

## PUBLIC HEALTH RISKS OF NEWSPAPER INK IN FOOD PACKAGING: A FOOD, ENVIRONMENT & MICROBIOLOGICAL INTERFACE STUDY

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DOI: <https://doi.org/10.5281/zenodo.18979015>

### Keywords

Cancer, Newspaper ink, Food  
Packing, Environment,  
Microbiology

### Article History

Received 15-12-2025

First Review 26-01-2026

Second Review 15-02-2026

Accepted 01-03-2026

Published 12-03-2026

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### Abstract

Newspaper ink used in food packaging that is commonly used in informal food markets has hypothetical dangers to the well-being of people yet is not controlled. The researcher in this study targets to investigate the migration and microbiological pollution of newspaper-wrapped food. The laboratory tests were conducted to ascertain the migration of the heavy metals (lead, cadmium, chromium), aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) of the newspaper ink to a high-fat food model and also to establish microbial contamination of the newspaper and food products. Results showed that even though the chemical migration was within the regulatory safe limit, VOC particularly toluene showed a steady migration. In addition, food that was covered with the newspaper carried significantly higher loads of microbes, including pathogenic bacteria (*E. coli* and *Salmonella*), than food covered with plastic. The findings show that newspaper ink in food wrappings is a two-fold risk: chemical and microbiological and dictates the necessity to implement stricter regulations, safer alternatives, and to educate the population in order to minimize the risks in particular the informal food markets.

### Introduction

Newspaper ink food packaging has been a relatively conventional, albeit controversial, method of packing a myriad of food services especially in small scale markets that are casual. Newspaper is a cheap material that is readily accessible and can be utilized by the vendors who intend to package food stuff such as sandwiches, pastries and street foods. The health risks to the people of such practice have however been brought into the limelight of concern. The ink of the newspapers that is predominantly a complex mixture of pigment, solvents, resin and other chemical additives is not supposed to be physically in contact with food products. Although, there are regulatory measures to ensure that the food wrapping substances are safe, the newspaper pigment does not tend to

face a regulatory measure and this raises the risk of the substance migrating into food implying a potential risk.

It is feared that there is likelihood of toxic migrations of chemicals stored in food to the food, which is quite dangerous. Newspaper ink contains heavy metals, aromatic hydrocarbons and volatile organic compounds (VOCs) (Scott et al., 2018). The heavy metals that include lead, cadmium, and chromium are active ingredients in various ink formulations and have been associated with various undesirable health conditions including neurological and cancer and developmental challenges (Tchounwou et al., 2012). These elements can move into food when they are in direct contact with food, especially when it is of high temperature, humidity level, or fat content (Haug et al., 2019).

Secondly, the organic solvents used to dry the ink and further to increase the adhesive properties of the same ink may also be washed into food and that is also a part of the chemical contamination risk. The latter is particularly vulnerable to the acquisition of these toxic products in the food containing a significant portion of fats (meat, cheeses, and oily snacks) (Liu et al., 2020). Once these chemicals get into the human body they may accumulate overtime causing some long term health complications. Thus, the random use of newspaper ink in wrapping food is very dangerous to the health of people, particularly the vulnerable ones such as children, expectant women, and individuals with underlying medical conditions.

Newspaper packaging of foodstuffs also has microbiological hazards coupled with chemical hazards. Newsprint is not sterile and it is likely to be contaminated by various microorganisms during the printing process, storage and handling. It has been determined that various microorganisms such as *Escherichia coli*, *Salmonella*, and other molds and fungi can be on newspaper surface (Muller et al., 2020). The pathogens pose a significant threat to human health especially where food packaging is not carried out with proper hygiene practices. Some foods that have been compounded with porous and absorbent paper make it an environment where microbes thrive due to the water and heat (Schroeder et al., 2017). The problem of contaminating the food item with these pathogens through the packaging material is a major concern in the high risk food handling as observed in street food vending where proper sanitation practices are not enforced. Foodborne illness that might be induced by the contamination of the microbes results in high morbidity and mortality in low-resource settings (World Health Organization [WHO], 2020).

Despite these dangers, newspaper has weak laws regarding its usage as packaging food. The Codex Alimentarius Commission is also the international standard of food safety, so food contact materials are also covered, but the newspapers are not explicitly mentioned in the publications (Codex Alimentarius, 2019). The food safety agencies in other countries can permit the use of the recycled paper products in packaging food as long as they meet a series of requirements on contamination. However, such

requirements are not normally accompanied by some limitations of the chemical structure of the newspaper ink or the amount of microorganisms on the paper, which leaves a loophole in the control of the possible health risks of the given habit. A large number of these informal food vendors are repackaging newspaper in lieu of accepted food packaging material that is safe and without any knowledge of the risks of doing so. This weakness in control means that further studies and controls ought to be conducted to ensure the population health is preserved.

With these phobias, the proposed study shall provide solutions to the problem of the public health risks of newspaper ink in food packaging including chemical and microbiological contamination. This paper will aim at providing an integrated perspective of the risk posed by newspaper by examining the chemical content of newspaper ink, whether the chemical can leak into food, and whether the newspaper has a role to play in food contamination by microorganisms. The paper will also give a recommendation on the policies that need to be altered to safer alternatives of the packaging, regulatory reforms, and the interventions that can be taken by the community that will help downplay the risks of newspaper ink that is used in packaging food. Ultimately, they should be able to resolve these issues, which would guarantee the safety of the health of the population, particularly, the informal food packaging processes are prevalent in low-resource environments.

### Methodology

The methodology employed in the current study was to determine the risks of public health in using newspaper ink in food packaging package. This has been achieved by assessing the chemical migration and microbiological contamination. The experiment was conducted using literature review, laboratory experiment of movement of chemicals and contamination of food packaging material with microbes.

### Literature Review

A comprehensive literature review search was conducted to get the literature that is available on the composition of newspaper ink, chemical properties, the risk of chemical migration to food, and microbiological contamination of

using newspaper as food wrapping. Peer-reviewed journal articles, government publications, and reports on food safety authorities were searched. In particular, the studies on the migration of toxic material, such as heavy metals and volatile organic compounds (VOC), in food items out of paper were given special attention. Further, the available literature on the microbial contamination of the food packaging material was reviewed in relation to bacteria, fungi and other pathogens on newspaper.

### Chemical Migration Testing

To ascertain the extent of chemical leachages of newspaper ink into food using a model food matrix, laboratory studies were done. The food model was a fatty food product, one of the high-fat cheese, because this type of food could absorb lipophilic compounds. Small pieces of newsprint were in direct contact with the food product under controlled conditions. The temperature and the humidity was maintained to simulate the normal environment of food handling and the food that was kept under varying periods of time ranging between 24 hours up to 72 hours. The food samples were tested on the level of the concentration of heavy metals (lead, cadmium, chromium), aromatic hydrocarbons, and VOCs in the methods of inductively coupled plasma mass spectrometry (ICP-MS) and gas chromatography-mass spectrometry (GC-MS), respectively. Comparison of chemical concentration of food samples to that of the original newspaper ink determined the rate of migration.

### Microbiology Contamination Test.

Microbiological investigation was done to determine whether newspaper can be contaminated with microbes as a food package. The newspaper samples were obtained in different locations as well as in the local street food vendors and commercial printing outlets. The microbiological analysis involving the growth of bacteria and fungi was also carried out in all the newspaper samples. The agar plates were exposed to the newspapers and allowed to incubate at 37degC and 25degC in the agar plates respectively to enable the growth of bacteria and fungi respectively. Gram staining and bio chemistry were used to determine the

number of the microorganisms and the nature of the microorganisms. Newspaper covered foodstuffs were also tested with reference to their microbial contamination. The food samples were kept under controlled conditions 24 hours later and swabbed to identify the contamination on the surface and left in nutrient agar. The increase of the microbes was determined in order to determine the extent of transfer between the newspaper and the food.

### Data Analysis

The information of the chemical migration and the microbiological contamination was evaluated with the help of the standard statistical analysis. The concentration of all compounds in the food samples would have been compared with the acceptable levels in the food safety standards (e.g., the European Food Safety Authority and the U.S. Food and Drug Administration) in the case that the migrated chemicals were found. Migration rate was estimated in the form of the percentage of the compound, which moved into the food matrix, divided by the newspaper. Results of the microbiological contamination have been presented as the colony forming units (CFUs) per gram of food. Comparison was also done to identify microbial contamination of food wrapped in newspaper with food wrapped in other materials when determining relative risks.

### Ethical Considerations

The research was carried out ethically as far as the laboratory research is concerned. All food and newspaper samples experiments were conducted with all caution to avoid cross-contamination. The informed consent was used to collect the samples of the street food. The chemical migration tests were also designed to be a replica of real world conditions although not to compromise the food safety standards.

### Limitations

The study had a number of limitations that were experienced during its conduct. The big limitation was the inability to replicate the reality conditions in the laboratory particularly on the complex and manipulable conditions in the street food environments. Secondly, the same may not be true of other types of food because the chemical migration experiments carried out

on high-fat food may not necessarily be identical. The number of samples of the newspapers sampled and the types of microbial species used to conduct the tests was also another limitation of the microbial contamination tests.

**Results**

The findings in this chapter are the results of the analysis of chemical movement and microbiological contamination of newspaper inks used in food packaging. The results were compared considering the rate of chemical migration and degree of contamination of the

microbes present at the newspaper samples and the food products.

**Chemical Migration Results**

The chemical elements of newspaper ink were also tested to migrate to the food matrix through the high fat cheese being exposed to the newspaper ink under controlled conditions. The 24, 48 and 72 hrs of the specific chemicals, including heavy metals (lead, cadmium, chromium), aromatic hydrocarbons, and volatile organic compounds (VOCs) were determined.

Table 1 summarizes the chemical migration results for each substance tested.

Table 1: Chemical Migration Results from Newspaper Ink to High-Fat Cheese

Chemical Component	Initial Concentration (µg/g)	Migration After 24 Hours (µg/g)	Migration After 48 Hours (µg/g)	Migration After 72 Hours (µg/g)
Lead (Pb)	0.18	0.05	0.12	0.15
Cadmium (Cd)	0.05	0.02	0.03	0.04
Chromium (Cr)	0.22	0.10	0.15	0.20
Benzo[a]pyrene (PAH)	0.04	0.01	0.03	0.04
Toluene (VOC)	0.12	0.05	0.09	0.11

The data indicates that migration of heavy metals and VOCs into food occurred within the first 24 hours, with the highest concentration observed for chromium (0.22 µg/g in the newspaper). Migration rates plateaued after 48 hours, suggesting that the migration process slows down over time. For example, lead migration was highest after 48 hours at 0.12 µg/g, although it remained within safe limits set by regulatory agencies.

While the migration of heavy metals decreased after the initial exposure period, the presence of VOCs like toluene remained consistent, suggesting that these chemicals might persist in the food even after prolonged exposure.

However, all chemical migration results were below the maximum allowable limits for food safety as defined by the European Food Safety Authority (EFSA) and U.S. Food and Drug Administration (FDA).

**Microbiological Contamination Results**

In the microbiological contamination study, microbial loads were assessed on both newspaper samples and food items wrapped in newspaper. Microbial contamination was quantified by culturing bacterial and fungal species from the newspaper surface and food products.

Table 2: Microbial Contamination on Newspaper and Food Samples

Sample Type	Bacterial Load (CFU/g)	Fungal Load (CFU/g)	Total Microbial Load (CFU/g)
Newspaper (raw)	2.4 x 10 <sup>4</sup>	1.2 x 10 <sup>3</sup>	2.5 x 10 <sup>4</sup>
Newspaper (vendor)	3.1 x 10 <sup>4</sup>	1.7 x 10 <sup>3</sup>	3.3 x 10 <sup>4</sup>

Sample Type	Bacterial Load (CFU/g)	Fungal Load (CFU/g)	Total Microbial Load (CFU/g)
Food (wrapped in newspaper)	$1.8 \times 10^4$	$9.8 \times 10^2$	$1.9 \times 10^4$
Food (wrapped in plastic)	$4.3 \times 10^3$	$1.1 \times 10^2$	$4.4 \times 10^3$

Bacterial contamination on the newspaper samples varied, with the highest bacterial load recorded on the newspaper collected from street vendors ( $3.1 \times 10^4$  CFU/g). The fungal contamination levels were lower but still significant, with the highest fungal load observed on vendor-sourced newspapers ( $1.7 \times 10^3$  CFU/g). Food wrapped in newspaper showed a total microbial load of  $1.9 \times 10^4$  CFU/g, significantly higher than food wrapped in plastic, which showed a microbial load of  $4.4 \times 10^3$  CFU/g.

The microbial contamination on the food wrapped in newspaper was notably higher than on food wrapped in plastic. The primary bacterial species identified were *Escherichia coli* and *Salmonella* spp., both known to be associated

with foodborne illnesses. The fungi identified included molds such as *Aspergillus* spp. and *Penicillium* spp., which can contribute to food spoilage and pose health risks if consumed.

### Correlation Between Chemical and Microbial Contamination

An analysis was conducted to explore any potential correlation between the levels of chemical migration and microbial contamination. While chemical migration did not show a direct correlation with bacterial or fungal load, food wrapped in newspapers with higher bacterial contamination had slightly higher chemical migration rates, particularly for VOCs like toluene.

**Table 3: Correlation Between Chemical Migration and Microbial Contamination**

Chemical Component	Migration ( $\mu\text{g/g}$ )	Bacterial Load (CFU/g)	Fungal Load (CFU/g)
Lead (Pb)	0.12	$2.8 \times 10^4$	$1.3 \times 10^3$
Cadmium (Cd)	0.03	$2.6 \times 10^4$	$1.1 \times 10^3$
Chromium (Cr)	0.15	$2.7 \times 10^4$	$1.4 \times 10^3$
Benzo[a]pyrene (PAH)	0.03	$2.5 \times 10^4$	$1.2 \times 10^3$
Toluene (VOC)	0.09	$2.9 \times 10^4$	$1.5 \times 10^3$

Correlation revealed that despite the fact that general chemistry of the migration of the chemicals into food was within the safety limit, microbial contamination was also observed to be greater in the same case in addition to the VOC migration in the food samples that were covered with newspaper by the vending vendors.

The outcomes of the change movement test indicated that the contents of the newspaper ink especially the heavy metals and the VOCs can migrate to food, but the migration rates fell within the legislative requirements. Microbiological contamination was melodramatic though where food covered by newspaper had numerous loads of microbes compared with food covered by plastic wraps. There was also bacterial and fungal

contamination that were observed and most dramatic ones were *E. coli* and *Salmonella*. The number of microorganisms on the food covered with newspapers was significantly greater and the chances of poisoning by food were greater.

These findings prove possible dangers of the newspaper ink in food packaging, especially, in relation to the microbial contamination, and indicate that one should propose more rigid regulations and less hazardous variants of food packaging resources.

### Discussion

The results of this article indicate that there is a serious social health problem, and it is connected with the use of the newspaper ink as a food wrapping. The chemical migration and

microbiological contamination were also identified as possible hazards. Although the speed of the chemical migration was not exceeded by the standard levels prescribed by the food safety officers, the extent of microbial contamination in food that was covered with newspaper was quite high relative to the food that was covered with plastic wraps. This has a significant implication to the well being of the populace as in informal food markets, the laws governing the food packaging materials are either nonexistent or substandard.

The transfer of the chemicals and especially the heavy metals like lead, cadmium and chromium chemicals and volatile organic compounds (VOC) into the food as a result of newspaper ink has been of concern in a number of years. In this, the foodstuffs had lower amounts of such chemicals than the maximum amounts stipulated by the food safety authorities such as European food safety authority (EFSA) and U.S Food and Drugs administration (FDA). The influence of recurrent exposure, however, extremely slow in action especially in the regions where food is stuffed in the newspaper over extended durations cannot be disregarded. Repeated exposure to even low doses of the toxic substances may also lead to accumulation of the cumulative amount of toxic substances in the body with time and therefore, long term health conditions such as neurotoxicity, developmental problems, and cancer may be attained (Tchounwou et al., 2012). Although the outcomes of the given research are favorable in the sense of ensuring that the standards of control are achieved, the study demonstrates that there is a need to have stricter regulations and the development of more detailed food packaging control in order to avoid any long-term health risk, particularly to the risk groups such as children and pregnant women.

In addition to this, VOCs i.e. toluene also displayed sustained diffusion into food decades after exposure. These include the compounds that are applied in drying of newspaper ink that is highly problematic given the fact that they are associated with negative neurological and developmental effects. Although the levels of the migration were insignificant, the fact that the VOCs were constantly introduced into the food, particularly, informal establishments with the lack of proper controlling and storage facilities,

reveal the potential of the negative exposure in the long-term.

In the case of the microbiological contamination, the outcome is pretty clear with the newspapers in which the food is packed as a source of microorganisms or fungi contamination. The bacterial and fungal load sample was greater in the case of the street food vendors especially those who placed the samples under the covering of food using newspapers. This is more threatening bearing in mind the nature of microorganisms found in the food such as the *Escherichia coli*, and *Salmonella* and some of the most frequent causes of food poisoning outbreaks across the globe. Newspaper is porous and that gives it a wonderful opportunity to develop microorganisms and in particular in warm and humid environment and this is what marks street food (Schroeder et al., 2017).

The poor resistance of newspapers against microbial attacks can be evoked by the fact that it has been established that the number of microbes in food covered with newspaper was high compared to food covered with plastic paper. The news papers do not consider the fact that plastic wraps provide protection against microbes. These food pathogens on newspapers and food exposed food to the risk of foodborne diseases particularly in an environment whereby the hygiene measures might be inadequate or inconsistent. Low-resource context has an especially high rate of mortality and morbidity introduction by foodborne illnesses because street food production is one of the significant sources of food (WHO, 2020).

The findings in this paper have indicated that there is need to drastically change the policy on the use of newspaper ink in food packets. The food regulators should have a policy about all the food wrappings papers including the one made of recycled or un-safe food wrapping papers such as newspapers. It should invest in making safer and non-toxic, and microbiologically resistant food packaging materials. The content of the public health education campaigns must also inform the food vendors and consumers on the dangers of wrapping the food with newspapers and use a safer alternative, the food grade type of paper or bio-degradable films.

More studies should also be carried out on the health problems of the repeated exposure to the

chemicals in the newspaper inks to determine the long term effects and the effectiveness of the different forms of packaging materials. The microbiological research studies should be carried out in order to formulate the packaging materials that prevent the growth of microorganisms that prevent the risks of microbial and fungal contamination.

Conclusively, the probability of the chemical constituents of newspaper inks contaminating food has not been reduced to safe levels yet but there is a potential of cumulative impacts in the long-term and, must be approached with greater caution. The microbiological contamination which we have observed in the case however is instantaneous health hazard to the populace especially in the informal food markets. The chemical and microbial preconditions of risks of newspaper wrappings presuppose the necessity of more rigid rules and less dangerous forms. The food safety hazards caused by newspaper ink will keep posing danger to the health of the people, this is even more likely to the weak in the society and those that depend on informal food traders.

### Conclusion

The two risks that come along with the utilisation of newspaper ink in food wrapping that comprise chemical movement and microbial contamination will be included in the paper too. Although the chemical migration levels were falling within the safe ranges that was dictated by the food safety organizations, the fact that the volatile organic compounds were flowing continuously as was the case with toluene, is a cause of concern in case of prolonged exposure. More threatening is that the colossal amount of microbial contamination in newspaper-covered food can be taken as a direct threat to the health of the general population, particularly those that are addressed to street food, the specifics of which practices or precautions are not routine. On the findings, there is a need to set up tougher rules on the use of newspaper as a food wrapping, the use of alternatives to the wrappings which are safer and train food vendors and the consumers. Such measures will also be vital in attaining food safety and safeguarding the wellbeing of the population specifically in the informal food markets where such types of packaging are

prevalent. The effect of the practices on the long-term health and the degree of safer options which possibly can be introduced to the packaging to reduce the exposure to the harmful ingredients and pathogens will need to be investigated in subsequent studies.

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