

Assessment of the Hygienic and Microbiological Quality of Street Vended Foods in Khartoum State, Sudan

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Abstract - *Background: Street vended foods are an essential source of affordable nutrition in Sudan but are prone to contamination due to poor hygienic practices. This study assessed the hygienic and microbiological quality of commonly vended foods in Khartoum State.*

Methods: A cross-sectional study was conducted between 2016 and 2018. Food samples (meat products, fried snacks, salads, juices, dairy products) were collected from vendors across Khartoum, Khartoum North, and Omdurman. Hygienic practices were observed using a structured checklist. Microbiological analyses included total plate count, coliform count, yeast and mold counts, and isolation of foodborne pathogens (Escherichia coli, Salmonella spp., Staphylococcus aureus, Klebsiella spp., Enterobacterspp.).

Results: Of 250 food samples, 72% exceeded acceptable microbial limits. The highest contamination was recorded in raw salads and fruit juices. Pathogens isolated included E. coli (41%), S. aureus (36%), Salmonella spp. (18%), Klebsiella spp. (14%), and Enterobacter spp. (11%). Yeast and mold contamination was detected in 29% of juice and dairy samples. Only 34% of vendors demonstrated good hygienic practices.

Conclusion: Street vended foods in Khartoum State present significant microbiological risks. Strengthened hygiene training, food safety monitoring, and enforcement of regulations are urgently needed to safeguard public health.

1. Introduction and Literature Review

Street foods provide affordable and accessible meals but often raise public health concerns due to microbial contamination. Contamination sources include unsafe water, poor handling, inadequate storage, and unhygienic environments. Foodborne pathogens such as *E. coli*, *Salmonella*, *S. aureus* and fungi are common in street foods worldwide. In Sudan, limited research has addressed the microbiological quality of these foods despite their widespread consumption. This study fills this gap by examining hygienic practices and microbiological contamination in Khartoum State.

Recent studies (2018–2024) from Africa and Asia have shown high contamination rates in street-vended foods. In Nigeria, *E. coli* and *Salmonella* were commonly reported in salads and meat snacks. In Ethiopia, juices and dairy products showed yeast and mold contamination exceeding standards. Studies in Asia similarly reported contamination with coliforms and poor hygienic practices among vendors. This highlights the global challenge of ensuring safe street food. In Sudan, the street food industry is widespread across urban centers, yet little empirical data exists regarding the sanitary conditions and microbiological safety of these foods.

2. Materials and Methods

Study design: Cross-sectional survey (2016–2018) in Khartoum, Khartoum North, and Omdurman. Sample collection: 250 food samples (meat products, fried snacks, raw salads, juices, dairy). Hygienic practices: Structured checklist observed vendor hygiene (handwashing, utensil cleanliness, storage). Microbiological analysis: Standard methods were used for total plate count, coliform count, yeast and mold count. Pathogens were isolated and identified using selective media and biochemical tests.

Data analysis: Results expressed as CFU/g or CFU/ml; frequencies and percentages calculated.

3. Results

The results highlight poor hygienic practices and widespread microbial contamination of street foods.

Table 1. Hygienic practices of food vendors in Khartoum State.

Hygienic Practice	Vendors Following (%)	Vendors Not Following (%)
Handwashing before serving	42	58
Use of gloves/utensils	29	71
Proper storage (covered food)	38	62
Clean water available	46	54
Waste disposal near vending site	33	67

Table 2. Microbial counts of street vended foods in Khartoum State.

Food Type	Total Plate Count (CFU/g or ml)	Coliform Count	Yeast & Mold Count	Exceeding Standards (%)
Meat products	2.5×10^5	1.2×10^4	8.5×10^3	65
Fried snacks	1.9×10^5	9.8×10^3	7.1×10^3	59
Raw salads	3.6×10^6	2.4×10^5	1.7×10^4	82
Fruit juices	4.1×10^6	3.2×10^5	2.5×10^4	88
Dairy products	2.9×10^6	1.7×10^5	2.0×10^4	76

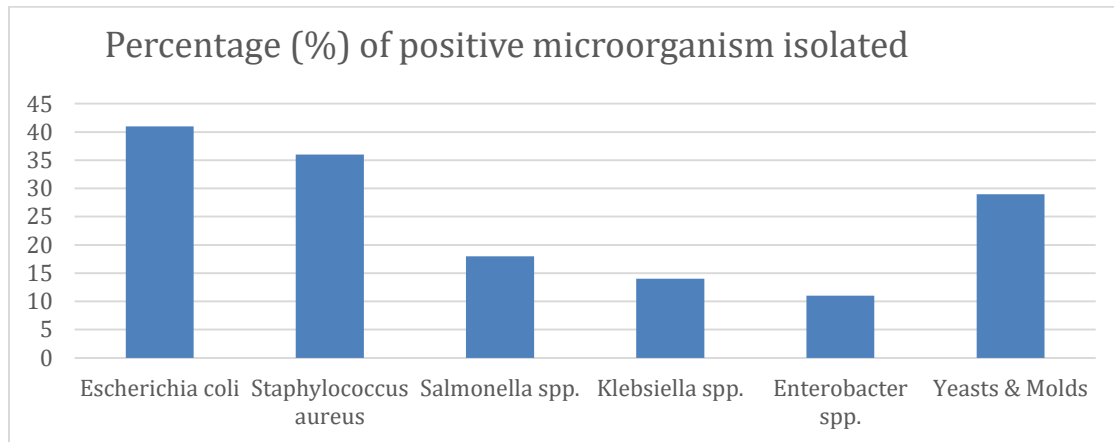


Figure 1. Frequency of microorganisms isolated from street vended foods.

4. Discussion

This study presents a comprehensive evaluation of the hygienic and microbiological quality of street-vended foods in Khartoum State, Sudan. The findings reveal significant public health concerns, primarily driven by poor vendor hygiene, inadequate food handling, and widespread microbial contamination.

4.1 Hygiene Practices and Vendor Behavior

The overall hygiene performance of vendors was poor, with only 2.7% achieving a "good" rating and a median hygiene score of 47.37%. This aligns with studies from other developing countries where vendors typically lack formal food safety training or infrastructure to support hygienic practices (Omemu & Aderoju, 2008; Tambekar et al., 2009). Notably, while the health status of vendors scored relatively higher, this is likely based on superficial observation rather than confirmed medical screening, as 90.7% of vendors lacked valid health certificates.

The poorest scores were recorded in the food preparation and handling category (0%), suggesting critical lapses in basic food safety measures such as reheating, use of protective gear, and proper storage. These findings mirror those reported in Ghana and India, where inadequate storage conditions and improper reheating of food were major contributors to foodborne illness outbreaks (Mensah et al., 2002; FAO/WHO, 2009).

4.2 Microbial Contamination Patterns

Microbiological analysis confirmed extensive contamination of food, hands, and equipment. The median total bacterial count in food samples (6.0×10^8 CFU/g) far exceeds acceptable limits set by international standards, indicating that the food is not safe for consumption. Juices and peanut butter, often served without further cooking, had the highest bacterial loads, consistent with findings from similar studies in West and East Africa (Barro et al., 2007; Mwangi et al., 2017).

E. coli was detected in 26.4% of food samples, confirming fecal contamination and reinforcing the lack of handwashing or use of clean water during food preparation. The presence of *Staphylococcus aureus* in 22.2% of food samples and 29.7% of hand swabs points to direct contamination from food handlers, likely due to poor personal hygiene practices. Although *Salmonella* spp. was detected in fewer samples (13.2%), its presence is highly concerning due to its pathogenic potential and environmental resilience (WHO, 2015).

4.3 Locality-Specific Risks

Variations in microbial contamination and hygiene scores across the seven localities indicate that environmental and infrastructural differences significantly impact food safety. Bahry and East Nile recorded the highest contamination levels, possibly due to higher population density, poor waste management, and limited access to potable water. Vendors in Karary

and Umbadda, by contrast, demonstrated relatively better hygiene scores, suggesting that localized interventions could be effective.

4.4 Hygiene Scores and Microbial Correlation

Statistical analysis revealed a strong inverse correlation between vendor hygiene scores and microbial contamination levels, especially for *E. coli* and total coliforms. This relationship supports findings from multiple international studies (Tambekar et al., 2009; Preethirani et al., 2015), highlighting that even marginal improvements in vendor hygiene can lead to significant reductions in contamination risk. The absence of proper waste disposal and refrigeration further exacerbates microbial growth and cross-contamination.

4.5 Implications for Public Health and Policy

The data underscore the urgent need for regulatory enforcement, structured hygiene education, and consistent surveillance of street food vendors in Sudan. Given the informal nature of the sector, public health authorities must adopt scalable, low-cost interventions—such as hygiene training workshops, provision of portable handwashing stations, and incentives for certified food handlers.

Implementing Codex Alimentarius-based inspection frameworks, coupled with molecular testing for pathogen detection, would enhance the capacity to monitor and control foodborne illnesses. Moreover, vendor licensing linked to hygiene compliance could be a sustainable strategy for improving food safety.

6. Conclusion

Street vended foods in Khartoum State are heavily contaminated with bacteria and fungi, posing serious health risks. Vendors' poor hygienic practices exacerbate contamination. Without regulatory enforcement and hygiene training, street food will remain a source of foodborne illnesses.

7. Recommendations

- Introduce mandatory food hygiene training for street vendors.
- Enforce regular inspections and microbiological testing of street foods.
- Improve access to clean water and sanitation facilities for vendors.
- Conduct public awareness campaigns on safe street food consumption.
- Develop policies integrating informal food vendors into food safety systems.

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