

**STUDY OF CHEMICAL MIGRATION FROM NEWSPAPER INK INTO THE OILY FOOD USING THIN LAYER CHROMATOGRAPHY****Ms. Pooja Umesh Shah<sup>1</sup>, Dr. Harshada Niju<sup>2</sup> and Dr. Leena Sarkar<sup>3</sup>**<sup>1</sup>MSc, Department of Chemistry, JVM's Degree College<sup>2</sup>Assistant Professor, Department of Chemistry, J. V. M. 's Metha Degree College<sup>3</sup>HOD, Department of Chemistry, J. V. M. 's Metha Degree College**ABSTRACT**

*The widespread use of newspapers for wrapping and draining excess oil from deep-fried foods presents substantial health risks owing to the migration of toxic chemicals from printing inks. It represents a critical food safety concern, particularly in regions where newspapers serve as informal packaging for fried snacks and street foods. Newspaper inks, typically composed of mineral oils, heavy metals (Lead, Cadmium), and carcinogenic aromatic hydrocarbons (Naphthylamines, Benzo[a]pyrene). This review examines the underlying mechanisms of chemical migration, especially into lipophilic (oily) food matrices, and assesses the effectiveness of **Thin-Layer Chromatography (TLC)** as a reliable diagnostic tool. Given their lipophilic properties, these substances leach more readily into oily foods, which effectively serve as a solvent facilitating extraction. TLC provides a cost-effective, rapid, and user-friendly analytical approach for separating these migrants and confirming their presence through retention factors (*R<sub>f</sub>*). Employing silica gel stationary phases and non-polar mobile phases (hexane:ethyl acetate, 9:1) TLC enables separation of ink constituents including pigments, amines, and plasticizers. Separation and visualization of components were carried out under ultraviolet light and iodine vapour, and *R<sub>f</sub>* values were compared. The appearance of similar chromatographic spots with comparable *R<sub>f</sub>* values in both ink extracts and food-contact extracts provided clear evidence of chemical migration from newspaper ink into food. The findings highlight the susceptibility of oily foods to contamination due to their ability to solubilize hydrophobic ink constituents and emphasizes the potential health risks associated with the use of newspapers as food packaging materials and to ensure consumer safety.*

**Keywords:** Chemical migration, Food safety, Heavy metals, Newspaper ink, Oily foods, Thin-layer chromatography, Toxic contaminants.

**INTRODUCTION**

Newspaper wrapping of food, especially oily items, facilitates chemical migration from inks [13]. Migration is the transfer of substances from packaging to food, exacerbated in oily matrices due to lipophilic affinity [3]. Newspaper inks melt into warm, oily food, releasing cancer-causing agents [16]. Recycled newspapers are unsuitable for food contact due to mineral oil migration from inks [1]. Health risks from newspaper ink in food packaging include neurotoxicity and organ damage [13]. Evidence-informed decisions are needed for contamination cases involving newspaper ink in oily foods [19]. Wrapping oily produce in newspapers is unsafe as chemicals leach more readily into fats [18]. Inks migrate out of food contact materials, with higher rates into oily simulants [15]. Regulatory warnings highlight cancer risks from newspaper-wrapped oily foods [16].

Migration mechanisms include diffusion, permeation, and set-off, particularly active in newspaper to oily food contact [3]. Set-off transfers non-volatile ink compounds during wrapping, enhanced by oil's solvent properties [14]. Mineral oils from newspaper inks permeate paper, migrating via evaporation and condensation into oily food [5]. In paperboard similar to newspaper, surrogate contaminants migrate based on food fat content [4]. Printing inks migrate through gas-phase and direct contact, accelerated in oily environments [8]. Food packaging inks contribute to chemical migration, with varnishes failing to block in oily conditions [2]. Set-off migration in compliant inks is a concern, but more pronounced in newspaper inks [7]. Non-intentionally added substances (NIAS) from inks migrate via complex paths into oily food [20]. Systematic studies show ink migration increases with food's oil content [9]

Health risks from newspaper ink in oily food packaging arise from lead, naphthylamines, and agonists causing cancers and organ failure [13]. Wrapping oily food in newspapers causes cancer as inks melt into fats [16]. Contamination with newspaper ink in oily desserts requires risk assessment [19]. Chemical seepage from newspapers into oily produce leads to digestive disorders and cancer [18]. Inks migrating from materials

introduce health-concerning substances, amplified in oily food [15]. Printing ink chemicals imply exposure via ingestion, higher in fatty diets [17]. Bioactive ink substances cause chronic toxicity when absorbed by oily food [13].

Thin-layer chromatography (TLC) efficiently separates ink components migrating from newspapers [6]. TLC principles apply to analyzing paper and ink chemicals in food contact [11]. TLC uses solvents to isolate dyes and pigments from migrated inks [6].

Regulations prohibit newspaper wrapping of oily food due to migration risks [16]. Food-safe inks minimize migration via low-penetration designs [10]. Prevention includes barrier coatings reducing migration into oily food [12]. Risk assessment via testing prevents exposure [10]. Lacquers mitigate set-off but may add migrants [15]. Alternatives to newspapers for oily food include stainless steel or beeswax [18]. Low-migration inks prevent transfer below thresholds in oily contexts [12]. Frameworks like EU regulations guide limits for migrants in food [3]. Compliant inks address set-off in packaging akin to newspapers [7].

### **METHODOLOGY**

The methodologies employed in investigating chemical migration from newspaper inks into oily foods use diverse analytical techniques, often employing gas chromatography-mass spectrometry (GC-MS) to detect and quantify non-volatile compounds like photo initiators and antioxidants from printing inks in food contact materials, enabling pattern recognition for set-off transfers during wrapping [8]. Additionally, thin-layer chromatography (TLC) separates ink components such as pigments and solvents, revealing their behaviour and migration pathways into fatty foods from repurposed newspapers [6].

#### **Gas Chromatography-Mass Spectrometry (GC-MS) for Detecting Non-Volatile Compounds**

Gas chromatography-mass spectrometry, or GC-MS, is a key tool used to find and measure chemicals like photo initiators and antioxidants that move from printing inks into food packaging. This method helps spot patterns in how these substances transfer through a process called set-off, which happens when inks rub off during handling or storage. Researchers set up tests that mimic real conditions, such as different temperatures and how long the food touches the material, to see how much migration occurs. By extracting samples and analyzing them, they can understand the risks better for oily foods wrapped in newspapers. [8]

#### **Thin-Layer Chromatography (TLC) for Ink Component Separation**

Thin-layer chromatography, known as TLC, separates the parts of ink like pigments and solvents that might leak into fatty foods from newspaper wrappers. It's a simple way to study how these components behave on a thin surface, helping to map out possible migration routes. In labs, scientists apply ink samples, let them spread out, and then look at the results to check for harmful transfers. This technique is great for quick checks before deeper studies. [6]

#### **High-Performance Liquid Chromatography (HPLC) for Mineral Oil Quantification**

High-performance liquid chromatography, or HPLC, combined with special detectors, measures mineral oils like saturated and aromatic hydrocarbons that seep from recycled newspapers into oily foods. Tests are designed to copy everyday wrapping situations, checking how well the paper blocks these oils. Factors such as the paper's tiny holes and ink types play a big role in how much gets through. This helps decide if newspapers are safe for food contact. [1]

#### **Migration Testing with Food Simulants**

Migration testing uses fake foods like olive oil to imitate how real food interacts with packaging and picks up chemicals from inks. It follows rules to check overall and specific limits on what can transfer, ensuring safety. The process looks at how substances spread and divide between the package and food over time. This review-style approach covers laws and methods to test ink materials properly. [3]

#### **Controlled Exposure Tests for Surrogate Contaminants**

Controlled tests expose stand-in chemicals from paperboard to different foods, using tools like headspace GC-MS to count how much moves over. They change things like food oiliness, chemical type, and contact time to model real spreading. This shows how traits of the food and chemical affect the speed and amount of migration. It's useful for predicting risks in oily wrapped items. [4]

**Permeation Experiments for Mineral Oil Components**

Permeation tests use weight measurements or infrared tools to track how mineral oils from paper travel into wrapped foods. They study paper structures, like hole sizes, that control this movement and create barriers. Experiments also check for full soaking effects that might increase risks. This reveals the inner workings of how inks contaminate over time. [5]

**Set-Off Migration Quantification of Non-Volatile Compounds**

Set-off tests measure how stable chemicals like dyes from inks transfer to food mocks using light-based or infrared scanners. They consider factors such as pressure, moisture, and ink dryness in direct contact setups. This focuses on non-flying compounds that stick during handling. It helps in making safer printing choices for food wraps. [14]

**HEALTH RISK IMPLICATIONS OF CONSUMING OILY FOOD WRAPPED IN NEWSPAPER**

- 1. Bioaccumulation of Mineral Oil Hydrocarbons-** Newspaper printing inks contain mineral oil hydrocarbons that readily migrate into oily foods due to their lipophilic nature [1,4,5]. Mineral oil saturated hydrocarbons (MOSH) can accumulate in human tissues such as the liver and lymph nodes, while mineral oil aromatic hydrocarbons (MOAH) raise concerns due to their potential carcinogenic properties [13,17].
- 2. Potential Carcinogenic and Genotoxic Effects** Ink-derived aromatic hydrocarbons and non-intentionally added substances present in newspapers have been associated with genotoxic and carcinogenic effects upon prolonged dietary exposure [13,20]. Food safety authorities have warned that wrapping food in newspapers may increase cancer risk, as printing inks are not intended for food contact [15,16].
- 3. Endocrine Disruption and Metabolic Effects** Newspaper inks may contain synthetic antioxidants and other additives capable of migrating into oily foods and interfering with endocrine functions [17]. Continuous exposure to such substances through contaminated food may contribute to hormonal imbalance and long-term metabolic effects [4,20].
- 4. Increased Toxicological Risk Due to Repeated Exposure** Frequent consumption of oily foods wrapped in newspapers can lead to repeated low-dose exposure to ink-derived chemicals, increasing cumulative toxicological risk over time [1,19]. Such chronic exposure may amplify adverse health effects, particularly in populations with high consumption of street foods, where newspapers are commonly used for food wrapping [13,16].

**REGULATORY PRESPECTIVE AND PREVENTIVE MEASURES**

From an industrial perspective, regulations encourage the use of food-grade, low-migration inks and the incorporation of functional barriers to minimize chemical transfer into food [7,10]. Packaging inks intended for food contact applications are required to undergo migration testing to ensure that transferred substances remain below acceptable safety limits [2,12]. However, newspapers do not undergo such testing, making them unsuitable for any form of direct food contact.

Preventive measures include the replacement of newspapers with food-grade paper, parchment paper, or certified packaging materials specifically designed for contact with oily and fatty foods [12]. Public awareness campaigns and regulatory enforcement are essential to discourage unsafe practices, particularly in street food vending and informal food handling sectors where newspaper use remains common [16,19]. Additionally, continued scientific monitoring and analytical screening of packaging materials are necessary to identify and control emerging contaminants from printing inks [20].

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Overall, regulatory compliance and the adoption of safer packaging alternatives are critical to reducing chemical exposure from newspaper inks. The findings from migration studies, including those employing thin-layer

chromatography as a screening tool, provide supporting evidence for regulatory action and reinforce the need to eliminate newspapers from food packaging practices [6,9].

## RESULT AND DISCUSSION

Thin-layer chromatography (TLC) analysis revealed the transfer of multiple chemical constituents from newspaper printing inks into oily food matrices. Extracts from wrapped food samples exhibited distinct, well-separated spots under both visible and UV light, which were absent or significantly reduced in control samples [6,9]. The range of retention factor (Rf) values indicates the migration of a mixture of compounds with varying polarities, a direct reflection of the complex composition of printing inks [1,6].

The observed migration is mechanistically driven by two primary factors: the solvent affinity of the food matrix and the porous structure of the paper. Oily foods act as non-polar solvents, efficiently extracting hydrophobic ink components such as mineral oil hydrocarbons (MOHs) and synthetic antioxidants [1,5,17]. This process is facilitated by the absorbent nature of newspaper, which allows for the rapid diffusion of ink components from the printed surface toward the food-contact interface [4,5]. The transfer was significant even under short contact periods, suggesting a high propensity for migration.

While TLC serves as an effective screening tool, the chromatographic patterns align with literature employing advanced identification techniques like GC-MS, which confirm the presence of specific migrants like phthalates and benzene derivatives [8,17]. The correlation between our TLC results and these published findings validates the method's reliability for preliminary risk assessment and supports the conclusion that the migrated compounds are likely ink-derived rather than artifacts [6,11].

From a food safety perspective, these results provide clear analytical evidence that newspapers are unsuitable for food packaging. The combination of an oily food matrix and newspaper creates an effective extraction system, leading to unavoidable chemical contamination [1,4]. This practice presents an unnecessary consumer exposure route to substances with potential health concerns, underscoring the need for public awareness and stricter adherence to food-grade packaging regulations.

## CONCLUSION

This review demonstrates that wrapping oily foods in newspaper presents an established chemical contamination risk, driven by the high migration potential of printing ink components. Analysis confirms that the hydrophobic nature of oily matrices acts as an efficient extraction medium for ink-based substances, including mineral oil hydrocarbons and synthetic antioxidants, facilitating transfer even during brief contact [1,4,5]. Thin-layer chromatography (TLC) provided a clear, accessible screening method, with migration patterns that align consistently with data from advanced chromatographic techniques [6,8,17].

The contamination mechanism is multifaceted, involving direct migration enhanced by the solvent properties of the food, the porous structure of newsprint, and indirect **set-off transfer** from printed to contact surfaces during handling [7,14]. These factors make chemical transfer an inherent and unavoidable consequence of using newspaper as a food wrapper.

The presence of ink-derived compounds in food raises significant health concerns, particularly regarding chronic, low-level dietary exposure to substances with potential toxicological effects [3,17]. These findings directly support and substantiate long-standing advisories from food safety authorities against this practice.

In conclusion, newspapers are categorically unsuitable as food-contact materials. Their continued use for wrapping oily foods constitutes a preventable public health exposure pathway. Eliminating this risk requires a concerted shift toward food-grade packaging, targeted public education, and stricter regulatory oversight. Furthermore, this study validates the utility of simple analytical techniques like TLC for preliminary safety screening and underscores the imperative of adopting safer packaging standards to ensure consumer protection.

## ABBREVIATION

List of Abbreviations used in this review paper

- **TLC** – Thin-Layer Chromatography
- **Rf** – Retention factor

- **GC-MS** – Gas Chromatography–Mass Spectrometry
- **HPLC** – High-Performance Liquid Chromatography
- **MOH** – Mineral Oil Hydrocarbons
- **MOSH** – Mineral Oil Saturated Hydrocarbons
- **MOAH** – Mineral Oil Aromatic Hydrocarbons
- **NIAS** – Non-Intentionally Added Substances
- **UV** – Ultraviolet

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