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Investigation of Parasitic Contaminants in Ready-to-Eat Fruits at Madina Market, Ghana

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Abstract

Ready-to-eat fruits are a vital component of a healthy diet but may pose significant health risks when contaminated. This study assessed the parasitic contamination of selected ready-to-eat fruits mangoes, oranges, bananas, watermelons, and apples sold at Madina Market in the La Nkwantanang Madina Municipality, Ghana. A total of 31 fruit samples from open market vendors and 30 control samples from grocery shops were examined using sedimentation and zinc sulfate concentration techniques. Microscopic examination revealed intestinal parasites such as Ascaris lumbricoides, Trichuris trichiura, Enterobius vermicularis, Loa loa, and unidentified rind worm eggs in the market samples, while no parasitic organisms were detected in the grocery shop samples. Watermelon exhibited the highest contamination rate (75%), followed by banana (62.5%), apple (57.14%), and mango (40%). Oranges showed no detectable contamination. The presence of these parasites is likely attributed to unhygienic handling, washing with contaminated water, and poor storage practices. The findings highlight a substantial public health concern and emphasize the need for improved hygiene practices, proper fruit washing techniques, and public education. These measures are crucial to minimizing the risk of parasitic infections linked to fruit consumption in urban markets.

Keywords*: Ascaris Lumbricoides, Food Safety, Loa Loa, Public Health, Parasitic Infection, Trichuris Trichiura.*

Introduction

Fruits are defined as the edible parts of plants that typically contain seeds and are surrounded by pulpy tissue. They often have a sweet or tart flavor and are commonly consumed as beverages, side dishes for breakfast or lunch, snacks, or desserts [1]. In contrast, vegetables refer to edible plant parts, including stems, stalks, roots, tubers, bulbs, leaves, flowers, and even some fruits. This category may also encompass seaweed and sweet corn, and in some contexts, mushrooms and pulses. Vegetables are usually consumed raw or cooked, either as part of a main dish, in salads, or as appetizers [1].

Raw or unprocessed fruits and vegetables are rich in essential nutrients such as carbohydrates, proteins, vitamins, and minerals, all of which are critical to human health [2]. Globally, the regular consumption of fruits and vegetables is encouraged due to their significant role in disease prevention, including reducing the risk of cancer, diabetes, cardiovascular conditions, and stroke [3].

Beyond their nutritional value, fruits and vegetables also contribute economically, especially in developing countries where they provide employment opportunities, particularly for women. However, these foods can become contaminated with various microorganisms during cultivation, harvest, and post-harvest handling. Although many of these microorganisms are harmless epiphytes, fruits and vegetables are often exposed to soil, water, and handling practices that can introduce pathogens, especially under unsanitary conditions [4].

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In Ghana, the risk of microbial contamination is heightened by practices such as cultivation in areas exposed to sewage, animal waste, and potentially toxic materials [5]. Additionally, in many low- and middle-income countries where unemployment is high, vendors frequently sell produce with minimal regulatory oversight regarding hygienic handling. As a result, the microbiological safety of fruits and vegetables is often compromised.

While much attention is given to foodborne illnesses linked to meat, fish, and dairy, contaminated fruits and vegetables also pose significant public health risks. Globally, food- and waterborne illnesses are responsible for over 2 million deaths annually, with Ghana alone accounting for an estimated 65,000 of these cases each year [6, 7]. Beyond health impacts, foodborne diseases contribute to substantial economic losses; Ghana reportedly spends approximately $65,000 annually managing such outbreaks [7].

To mitigate these risks, the U.S. Food and Drug Administration (FDA) released the *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* in 1998, advocating for the adoption of Good Agricultural Practices (GAPs) by producers, packers, and shippers [8].

Additionally, pre-cut fruits and vegetables—those that have been peeled, sliced, and packaged while retaining freshness—are increasingly offered at retail outlets. These products, though convenient, require strict safety protocols due to their higher vulnerability to contamination [9].

The World Health Organization (WHO), the Food and Agriculture Organization (FAO) of the United Nations, and the World Cancer Research Fund (WCRF) recommend a daily intake of 400 to 600 grams of fruits and vegetables to promote optimal health and reduce the risk of chronic diseases [10].

The global demand for fresh produce has surged due to increased consumer awareness and year-round availability of fruits and vegetables [11]. However, emerging risks such as climate change and global trade introduce additional challenges to food safety management [12]. Temperature fluctuations and extreme weather events can influence pathogen prevalence on crops [13]. Furthermore, cross-border trade can introduce contaminants from one region to another, posing a risk of transboundary foodborne outbreaks [14].

The nutritional composition of fruits and vegetables not only supports physical health but also cognitive function and mental well-being [15]. Research indicates that antioxidants in fruits and vegetables help neutralize harmful free radicals, thereby slowing cellular aging and reducing oxidative stress [16]. Additionally, polyphenols and flavonoids present in many fruits exhibit anti-inflammatory properties, contributing to reduced risks of chronic inflammation-related diseases [17].

Despite the recognized benefits, inadequate post-harvest practices, including improper washing, storage, and packaging, significantly contribute to the microbial contamination of produce [18]. Studies highlight that contamination with parasites, bacteria, and fungi can occur at various stages, from field to table [19]. Moreover, human handling without proper sanitation has been identified as a key factor in cross-contamination of fresh produce [20].

In recent years, innovative technologies such as ozone treatment and ultraviolet (UV) irradiation have shown promise in reducing microbial contamination on fresh fruits and vegetables [21]. Nonetheless, the adoption of such technologies remains limited in many low-resource settings [22]. Education and training of vendors and consumers are critical to enhancing food safety awareness and reducing health risks associated with contaminated produce [23]. Collaborative efforts between governments, industry stakeholders, and consumers are essential to address these challenges effectively [24].

Finally, the integration of food safety protocols with sustainable agricultural practices is crucial for ensuring long-term food security and public health [25].

Methodology

Study Site

The study was conducted in Madina Market, located in the La Nkwantanang Madina Municipal District of the Greater Accra Region, Ghana. Madina is a populous urban suburb of Accra and serves as a significant commercial hub, particularly for fresh produce and ready-to-eat fruits. The market is characterized by high human traffic and informal trading activities, where fruits are displayed and sold under varying hygienic conditions. The area lacks consistent regulatory oversight regarding food safety practices, making it a relevant location for assessing potential parasitic contamination.

Additionally, comparative control samples were obtained from the Accra Mall, a modern retail center with regulated sanitary conditions. This provided a baseline for evaluating the difference in contamination levels between open market vendors and retail grocery outlets. Laboratory analyses for the study were conducted at the Microbiology Laboratory of New Crystal Hospital in Ashaiman, Accra.

Study Population

The study population consisted of ready-to-eat fruits commonly consumed raw, specifically mangoes (*Mangifera indica*), oranges (*Citrus sinensis*), bananas (*Musa acuminata*), watermelons (*Citrullus lanatus*), and apples (*Malus domestica*). A total of 70 fruit samples were collected for the study. Of these, 40 samples were randomly purchased from various fruit vendors operating within Madina Market, and 30 control samples were obtained from the Accra Mall, a commercial retail outlet with better sanitary standards.

Fruit vendors at Madina Market were selected through random sampling to reflect the diversity of handling and storage practices typical in open markets. The inclusion criteria required that fruits be ready-to-eat, commonly consumed raw, and available for purchase during the study period. Exclusion criteria included fruits subjected to visible washing or preservation treatments by vendors prior to sale.

The study aimed to compare the parasitic contamination levels in fruits from open markets with those from a more controlled retail environment, thereby providing insights into the impact of handling and environmental conditions on food safety.

Laboratory Analysis

The laboratory analysis was conducted to detect and quantify parasitic contamination in selected ready-to-eat fruit samples. The procedures were carried out at the Microbiology Laboratory of New Crystal Hospital, Ashaiman, using standard parasitological techniques.

Each fruit sample (approximately 0.8 grams) was washed in 25 mL of normal saline solution (0.85% NaCl) in a sterile plastic container. The fruits were thoroughly agitated to dislodge potential parasitic elements adhering to their surfaces. The resulting wash solutions were filtered using fine mesh and then centrifuged at 3,000 rpm for 5 minutes. The supernatant was discarded, and the sediment was re-suspended in saline and centrifuged again until a clear supernatant was obtained.

Two diagnostic methods were employed:

1. Direct Wet Mount Microscopy: A drop of the final sediment was placed on a clean glass slide, stained with a drop of Lugol's iodine, and covered with a cover slip. The slide was examined microscopically under ×10 and ×40 objectives for the presence of ova, cysts, or larvae of intestinal parasites.
2. Zinc Sulphate Flotation Technique**:** For enhanced detection, a 1 mL aliquot of the wash solution was mixed with a zinc sulphate solution (specific gravity 1.18)

and centrifuged. A clean cover slip was placed on top of the test tube for 15–30 minutes to allow parasite eggs or cysts to adhere. The cover slip was then mounted on a slide and examined microscopically.

Tables and Data Analysis

Quantitative and qualitative data from the parasitological examination of fruit samples were analyzed using descriptive statistical methods. The presence of parasite ova, cysts, or larvae was recorded and expressed as frequencies and percentages. The level of contamination across different fruit types was calculated using the formula:

Contamination Rate (%) =Total Number of Samples Examined / Number of Positive Samples) ×100

Table 1. Presents the distribution and scale of sample collection for the study. Mangoes were the most sampled fruit, with 15 collected and 10 examined. The average weight of each fruit sample was standardized at 100 g to ensure consistency in analysis. The inclusion of different fruits, each representing varying levels of exposure and handling in open markets, allows for a comparative assessment of contamination levels. Notably, the sample size was robust enough to provide meaningful insights into parasitic contamination patterns, although a broader sampling across more markets could enhance generalizability.

Table 1. Summary of Fruit Samples Collected and Analyzed

	Total Collected	**Number Examined**	**Average Weight per Sample (g)**
Mango	15	10	100
Orange	10	5	100
Watermelon	5	4 (portions)	100
Apple	10	7	100
Banana	10	8	100
Total	**50**	**34**	

Table 2. provides a clear breakdown of the specific parasites detected in each fruit type and their estimated concentrations. The presence of *A. lumbricoides*, *T. trichiura*, and *Loa loa* eggs in mango, apple, and banana samples is particularly concerning due to their pathogenicity and the potential for causing gastrointestinal and systemic infections. Watermelons, despite being pre-cut and likely exposed during handling, showed a lower parasite load. The absence of contamination in oranges may be attributed to their thick rind, which offers a natural barrier. This table effectively highlights the diversity and severity of parasitic contamination across different fruit types.

Table 2. Parasites Identified in Fruit Samples

Fruit Type	**Parasite Identified**	**Number of Eggs Observed**	**Estimated Eggs/100g (Stoll's Method)**
Mango	*Loa loa*	4	20
Apple	*Ascaris lumbricoides*	4	20
Banana	*Trichuris trichiura*	5	25
Watermelon	Rind worm (unidentified)	3	15
Orange	None	0	0

Table 3. Below quantifies the contamination prevalence for each fruit type, revealing a high overall contamination rate of 47.06%. Watermelon had the highest contamination rate

at 75%, likely due to the ease of microbial infiltration once cut. Bananas and apples followed with rates exceeding 50%, reflecting the vulnerability of these fruits to contamination during handling and storage. Oranges, with a contamination rate of 0%, underscore the protective effect of intact peels. The disparity in contamination rates highlights the influence of fruit structure, handling practices, and market sanitation conditions on parasitic contamination risk.

Table 3. Contamination Rates by Fruit Type

Fruit Type	Number Positive	Number Examined	Contamination Rate (%)
Mango	4	10	40.0
Apple	4	7	57.14
Banana	5	8	62.5
Watermelon	3	4	75.0
Orange	0	5	0.0
Total	**16**	**34**	**47.06 (Average)**

Results

A total of 31 fruit samples were examined for parasitic contamination. These samples were randomly collected from fruit vendors operating in Madina Market. Control samples (30 in total) were obtained from the Accra Mall, where no parasitic contamination was detected. The parasitological analysis revealed the presence of several intestinal parasites in the fruit samples from Madina Market. Specifically, the following pathogenic parasites were identified:

- *Loa loa* (eggs)
- *Ascaris lumbricoides* (eggs)
- *Trichuris trichiura* (eggs)
- Unidentified rind worm eggs

Oranges showed no detectable contamination. In contrast, the highest contamination rate was observed in watermelon samples (75%), followed by banana (62.5%), apple (57.14%), and mango (40%). Control fruits from the Accra Mall were free from parasitic contamination, suggesting a strong association between market handling conditions and contamination.

Quantitative estimation of the parasite load, based on the modified Stoll's technique, revealed:

- Mangoes: 4 *Loa loa* eggs, equivalent to 20 eggs/100g of fruit
- Apples: 4 *Ascaris lumbricoides* eggs, equivalent to 20 eggs/100g of fruit
- Bananas: 5 *Trichuris trichiura* eggs, equivalent to 25 eggs/100g of fruit
- Watermelon: 3 rind worm eggs, equivalent to 15 eggs/100g of fruit
- Oranges: No parasite detected as showed in figure 1

The overall contamination rate for the examined fruit samples from Madina Market was calculated as 47.06%.

These findings underscore the significant risk of parasitic contamination associated with ready-to-eat fruits sold at Madina Market and highlight the need for improved handling, sanitation, and consumer education.

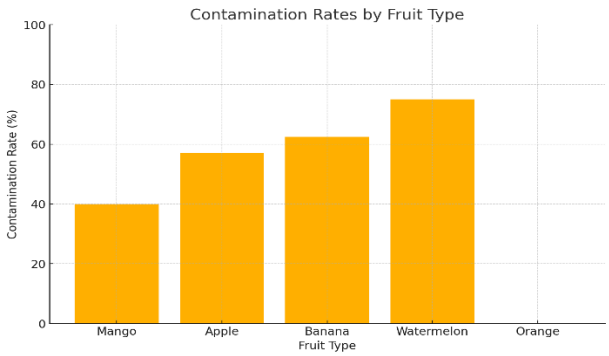

Figure 1. Bar Chart representing the Contamination Rates of Different Fruit Types in your Study

Discussion

This study investigated the prevalence of parasitic contamination in ready-to-eat fruits sold at Madina Market, Ghana, comparing the results with control samples from Accra Mall. The findings revealed a high contamination rate of 47.06% among market samples, with various intestinal parasites identified, including *Ascaris lumbricoides*, *Trichuris trichiura*, *Loa loa*, and unidentified rind worm eggs. Notably, control fruits from Accra Mall showed no contamination, highlighting the significant disparity in hygiene standards between informal and formal retail outlets.

The detailed parasitological analysis (Table 2) revealed that watermelon had the highest contamination rate at 75%, followed by banana (62.5%), apple (57.14%), and mango (40%). Oranges showed no contamination, likely due to their thick protective rind, which may limit exposure to parasites during handling and storage. The quantitative assessment of parasite load using the modified Stoll's method demonstrated a substantial concentration of helminth eggs in mangoes (20 eggs/100g), apples (20 eggs/100g), bananas (25 eggs/100g), and watermelons (15 eggs/100g). The detection of *A. lumbricoides* and *T. trichiura*—both of which are known to cause gastrointestinal distress, anemia, and malnutrition—underscores the public health significance of these findings.

These results align with previous studies reporting parasitic contamination of fruits and vegetables in developing countries [26]. Contributing factors include the use of untreated irrigation water, unsanitary conditions during harvesting and transport, and inadequate hygiene practices by vendors. Informal markets such as Madina Market often lack effective regulatory oversight, allowing these practices to persist. In contrast, the absence of contamination in Accra Mall samples emphasizes the impact of proper handling, storage, and hygiene protocols on food safety.

This study also highlights the critical role of consumer education in reducing infection risks. Public health initiatives should focus on promoting thorough washing of fruits before consumption, particularly those sourced from informal markets. Additionally, interventions aimed at improving vendor hygiene practices and enforcing sanitary regulations in markets are crucial to curbing the spread of foodborne parasitic infections.

The findings also point to a need for infrastructural improvements in market environments. Providing access to clean water, waste disposal systems, and protective packaging for fruits could substantially reduce contamination levels. Further research could explore contamination risks at different stages of the supply chain, from farm to market, to develop comprehensive food safety strategies.

Conclusion

This study demonstrates a significant risk of parasitic contamination in ready-to-eat fruits sold at Madina Market, Ghana. The detection of multiple intestinal parasites, including *A.*

lumbricoides, *T. trichiura*, and *Loa loa*, highlights the potential health hazards associated with consuming improperly handled fruits from informal markets. In contrast, control samples from Accra Mall were free from contamination, underscoring the effectiveness of stringent hygiene and handling practices.

These findings emphasize the urgent need for enhanced food safety protocols, including regulatory oversight, vendor training, and public education on proper fruit washing and handling. Infrastructure improvements such as clean water access and better waste management in markets are also essential. Ultimately, addressing these challenges will contribute to reducing the burden of foodborne parasitic infections, improving public health outcomes, and fostering consumer confidence in the safety of fresh produce.

Recommendations

1. Vendors should be trained on proper hygiene practices, including the use of clean water for washing fruits and maintaining sanitary storage conditions.
2. Local authorities should implement and enforce regulations governing food safety in open markets, including routine inspections and monitoring.
3. Public education campaigns are necessary to raise awareness of the risks associated with consuming improperly washed fruits and the importance of washing fruits thoroughly before consumption.
4. Provision of clean water and waste disposal facilities in market areas to minimize contamination risks.
5. Additional studies should be conducted to investigate contamination at other market sites and to evaluate the effectiveness of interventions aimed at reducing parasitic contamination in ready-to-eat fruits.

Conflict of Interest

There is no conflict of interest.

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References

[1]. International Agency for Research on Cancer (IARC). 2003, *IARC handbooks of cancer prevention: Fruit and vegetables* (Vol. 6.8). H. J. Vainio & F. Bianchini.

[2]. Buyukunal, S., et al., 2015, Microbiological quality of fresh vegetables and fruits collected from supermarkets in Istanbul, Turkey. *Journal of Food and Nutrition Sciences, 3*, 152–159.

[3]. Obeta, S. E., et al., 2011, Microbial effect of selected stored fruits and vegetables under ambient conditions in Markudi, Benue State, Nigeria. *Research Journal of Applied Sciences, Engineering and Technology*.

[4]. Jennylynd, J., 2006, Overview of microbial hazards in fresh fruit and vegetables operations. *John Wiley & Sons, Inc.*

[5]. Mathur, A., et al., 2014, Microbial contamination of raw fruits and vegetables. *Internet Journal of Food Safety, 16*, 26–28.

[6]. World Health Organization (WHO). 2001, Background paper: Developing a food safety strategy (WHO strategic planning meeting).

[7]. Ghana News Agency (GNA). 2010, Producing unsafe food is unwise.

[8]. Barth, M., et al., 2009, Microbiological spoilage of fruits and vegetables. In W. Sperber & M. Doyle (Eds.), *Compendium of the Microbiological Spoilage of Foods and Beverages*. pp. 135–138. Springer.

[9]. Centre for Food Safety. 2006, Microbiological quality of pre-cut fruits for sale or serving in retail outlets.

[10]. Isa, A., et al., 2014, Bacteriological quality of fruits and vegetables sold at Maiduguri Metropolis,

Nigeria. *International Journal of Current Microbiology and Applied Sciences, 3*(2).

[11]. Odamtten, G. T., et al. 2018, Resident microbial load, toxigenic potential and possible quality control measures of six imported seasoning powders on the Ghanaian market. *Journal of Nutritional Health and Food Engineering, 8*(1), 1–11.

[12]. Amoah, D., 2014, Microbial risk assessment of mixed vegetables salads from selected canteens in the Kumasi Metropolis. *Kumasi.*

[13]. Slavin, J. L., & Lloyd, B., 2012, Health benefits of fruits and vegetables. *Advances in Nutrition, 3*(4), 506–516.

[14]. Lake, I. R., et al., 2012, Climate change and foodborne disease in the UK. *Environmental Health, 11*(1), 29.

[15]. Tirado, M. C., et al., 2010, Climate change and food safety: A review. *Food Research International, 43*(7), 1745–1765.

[16]. Todd, E. C. D., 1997, Epidemiology of foodborne diseases: A worldwide review. *World Health Statistics Quarterly, 50*(1–2), 30–50.

[17]. Gómez-Pinilla, F., 2008, Brain foods: The effects of nutrients on brain function. *Nature Reviews Neuroscience, 9*(7), 568–578.

[18]. Liu, R. H., 2013, Health-promoting components of fruits and vegetables in the diet. *Advances in Nutrition, 4*(3), 384S–392S.

[19]. Manach, C., et al., 2004, Polyphenols: Food sources and bioavailability. *American Journal of Clinical Nutrition, 79*(5), 727–747.

[20]. Olaimat, A. N., & Holley, R. A., 2012, Factors influencing the microbial safety of fresh produce: A review. *Food Microbiology, 32*(1), 1–19.

[21]. Monge, R., & Chaves, A., 1994, Presence of parasitic contaminants in fresh vegetables sold in Costa Rican markets. *International Journal of Food Microbiology, 23*(1), 13–17.

[22]. Beuchat, L. R., 1996, Pathogenic microorganisms associated with fresh produce. *Journal of Food Protection, 59*(2), 204–216.

[23]. Kim, J. G., et al. 1999, Use of ozone to inactivate microorganisms on lettuce. *Journal of Food Safety, 19*(1), 17–34.

[24]. Pohlman, J. R., et al. 2014, Low adoption of ultraviolet and ozone decontamination technologies in food production. *Journal of Food Protection, 77*(3), 386–392.

[25]. Grace, D., 2015, Food safety in developing countries: Research gaps and opportunities. *White Paper, International Livestock Research Institute*.

[26]. Obeagu, E. I., Obeagu, G. U., & Nwachukwu, C. C., 2021, Public health risks associated with fruits and vegetables at Owo markets. *International Journal of Current Research in Medical Sciences, 8*(1), 29–41.