमन विष्वविद्यालय, बिलासपुर

डॉ रीना तिवारी

सहायक प्राध्यापक, समाजषास्त्र, डॉ सीवी रमन विष्वविद्यालय, बिलासपुर

## षोध सारांष

आदिवासी प्राचीन समय से दुर्गम पठारी वनों से अच्छादित पहाड़ी भागों मे निवासरत् है। इनके सामाजिक जीवन के साधन आसान नहीं होते हैं। इनमें राज्य सुदूर पूर्वी अंचल के बीहड़ जंगलों, पहाड़ों तथा पठारों में बसा ''कोरवा'' जनजाति बरसो से ही अलग–थलग तथा विभिन्न समस्याओं से ग्रस्त और अस्तित्व के लिये संघर्षरत रहा है। इनका जीवन पूर्णतः भौगोलिक परिस्थितियों और प्रकृति पर निर्भर रहती है। अपनी विषिश्ठ संस्कृति, बोली एवं भौगोलिक परिस्थिति का सामना करते विकास की मुख्य धारा से दूर ये जनजाति कई पीढ़ियों से रूढ़िवादी तरीकों से जीवनयापन कर रही है। जनजाति के लोगों में इस आधुनिक युग में भी कोई खास परिवर्तन नहीं आया है। स्थानीय षासन के लोग भी इस लोगों में इच्छा एवं जागरूकता की कमी और स्थान परिवर्तन ना करने के कारण ध्यान नहीं देते है। प्रस्तुत षोध के माध्यम से कोरवा जनजाति की वर्तमान सामाजिक और आर्थिक स्थिति की विवेचना की गई है।

कीवर्ड : पहाड़ी कोरवा, जनजाति, सामाजिक स्थिति, आर्थिक स्थिति

# पेसा से अनुसूचित क्षेत्र का सामाजिक विकासः एक कल्पना

सुदर्षन कुमार मंडल

षोधार्थी, समाज कार्य, डॉ सीवी रामन विष्वविद्यालय, बिलासपुर

डॉ ऋचा यादव

विभागाध्यक्ष, समाजषास्त्र, डॉ सीवी रामन विष्वविद्यालय, बिलासपुर

## षोध सारांष

अनुसूची क्षेत्र (पेसा) में सरकारी संस्था/गैर सरकारी संगठन द्वारा अनूसूचित जाति/अनुसूचित जनजाति में षैक्षणिक, आर्थिक, सामाजिक तथा मानसिक परिवर्तन हेतु कार्य अपेक्षित होता है। ग्रामीण क्षेत्रों में रहने वाले लोग आर्थिक अभाव के कारण पारिवारिक तथा सामाजिक समस्याओं से ग्रस्त है। आय अत्यधिक कम होने के कारण वांच्छित लक्ष्य प्राप्त नहीं कर पा रहे है। षासकीय सुविधाओं के जानकारी के अभाव में षासकीय सुविधाओं का लाभ नहीं उठा पा रहे है। सरकारी संस्था/गैर सरकारी संगठन अनुसूचित जाति एवं जनजाति में मानसिक, षैक्षणिक, आर्थिक, सामाजिक क्षेत्र में महत्वपूर्ण भूमिका निभा सकती है। प्रस्तुत षोध में पेसा एक्ट के अधीन आने वाले क्षेत्रों में इसकी भूमिका पर प्रकाष डाला गया है।

कीवर्डः अनुसूची, पेसा, विकास

# पेसा एक्ट और उसके कियांवयन का तुलनात्मक अध्ययनः छत्तीसगढ़ के विषेश संदर्भ में

सुदर्षन कुमार मंडल

षोधार्थी, समाज कार्य, डॉ सीवी रामन विष्वविद्यालय, बिलासपुर

डॉ ऋचा यादव

विभागाध्यक्ष, समाजषास्त्र, डॉ सीवी रामन विष्वविद्यालय, बिलासपुर

## षोध सारांष

पेसा कानून में अनेक प्रावधान किये गये है। ग्रामसभा संरचना और कार्य एवं उसकी बैठकें, ग्रामसभा की स्थाई समितियां, ग्रामसभा कोष गठन, ग्रामसभा द्वारा प्राकृतिक संसाधनों का संरक्षण एवं विकास कार्यो का अनुमोदन, अनुसूचित क्षेत्रों में लघु जल निकाय, गौण खनिजों का खनन पट्टा, पर्यावरण संरक्षण, अनुसूचित क्षेत्रों में अतिक्रमण रोकने, धन उधार व्यवस्था, हाट बाजार नियंत्रण, सामाजिक क्षेत्र के संस्थाओं एवं कर्मचारियों का नियंत्रण, नशीले पदार्थ की बिक्री एवं खपत का विनियमन, सांस्कृतिक विरासत और उसकी समृद्धि, लघु वनोपज का प्रबंधन, शांति, सुरक्षा तथा चुनाव के मामले में परंपरा और कानून, जैव विविधता का प्रबंधन एवं बौद्धिक संपदा नियंत्रण और दंड, प्राकृतिक संसाधनों का प्रबंधन, श्रम शक्ति एवं मानव साधन, ग्रामसभा में विकास कार्ययोजना, अनुमोदन इत्यादि इस कानून के महत्वपूर्ण अंग है। इस षोध पत्र में पेसा एक्ट से ग्राम सभा को प्राप्त षक्तियॉ और जमीनी स्तर पर एक्ट का तुलनात्मक अध्ययन किया गया है।

कीवर्डः पेसा, ग्रामसभा, तुलनात्मक अध्ययन

# MANUSCRIPT SUBMISSION

## GUIDELINES FOR CONTRIBUTORS

1. Manuscripts should be submitted preferably through email and the research article / paper should preferably not exceed 8 – 10 pages in all.

2. Book review must contain the name of the author and the book reviewed, the place of publication and publisher, date of publication, number of pages and price.

3. Manuscripts should be typed in 12 font-size, Times New Roman, single spaced with 1" margin on a standard A4 size paper. Manuscripts should be organized in the following order: title, name(s) of author(s) and his/her (their) complete affiliation(s) including zip code(s), Abstract (not exceeding 350 words), Introduction, Main body of paper, Conclusion and References.

4. The title of the paper should be in capital letters, bold, size 16" and centered at the top of the first page. The author(s) and affiliations(s) should be centered, bold, size 14" and single-spaced, beginning from the second line below the title.

<div align="center">

**First Author Name1, Second Author Name2, Third Author Name3**

1Author Designation, Department, Organization, City, email id

2Author Designation, Department, Organization, City, email id

3Author Designation, Department, Organization, City, email id

</div>

5. The abstract should summarize the context, content and conclusions of the paper in less than 350 words in 12 points italic Times New Roman. The abstract should have about five key words in alphabetical order separated by comma of 12 points italic Times New Roman.

6. Figures and tables should be centered, separately numbered, self explained. Please note that table titles must be above the table and sources of data should be mentioned below the table. The authors should ensure that tables and figures are referred to from the main text.

## EXAMPLES OF REFERENCES

All references must be arranged first alphabetically and then it may be further sorted chronologically also.

- **Single author journal article:**

Fox, S. (1984). Empowerment as a catalyst for change: an example for the food industry. *Supply Chain Management*, *2*(3), 29–33.

Bateson, C. D.,(2006), 'Doing Business after the Fall: The Virtue of Moral Hypocrisy', Journal of Business Ethics, 66: 321 – 335

- **Multiple author journal article:**

Khan, M. R., Islam, A. F. M. M., & Das, D. (1886). A Factor Analytic Study on the Validity of a Union Commitment Scale. *Journal of Applied Psychology*, *12*(1), 129-136.

Liu, W.B, Wongcha A, & Peng, K.C. (2012), "Adopting Super-Efficiency And Tobit Model On Analyzing the Efficiency of Teacher's Colleges In Thailand", International Journal on New Trends In Education and Their Implications, Vol.3.3, 108 – 114.

- **Text Book:**

Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2007). *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies* (3rd ed.). New York: McGraw-Hill.

S. Neelamegham," Marketing in India, Cases and Reading, Vikas Publishing House Pvt. Ltd, III Edition, 2000.

- **Edited book having one editor:**

Raine, A. (Ed.). (2006). *Crime and schizophrenia: Causes and cures.* New York: Nova Science.

- **Edited book having more than one editor:**

Greenspan, E. L., & Rosenberg, M. (Eds.). (2009). *Martin's annual criminal code:Student edition 2010.* Aurora, ON: Canada Law Book.

- **Chapter in edited book having one editor:**

Bessley, M., & Wilson, P. (1984). Public policy and small firms in Britain. In Levicki, C. (Ed.), *Small Business Theory and Policy* (pp. 111–126). London: Croom Helm.

- **Chapter in edited book having more than one editor:**

Young, M. E., & Wasserman, E. A. (2005). Theories of learning. In K. Lamberts, & R. L. Goldstone (Eds.), *Handbook of cognition* (pp. 161-182). Thousand Oaks, CA: Sage.

- **Electronic sources should include the URL of the website at which they may be found, as shown:**

Sillick, T. J., & Schutte, N. S. (2006). Emotional intelligence and self-esteem mediate between perceived early parental love and adult happiness. *E-Journal of Applied Psychology*, 2(2), 38-48. Retrieved from http://ojs.lib.swin.edu.au/index.php/ejap

- **Unpublished dissertation/ paper:**

Uddin, K. (2000). A Study of Corporate Governance in a Developing Country: A Case of Bangladesh (Unpublished Dissertation). Lingnan University, Hong Kong.

- **Article in newspaper:**

Yunus, M. (2005, March 23). Micro Credit and Poverty Alleviation in Bangladesh. *The Bangladesh Observer*, p. 9.

- **Article in magazine:**

Holloway, M. (2005, August 6). When extinct isn't. *Scientific American, 293*, 22-23.

- **Website of any institution:**

Central Bank of India (2005). *Income Recognition Norms Definition of NPA*. Retrieved August 10, 2005, from http://www.centralbankofindia.co.in/ home/index1.htm, viewed on

7. The submission implies that the work has not been published earlier elsewhere and is not under consideration to be published anywhere else if selected for publication in the journal of Indian Academicians and Researchers Association.

8. Decision of the Editorial Board regarding selection/rejection of the articles will be final.

# INTERNATIONAL JOURNAL OF RESEARCH
# IN MANAGEMENT & SOCIAL SCIENCE
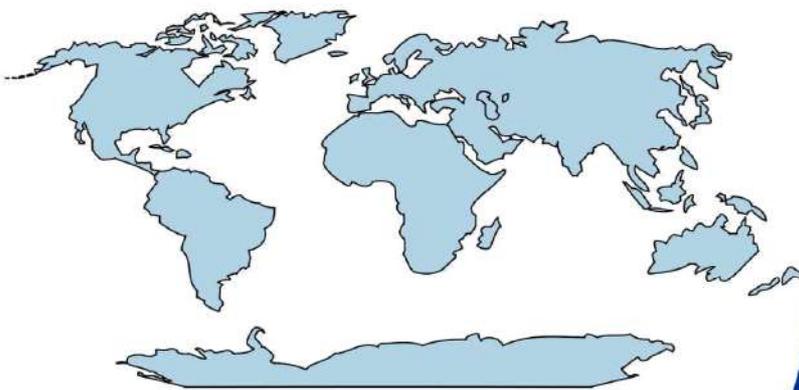
# International Journal of Research in
# Science and Technology

# INDIAN ACADEMICIANS AND RESEARCHERS ASSOCIATION

Membership No: M / M – 1365

## Certificate of Membership

This is to certify that

### XXXXXXXX

is admitted as a

**Fellow Member**

of

### Indian Academicians and Researchers Association

in recognition of commitment to Educational Research

and the objectives of the Association

Date: 27.01.2020

Director

President

# INDIAN ACADEMICIANS AND RESEARCHERS ASSOCIATION

**Membership No: M / M – 1365**

## Certificate of Membership

This is to certify that

### XXXXXXXXXX

is admitted as a

**Life Member**

of

## Indian Academicians and Researchers Association

in recognition of commitment to Educational Research

and the objectives of the Association

Date: 27.01.2020

Director

President

# INDIAN ACADEMICIANS AND RESEARCHERS ASSOCIATION

**Membership No: M / M – 1365**

## Certificate of Membership

This is to certify that

## XXXXXXXX

is admitted as a

**Member**

of

## Indian Academicians and Researchers Association

in recognition of commitment to Educational Research

and the objectives of the Association

Date: 27.01.2020

Director

President

# IARA Organized its 1$^{st}$ International Dissertation & Doctoral Thesis Award in September'2019

## 1$^{st}$ International
## Dissertation & Doctoral Thesis Award
## (2019)

Organized By

Indian Academicians and Researchers Association ( IARA )

Ashish Kumar Sinha, Dr. Soubhik Chakraborty
Dr. Amritanjali
ISBN : 978-81-930928-8-0
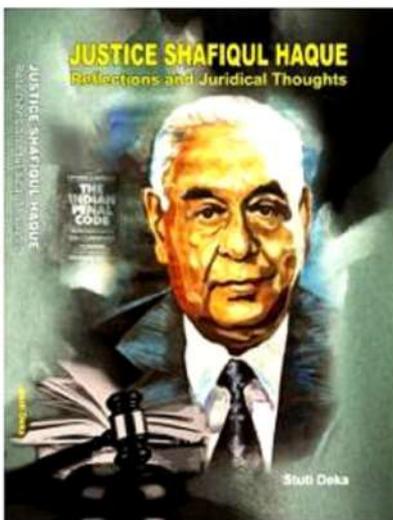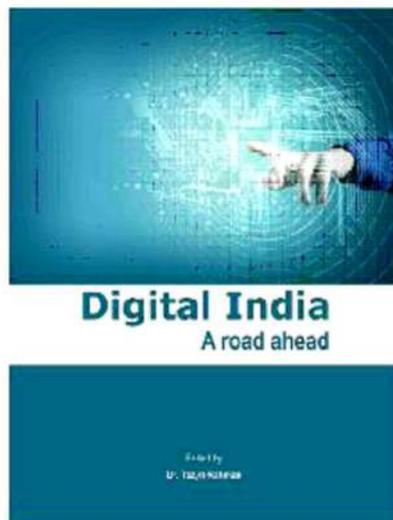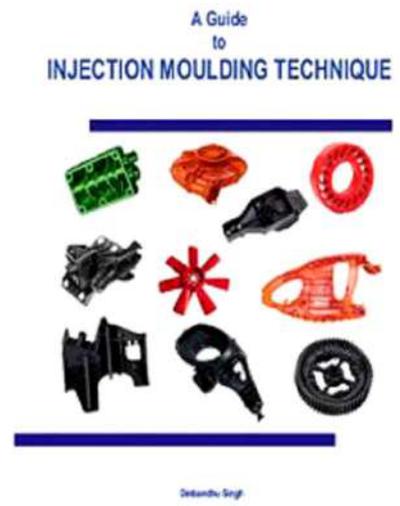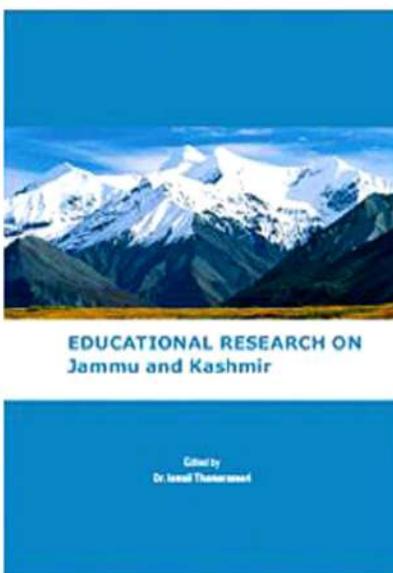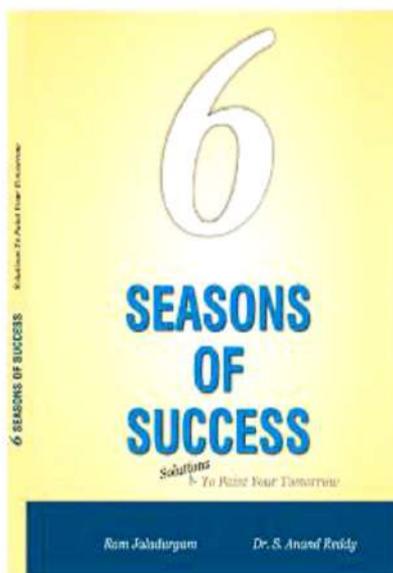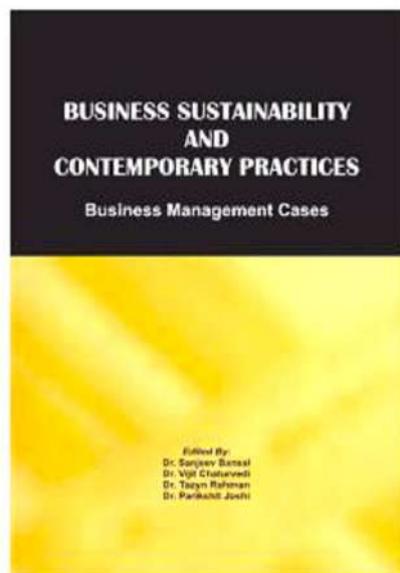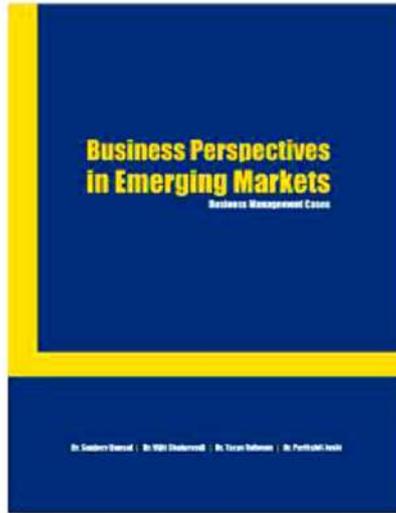


Dr Sanjeev Bansal, Dr. Vijit Chaturvedi
Dr. Tazyn Rahman, Dr. Parikshit Joshi
ISBN : 978-81-936264-0-5



Dr. Jyotsna Golhar
Dr. Sujit Metre
ISBN : 978-81-936264-6-7
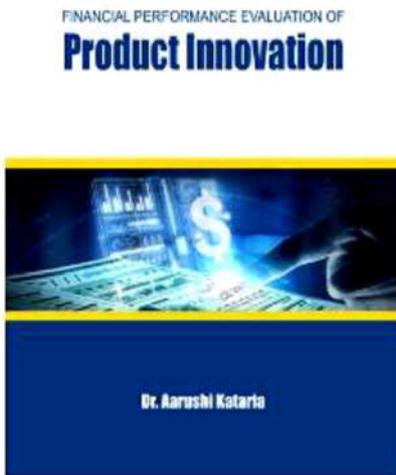


Dr. Aarushi Kataria
ISBN : 978-81-936264-3-6
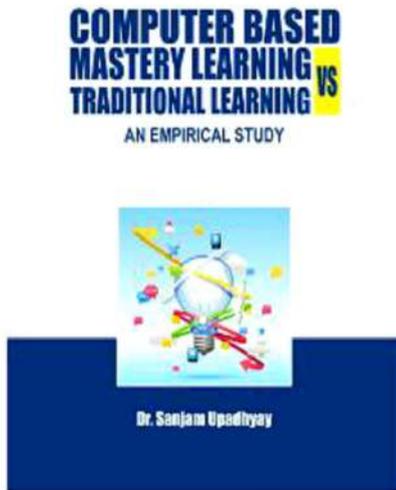


Dr. Sanjam Upadhyay
ISBN : 978-81-936264-5-0
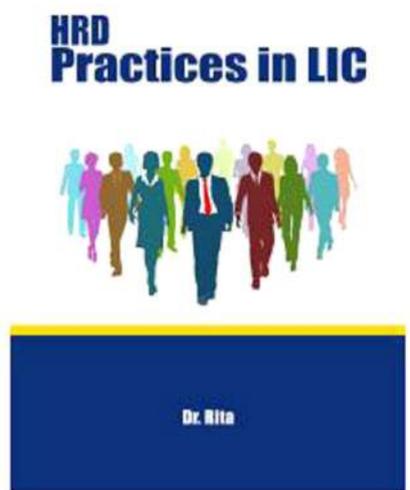


Dr. Rita
ISBN : 978-81-930928-7-3
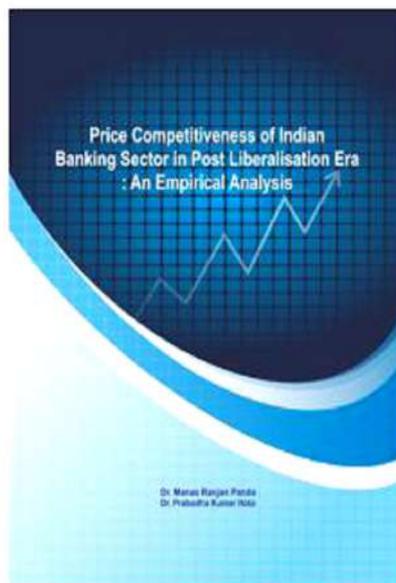


Dr. Manas Ranjan Panda, Dr. Prabodha Kr. Hota
ISBN : 978-81-930928-4-2



Poornima University
ISBN : 978-8193-6264-74



Institute of Public Enterprise
ISBN : 978-8193-6264-4-3

## Vitamin D Supplementation in SGA Babies

Dr. Jyothi Naik, Prof. Dr. Syed Manazir Ali
Dr. Uzma Firdaus, Prof. Dr. Jamal Ahmed

## Gold Nanoparticles: Plasmonic Aspects And Applications

Dr. Abhitosh Kedia
Dr. Pandian Senthil Kumar

Dr. Abhitosh Kedia
Dr. Pandian Senthil Kumar

## Social Media Marketing and Consumer Behavior

Dr. Vinod S. Chandwani

Dr. Vinod
S. Chandwani

## Select Research Papers of Prof. Dr. Dhananjay Awasarikar

Prof. Dr. Dhananjay
Awasarikar

## Recent ReseaRch Trends in ManageMenT

Dr. C. Samudhra Rajakumar, Dr. M. Ramesh
Dr. C. Kathiravan, Dr. Rincy V. Mathew

## Recent ReseaRch Trends in Social Science

Dr. C. Samudhra Rajakumar, Dr. M. Ramesh
Dr. C. Kathiravan, Dr. Rincy V. Mathew

## Recent Research Trend in Business Administration

Dr. C. Samudhra Rajakumar, Dr. M. Ramesh
Dr. C. Kathiravan, Dr. Rincy V. Mathew

## Recent Innovations in Biosustainability and Environmental Research II
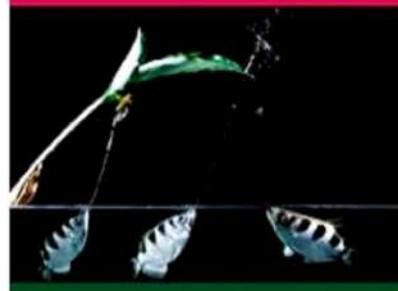
Dr. V. I. Paul, Dr. M. Muthulingam
Dr. A. Elangovan, Dr. J. Nelson Samuel Jebastin

## Teacher Education: Challenges Ahead

Sajid Jamal
Mohd Shakir

**Pr oj ect Ma na ge Ment**

Dr. R. Emmaniel
ISBN : 978-81-939070-3-0

The *théâtre engagé*
American Drama from the '29 Crash to World War II
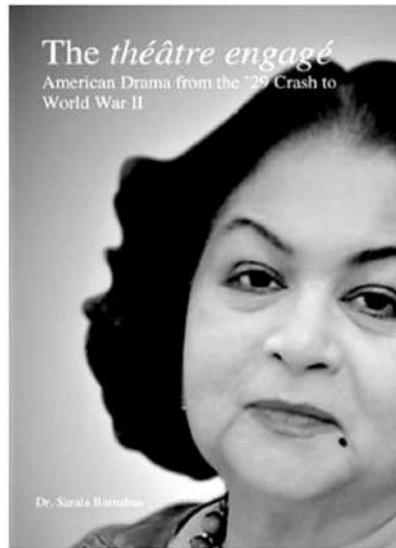
Dr. Sarala Barnabas

Dr. Sarala Barnabas
ISBN : 978-81-941253-3-4

*Corporate* **Entrepreneurship**

AUTHORS
Dr. M. Banumathi
Dr. C. Samudhra Rajakumar

Dr. M. Banumathi
Dr. C. Samudhra Rajakumar
ISBN : 978-81-939070-5-4

**VIJANAN**
COMMERCE AND MANAGEMENT
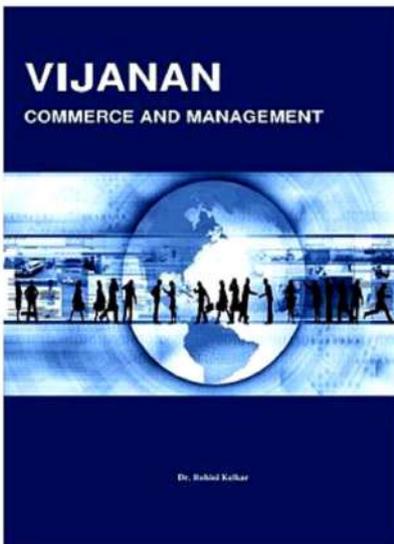
Dr. Rohini Kelkar

Dr. (Mrs.) Rohini Kelkar
ISBN : 978-81-941253-0-3

**Recent Research Trends in** Management and Social Science

Dr. Tazyn Rahman

Dr. Tazyn Rahman
ISBN : 978-81-941253-2-7

**VIJANAN**
INFORMATION TECHNOLOGY

N. Lakshmi Kavitha
Mithila Satam
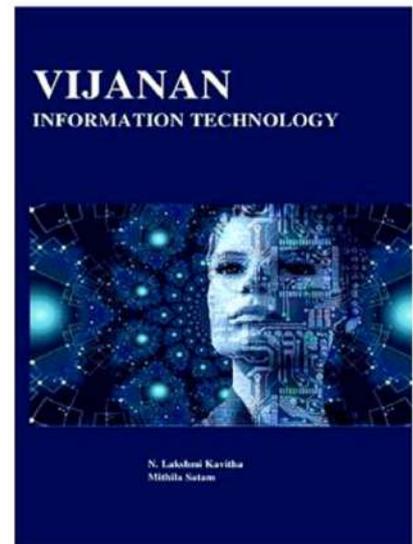
Dr. N. Lakshmi Kavitha
Mithila Satam
ISBN : 978-81-941253-1-0

**Emerging Research**
Trends in Management and Social Science

Dr. Hiresh Luhar
Prof. Arti Sharma
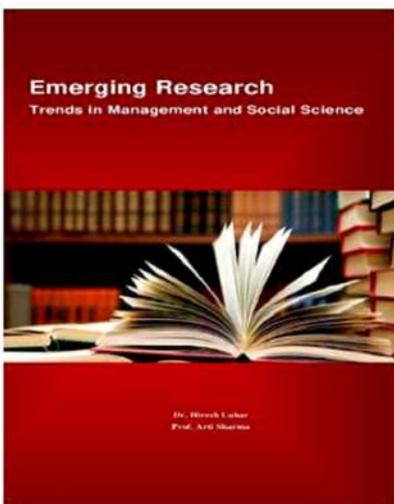
Dr. Hiresh Luhar
Prof. Arti Sharma
ISBN : 978-81-941253-4-1

**Life of Slum Occupants** & **Saving Pattern**

Dr. Hiresh S. Luhar
Dr. Ashok S. Luhar

Dr. Hiresh S. Luhar
Dr. Ashok S. Luhar
ISBN : 978-81-941253-5-8

**Computerised Information System:**
Concepts & Applications

Babita Kanojia
Dr. Arvind S. Luhar
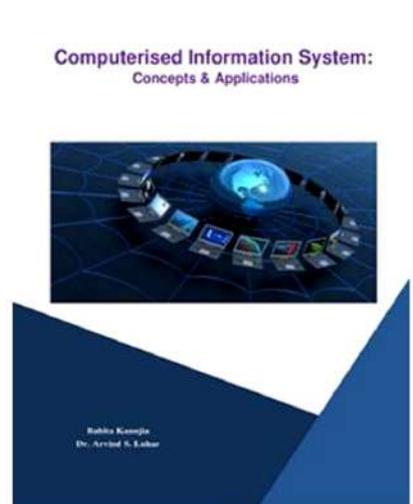
Dr. Babita Kanojia
Dr. Arvind S. Luhar
ISBN : 978-81-941253-7-2

**SKILLS FOR SUCCESS**

Dr. Sw Rajamonaharane
SK Nathan
ISBN : 978-81-942475-0-0



**Witness Protection Regime**
An Indian Perspective

Aditi Sharma
ISBN : 978-81-941253-8-9



**Self-Finance Courses:**
Popularity & Financial Viability

Dr. Ashok S. Luhar
Dr. Hiresh S. Luhar
ISBN : 978-81-941253-6-5



SMALL SCALE INDUSTRIES MANAGEMENT
Issues, Challenges and Opportunities

Dr. B. Augustine Arockiaraj
ISBN : 978-81-941253-9-6



**SPOILAGE OF VALUABLE SPICES BY MICROBES**

Dr. Kuljinder Kaur
ISBN : 978-81-942475-4-8



**Financial Capability of Students: An Increasing Challenge in Indian Economy**

Dr. Priyanka Malik
ISBN : 978-81-942475-1-7



THE RELATIONSHIP BETWEEN ORGANIZATION CULTURE AND EMPLOYEE PERFORMANCE: HOSPITALITY SECTOR

Dr. Rekha P. Khosla
ISBN : 978-81-942475-2-4



**A GUIDE TO**
TWIN LOBE BLOWER AND ROOT BLOWER TECHNIQUE

Dilip Pandurang Deshmukh
ISBN : 978-81-942475-3-1



**SILVER JUBLIEE**
COMMEMORATIVE LECTURE SERIES 2019-SNGC

Dr. D. Kalpana, Dr. M. Thangavel
ISBN : 978-81-942475-5-5

## Indian Commodity
### Futures and Spot Markets

Dr. Aloysius Edward J

**Dr. Aloysius Edward J.**
ISBN : 978-81-942475-7-9

## Correlates of Burnout Syndrome Among Servicemen

Dr. Rosemary Obiageeri Ekechukwu

**Dr. R. O. Ekechukwu**
ISBN : 978-81-942475-8-6

## Advances in Mathematical Sciences
(A Collection of Survey Research Articles)
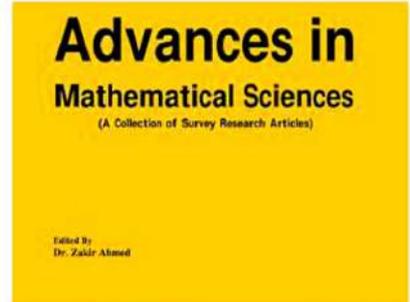
Edited By
Dr. Zakir Ahmed
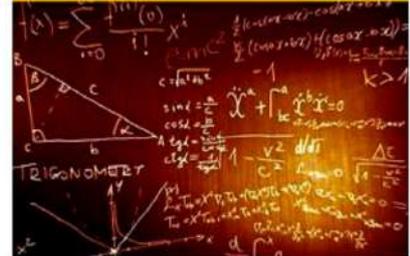
**Dr. Zakir Ahmed**
ISBN : 978-81-942475-9-3
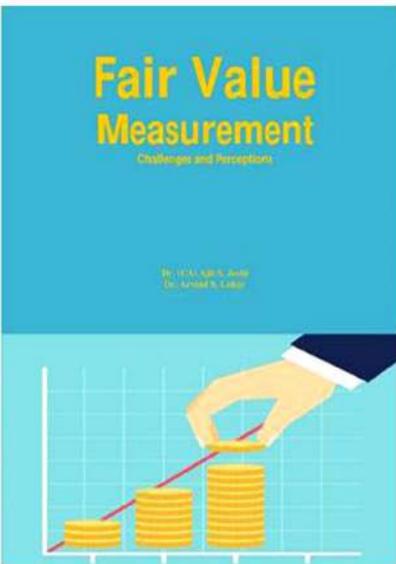
## Fair Value Measurement
Challenges and Perceptions

Dr. (CA) Ajit S. Joshi
Dr. Arvind S. Luhar

**Dr. (CA) Ajit S. Joshi**
**Dr. Arvind S. Luhar**
ISBN : 978-81-942475-6-2
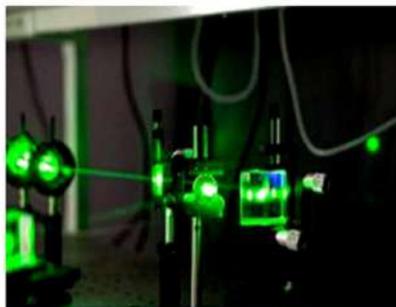
## NONLINEAR OPTICAL CRYSTALS FOR LASER
Growth and Analysis Techniques

Madhav N Rode
Dilipkumar V Mehsram

**Madhav N Rode**
**Dilip Kumar V Mehsram**
ISBN : 978-81-943209-6-8

## Remote Sensing of River Pollution And Agricultural Soils

Dr. Saif Said
Mr. Shadab Ali Khan

**Dr. Saif Said**
**Shadab Ali Khan**
ISBN : 978-81-943209-1-3
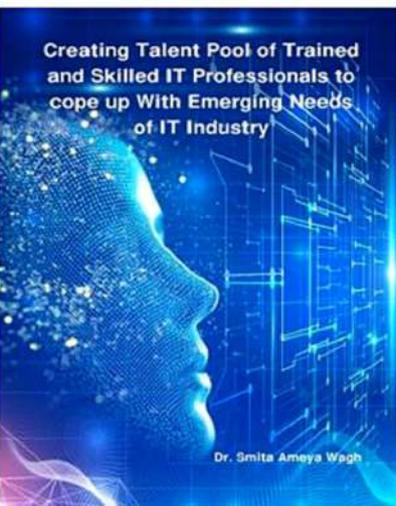
## Creating Talent Pool of Trained and Skilled IT Professionals to cope up With Emerging Needs of IT Industry

Dr. Smita Ameya Wagh

**Dr. Smita Ameya Wagh**
ISBN : 978-81-943209-9-9
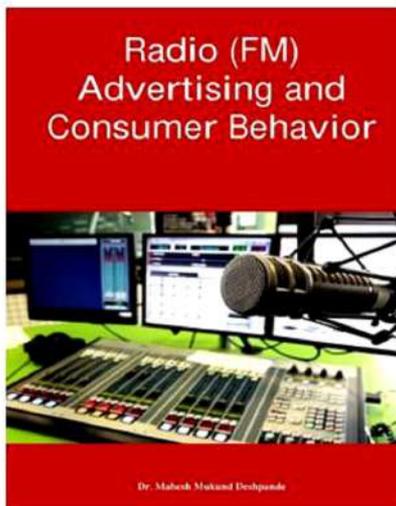
## Radio (FM) Advertising and Consumer Behavior

Dr. Mahesh Mukund Deshpande

**Dr. Mahesh Mukund Deshpande**
ISBN : 978-81-943209-7-5
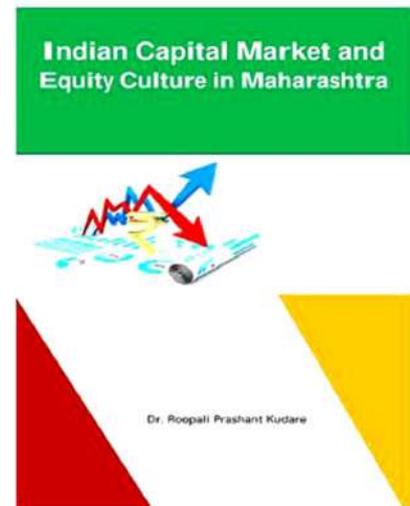
## Indian Capital Market and Equity Culture in Maharashtra

Dr. Roopali Prashant Kudare

**Dr. Roopali Prashant Kudare**
ISBN : 978-81-943209-3-7
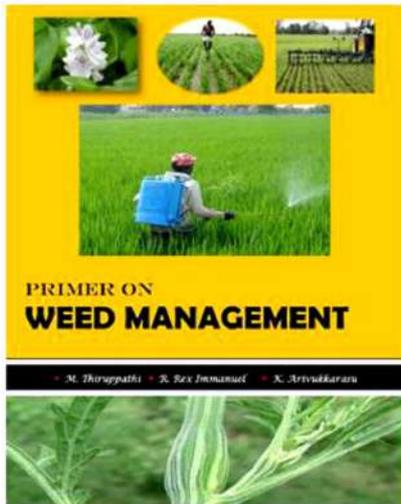
M. Thiruppathi
R. Rex Immanuel
K. Arivukkarasu
ISBN : 978-81-930928-9-7
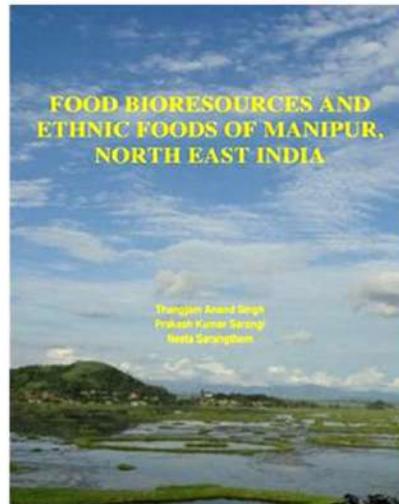


Dr. Th. Anand Singh
Dr. Prakash K. Sarangi
Dr. Neeta Sarangthem
ISBN : 978-81-944069-0-7
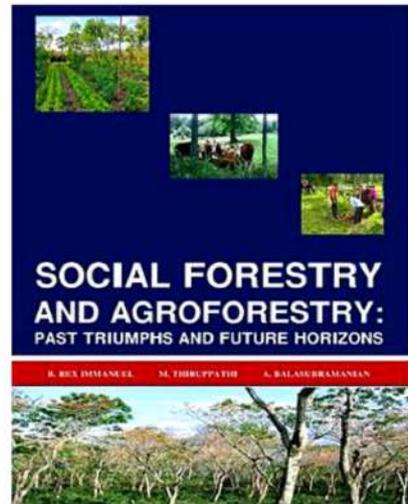


R. Rex Immanuel
M. Thiruppathi
A. Balasubramanian
ISBN : 978-81-943209-4-4
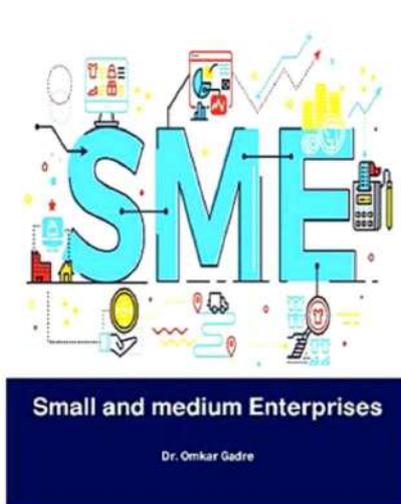


Dr. Omkar V. Gadre
ISBN : 978-81-943209-8-2
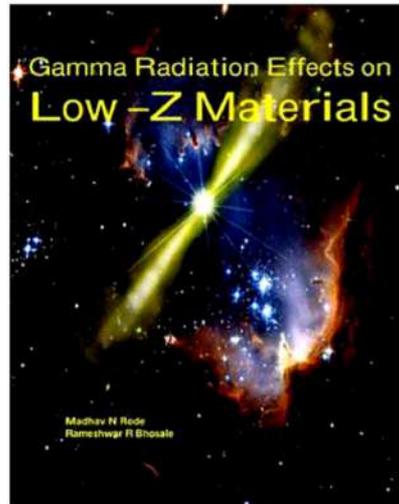


Madhav N Rode
Rameshwar R. Bhosale
ISBN : 978-81-943209-5-1
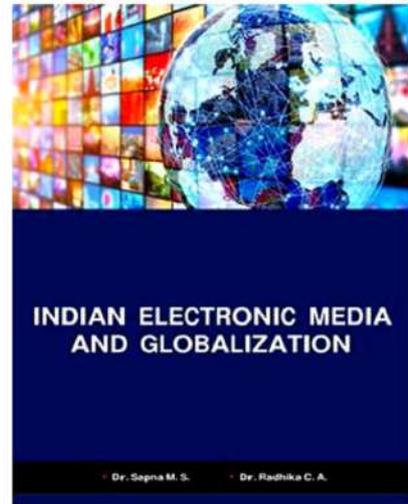


Dr. Sapna M S
Dr. Radhika C A
ISBN : 978-81-943209-0-6
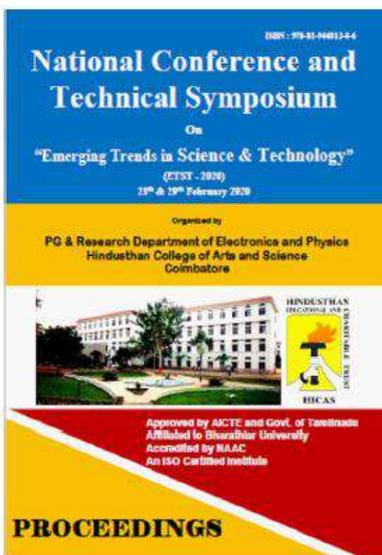


Hindusthan College
ISBN : 978-81-944813-8-6
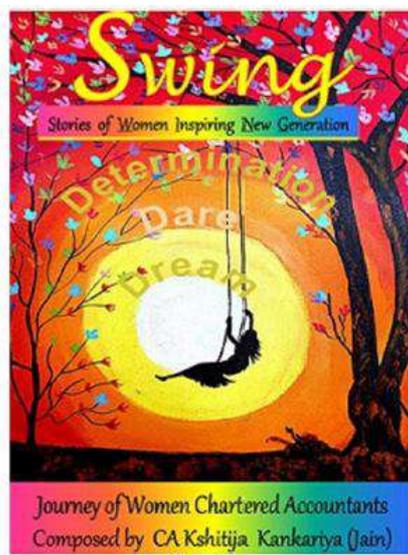


Swing
ISSN: 978-81-944813-9-3
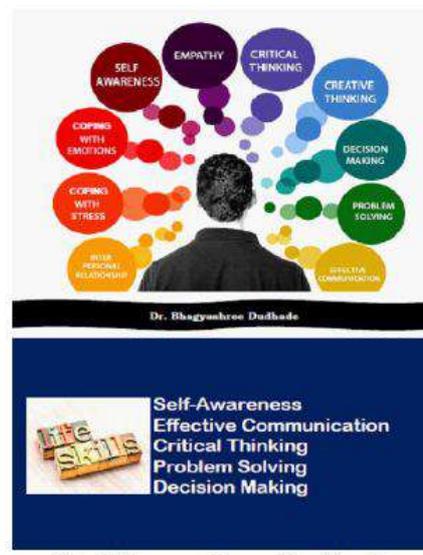


Dr. Bhagyashree Dudhade
ISBN : 978-81-944069-5-2
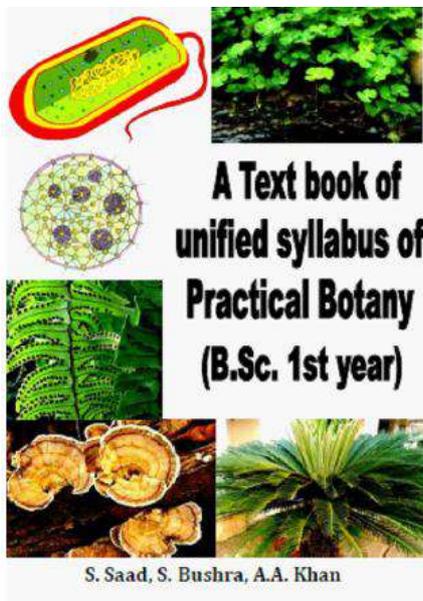
S. Saad, S. Bushra, A.A. Khan

**S. Saad, S. Bushra, A. A. Khan**
ISBN: 978-81-944069-9-0
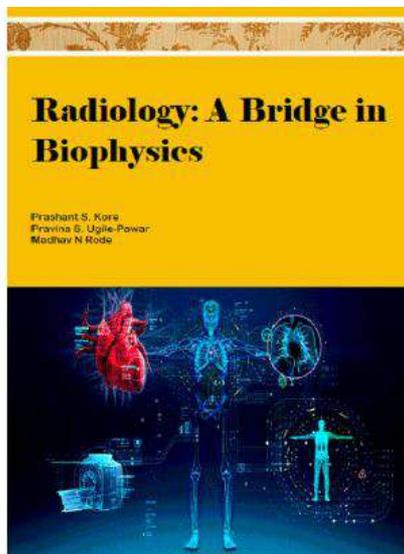


**Prashant S. Kore**
**Pravina S. Ugile-Pawar**
**Madhav N Rode**
ISSN: 978-81-944069-7-6
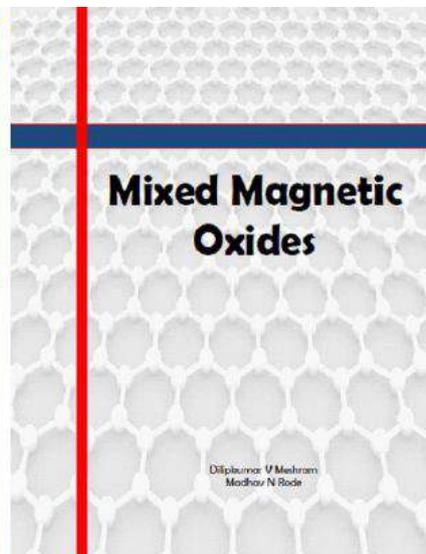


**Dilipkumar V Meshram and**
**Madhav N Rode**
ISSN: 978-81-944069-6-9
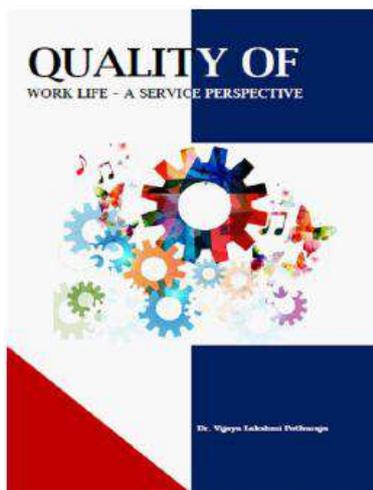


**Dr. Vijaya Lakshmi Pothuraju**
ISBN : 978-81-943209-2-0



**Pratibha College**
ISBN : 978-81-944813-2-4



**Pratibha College**
ISBN : 978-81-944813-3-1
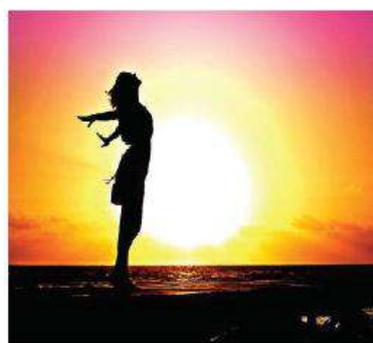


**Dr. Tazyn Rahman**
ISBN : 978-81-936264-1-2
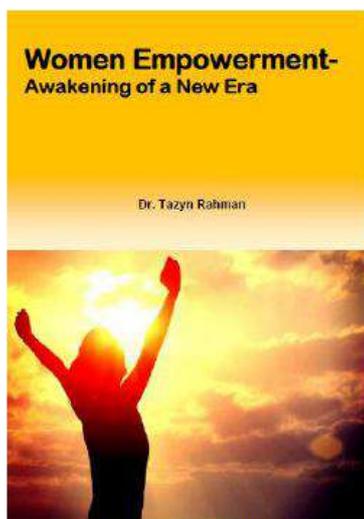


**Dr. Tazyn Rahman**
ISBN : 978-81-944813-5-5
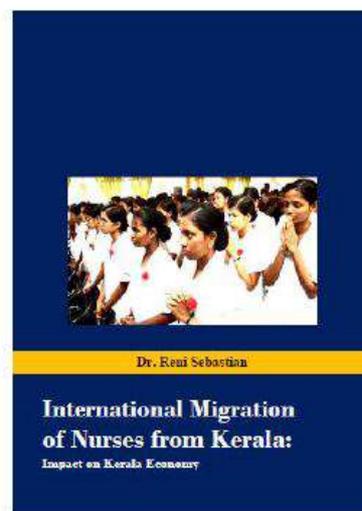


**Dr. Reni Sebastian**
ISBN : 978-81-944069-2-1
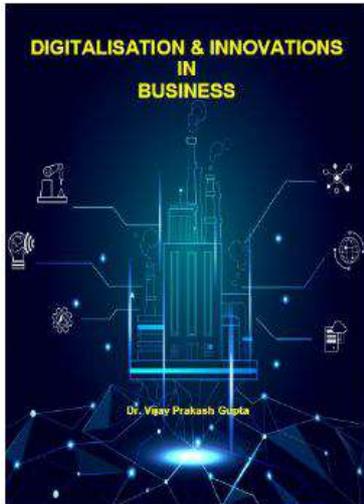
**Dr. Vijay Prakash Gupta**
ISBN : 978-81-944813-1-7
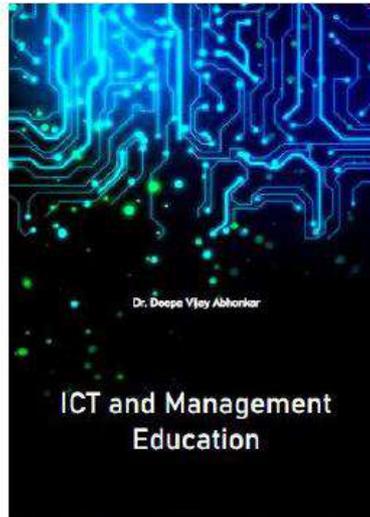


**Dr. Deepa Vijay Abhonkar**
ISBN : 978-81-944813-6-2



**Arasu Engineering College**
ISSN: 978-81-944813-4-8
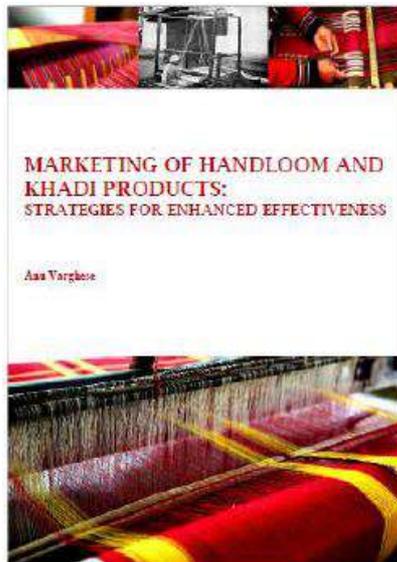


**Dr. Anu Varghese**
ISBN : 978-81-944069-4-5



**Dr. Renuka Vanarse**
ISBN : 978-81-944069-1-4