v7.n10. 2026

SCIENTIFIC JOURNAL - RECIMA21 ISSN 2675-6218

ASSESSMENT OF HYGIENIC-SANITARY CONDITIONS IN MEAL PREPARATION UNITS AT LIMPOPO MARKET, IN THE CITY OF XAI-XAI

AVALIAÇÃO DAS CONDIÇÕES HIGIÊNICO-SANITÁRIAS EM UNIDADES DE CONFEÇÃO DE REFEIÇÕES DO MERCADO LIMPOPO, NA CIDADE DE XAI-XAI

EVALUACIÓN DE LAS CONDICIONES HIGIÉNICO-SANITARIAS EN UNIDADES DE PREPARACIÓN DE COMIDAS DEL MERCADO LIMPOPO, EN LA CIUDAD DE XAI-XAI

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e7109211

https://doi.org/10.47820/recima21.v7i10.9211

PUBLISHED: 10/2026

ABSTRACT

Meal preparation and sales in markets offer an income-generating alternative in developing countries. However, this practice poses major foodborne risks when hygienic-sanitary conditions are neglected. Objective: To assess the hygienic-sanitary conditions in meal preparation units at Limpopo Market. Methodology: A descriptive, cross-sectional quantitative study was conducted with a sample of 54 units selected via simple random sampling. Through direct observation, the study evaluated food handlers' health and hygiene; premises' sanitation; equipment hygiene; raw material preservation; and pest control. Results: Non-compliant units predominated. The highest non-compliance rates occurred in pest control (88.9%), food handlers' health and hygiene (66.7%), and raw material preservation (61.1%). Conversely, compliant units predominated in equipment hygiene (64.8%) and premises' sanitation (53.7%). Conclusion: The assessed units show critical weaknesses in meeting the requirements of the Food Hygiene Legislation Collection, particularly regarding pest control, food handlers' practices, and raw material preservation. Developing food hygiene education campaigns, enforcement inspections, and structural improvements is essential.

KEYWORDS: *Hygienic-sanitary conditions. Food hygiene. Meal preparation unit.*

RESUMO

A preparação e venda de refeições nos mercados é uma alternativa que a população de vários países em desenvolvimento encontra para garantir a renda familiar. No entanto, apesar das inúmeras vantagens desta prática, existem vários riscos alimentares, principalmente quando as condições higiênico-sanitárias não são atendidas. Objetivo: Avaliar as condições higiênico-sanitárias em unidades de confeção de refeições do Mercado Limpopo. Metodologia: Foi um estudo descritivo, transversal com abordagem quantitativa, com uma amostra de 54 unidades de confeção de refeições selecionadas por amostragem aleatória simples. Recorreu-se à observação para a coleta de dados e à análise de conteúdo para a respectiva análise.

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Resultados: Os resultados indicam uma predominância de unidades irregulares. As maiores proporções de unidades classificadas como irregulares foram observadas na proteção contra vetores (88,9%), na sanidade, higiene e segurança dos manipuladores (66,7%) e na conservação de matéria-prima (61,1%). Em contrapartida, predominaram unidades classificadas como regulares na higiene de equipamentos e utensílios (64,9%) e na higiene e saneamento dos locais e instalações (53,7%). **Conclusão**: As unidades avaliadas apresentam fragilidades no cumprimento das condições higiênico-sanitárias exigidas pela Colectânea de Legislação no Âmbito da Higiene Alimentar, principalmente na proteção contra vetores, nas práticas de higiene e segurança dos manipuladores e na conservação de matéria-prima. Assim, é necessário desenvolver campanhas de educação em higiene alimentar, visitas de fiscalização das condições e melhoria das condições higiênico-sanitárias.

PALAVRAS-CHAVE: Condições higiênico-sanitárias. Higiene dos alimentos. Unidade de confeção de refeições.

RESUMEN

La preparación y venta de comidas en los mercados ofrece una alternativa de generación de ingresos en los países en desarrollo. Sin embargo, esta práctica plantea importantes riesgos alimentarios cuando se descuidan las condiciones higiénico-sanitarias. Objetivo: Evaluar las condiciones higiénico-sanitarias en las unidades de preparación de comidas del Mercado Limpopo. Metodología: Se realizó un estudio descriptivo, transversal y cuantitativo con una muestra de 54 unidades seleccionadas mediante muestreo aleatorio simple. A través de la observación directa, se evaluó la salud e higiene de los manipuladores, el saneamiento de las instalaciones, la higiene de los equipos, la conservación de las materias primas y el control de plagas. Resultados: Predominaron las unidades no conformes. Las mayores tasas de no conformidad se registraron en el control de plagas (88,9%), la salud e higiene de los manipuladores (66,7%) y la conservación de materias primas (61,1%). Por el contrario, las unidades conformes predominaron en la higiene de equipos (64,9%) y el saneamiento de las instalaciones (53,7%). Conclusión: Las unidades evaluadas muestran debilidades críticas en el cumplimiento de los requisitos de la Colectánea de Legislación en materia de Higiene Alimentaria, particularmente en el control de plagas, las prácticas de los manipuladores y la conservación de materias primas. Es esencial desarrollar campañas de educación en higiene alimentaria, visitas de inspección y mejoras estructurales.

PALABRAS CLAVE: *Condiciones higiénico-sanitarias. Higiene de los alimentos. Unidad de preparación de comidas.*

INTRODUCTION

The street food trade and market meal consumption are widespread globally, with particularly high prevalence in developing nations across Latin America, Asia, and Africa. In these regions, high unemployment rates, low wages, limited social protection programs, and rapid urbanization drive reliance on low-cost food vendors (Macaza, 2017).

While acknowledging the economic advantages of this sector, researchers warn of severe public health risks, such as inadequate food preparation infrastructure, poor potable water supply, and limited food handler awareness regarding basic hygiene and safety protocols (Macaza, 2017). Studies indicate that contaminated utensils, environmental air, and food

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contact surfaces contribute to approximately 16% of foodborne outbreaks, whereas contaminated hands account for up to 26% of bacterial outbreaks (Cassimiro, 2021).

Figueiredo (2019) emphasizes that poor hygiene during food production, storage, distribution, and handling directly facilitates contamination, leading to foodborne diseases (FBDs) that cause substantial morbidity, mortality, and socioeconomic loss worldwide. Over 250 known FBDs affect 1 in 10 people globally, causing an estimated 600 million illnesses, 420,000 deaths, and 33 million disability-adjusted life years (DALYs) annually, primarily caused by bacteria, bacterial toxins, fungi, viruses, and parasites (Cassimiro, 2021; FAO & PAHO, 2019).

In Mozambique, food hygiene is governed by Decree No. 15/2006, which assigns the oversight and inspection of food production, transport, and commercialization to the Ministry of Industry and Commerce in coordination with the Ministry of Health. Under this mandate, the National Inspectorate of Economic Activities (INAE) was established by Decree No. 46/2009 of August 19 as a national public body with administrative autonomy to inspect commercial, industrial, service, and tourism activities (Council of Ministers, 2006).

Limpopo Market is the primary hub for meal preparation and sales in Xai-Xai City, serving numerous market vendors and visitors daily. Despite regulatory efforts, several meal preparation units fail to meet basic hygienic-sanitary standards. This study was conducted to evaluate these units, generate scientific evidence to support public health interventions, and guide decision-making by regulatory authorities.

The primary objective of this study was to evaluate the hygienic-sanitary conditions of meal preparation units in Limpopo Market, Xai-Xai City. Specific objectives included: (1) assessing the health, hygiene, and safety practices of food handlers; (2) describing facility sanitation, equipment cleanliness, raw material storage, and vector control measures; and (3) benchmarking these conditions against Mozambique's official Compilation of Food Hygiene Legislation.

1. THEORETICAL FRAMEWORK

The Council of Ministers (2006) defines food as any substance ingested in its natural, semi-processed, or processed state for human consumption, including beverages, chewing gum, and processing ingredients, but excluding cosmetics, tobacco, and medicinal substances. Similarly, the Department of Environmental Hygiene (DHA, 2012) defines food as natural or manufactured products intended for human nutrition or pleasure.

From a safety perspective, food is classified as safe or unsafe based on the presence of hazardous contaminants. Rossi (2006) defines safe food as food in which hazards are absent

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or below risk thresholds, whereas unsafe food contains hazards at or above unsafe levels. De Souza (2006) notes that safe food is free from chemical, physical, and microbiological contamination that could cause disease or injury to consumers.

Consuming unsafe food leads to foodborne diseases, representing a major and growing global public health challenge. Worldwide, an estimated 600 million people fall ill and 420,000 die annually after consuming contaminated food—a burden projected to increase due to population growth, poverty, global trade expansion, and urban pressure (De Souza, 2006; FAO & PAHO, 2019).

Economically, FBDs inflict substantial burdens on both developed and developing economies. In the Caribbean, annual medical costs tied to FBDs range from USD 700,000 to USD 19 million, while in the United States, costs exceed USD 77 billion (Cassimiro, 2021).

Clinical manifestations of FBDs stem from ingesting biological, chemical, or physical hazards, including pathogen toxins, industrial chemicals, or foreign objects. Common non-specific gastrointestinal symptoms include nausea, vomiting, abdominal pain, and diarrhea (Cassimiro, 2021). De Christina and Corrêa (2017) note that symptoms range from mild, self-limiting discomfort lasting 1–7 days to severe, life-threatening complications such as bloody diarrhea, severe dehydration, acute kidney injury, and respiratory failure. Major foodborne pathogens include Shigella, Vibrio cholerae, pathogenic Escherichia coli, Rotavirus, Norovirus, Poliovirus, Entamoeba, Giardia, Cryptosporidium, Cyclospora, Staphylococcus aureus, Salmonella spp., Clostridium perfringens, Clostridium botulinum, and Bacillus cereus (Gomes, 2019; Pereira, 2015).

1.1. Importance of Hygienic-Sanitary Evaluation

Preventing FBDs requires strict oversight across the entire food supply chain (De Christina & Corrêa, 2017). Food safety surveillance is essential to identify, mitigate, prevent, or control public health hazards inherent to food production and handling (Nascimento, 2023). Hygienic-sanitary evaluations yield critical data on manufacturing, storage, distribution, and vending practices, helping establish shelf-life parameters and risk mitigation strategies.

1.2. African and Mozambican Studies on Hygienic-Sanitary Conditions

Studies across Africa consistently highlight major infrastructural and behavioral deficits in food vending environments. In Benin City, Nigeria, Okojie and Isah (2014) evaluated 286 vending sites; despite appearing visibly clean, only 43.4% had waste bins, 71.2% provided handwashing facilities, and 76.9% provided soap. Vector presence (flies) was frequent, proving that visual cleanliness does not guarantee microbiological safety.

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In South Africa, Nkosi and Tabit (2021) surveyed 399 vendors and inspected 200 vending sites in Zululand District, identifying significant knowledge gaps and poor sanitary infrastructure, underscoring the need for vendor training and structural upgrades.

In Zanzibar, Tanzania, Hassan and Fweja (2020) reported deficiencies in handwashing facilities, soap availability, waste management, and personal hygiene practices among street food vendors.

In Mozambique, Manhique et al. (2019) evaluated 191 food establishments across seven markets in Maputo City. They reported widespread deficiencies in water availability, cold-chain storage, hand hygiene, and waste disposal; notably, 91.1% of vendors stored cooked food without refrigeration, and 85.8% had a "Low" Food Safety Index score.

In Lichinga, Caude (2024) evaluated informal market food vendors, observing inadequate personal hygiene, lack of proper attire, poor utensil cleaning, improper food preservation, and poor ambient waste management.

Collectively, these studies show that across sub-Saharan Africa, poor physical infrastructure and improper food handling practices co-exist, reinforcing the necessity of evaluating facilities and behavioral practices concurrently.

2. METHODOLOGY

2.1. Study Location

The study was conducted at Limpopo Market, located in Neighborhood 12, lower Xai-Xai City, approximately 100 meters from National Road No. 1 (N1). Also known as the Municipal Market, it is one of Xai-Xai Municipality's largest commercial centers, hosting formal and informal vendors selling food, live animals, cosmetics, electronics, apparel, and housewares.

Figure 1. Location of the Limpopo Market. Source: Google Maps, 2026



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The market houses 63 ready-to-eat meal preparation units, serving as an essential affordable food source for local workers and customers, as well as a key source of self-employment.

2.2. Population, Sample, and Sampling Technique

The target population comprised all 63 meal preparation units operating in Limpopo Market. A simple random sampling strategy was employed to select 54 units. All 63 units were enumerated (1 to 63), and 54 numbers were drawn via a lottery method to ensure equal selection probability (Simões, 2017). No selected vendor refused participation; two closed units were replaced by drawing alternative numbers from the remaining population.

2.3. Inclusion and Exclusion Criteria

Inclusion criteria: Active meal preparation units operating inside Limpopo Market.

Exclusion criteria: Closed or inactive units, and units whose managers declined to participate.

2.4. Study Design

This was a descriptive, cross-sectional, quantitative observational study. Data were collected at a single time point to quantify hygienic-sanitary compliance (Magibire, 2019; Merchán-Hamann & Tauil, 2021; Vera Cruz & Dlamini, 2021).

2.5. Data Collection Instrument and Procedure

Data were gathered through systematic observation using a structured observation checklist adapted from Mozambique's official health inspection forms (De Oliveira, 2011). The checklist comprised 35 parameters across 5 categories (Table 1).

Table 1. Evaluation categories and parameter counts assessed across 54 meal preparation units in Limpopo Market

Evaluated Categories	Evaluated Parameters
Food handler health, hygiene, and safety	10
Facility hygiene and sanitation	15
Equipment and utensil cleanliness	4
Raw material storage	3

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Vector control	3
Total	**35**

Source: Authors, 2026.

Data collection occurred between February 9 and February 27, 2026, conducted by a team of five trained evaluators. Evaluator training included a pre-fieldwork simulation with six participants covering food handling practices, environmental sanitation, cold chain storage, vector control, and Mozambican food regulations to minimize observer bias.

Evaluation criteria followed the technical standards set by the *Compilation of Food Hygiene Legislation* (DHA, 2012) and *Codex Alimentarius* guidelines. Each parameter was scored as compliant (1 point) or non-compliant (0 points). Units achieving a Compliance Index above 75% without critical safety violations were classified as Regular (compliant). Units scoring 75% or below, or presenting critical food safety risks, were classified as Irregular (non-compliant).

2.6. Ethical Considerations

Formal ethics committee approval was not required as no human biological specimens or personal identifiable data were collected. Official authorization was granted by the Local Economy and Development Directorate of the Xai-Xai Municipal Council and the Limpopo Market Administration prior to data collection.

3. RESULTS AND DISCUSSION

Overall findings across all 54 meal preparation units are summarized in Table 2.

Table 2. Summary of hygienic-sanitary conditions observed in meal preparation units at Limpopo Market

Category	Evaluated Parameters	Compliant (n)	Compliant (%)	Non-compliant (n)	Non-compliant (%)	n
Handler health,	Hair covering, proper uniform, personal cleanliness,	18	33.3%	36	66.7%	54

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hygiene & safety	trimmed/unpolished nails, absence of jewelry, skin/respiratory health, valid health certificates, handwashing, risky behaviors.					
Facility hygiene & sanitation	Location, potable running water, gender-segregated clean toilets/dressing rooms, yard cleanliness, washable floors/walls, waste management, sewage system, ventilation, lighting, sanitary logbook, training plan, dining area size.	29	53.7%	25	46.3%	54
Equipment & utensil cleanliness	Dishware hygiene, surface cleanliness, easy-to-clean non-toxic materials.	35	64.8%	19	35.2%	54
Raw material storage	Expiration dates, proper stacking, chemical/food separation, raw meat preservation.	21	38.9%	33	61.1%	54
Vector control	Presence of insects/rodents, signs of rodent infestation, vector proofing measures.	6	11.1%	48	88.9%	54

Source: Authors, 2026.

3.1. Handler Health, Hygiene, and Safety

In this category, 66.7% (36/54) of units were non-compliant (irregular). Major violations included uncovered hair, lack of appropriate aprons/uniforms, untrimmed or painted fingernails, expired or missing health certificates, and wearing personal jewelry (rings and bracelets) during food handling.

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Improper handling practices introduce pathogens into ready-to-eat foods via hands, skin lesions, hair, or respiratory droplets. Food handlers serve as primary reservoirs for *Staphylococcus aureus* and enteric pathogens (Ferreira, 2006).

Our findings align with Cunha et al. (2019), who evaluated fruit salad vendors in Vitória da Conquista, Brazil, and found that 83% of handlers wore personal jewelry, lacked hair restraints, and wore improper attire. Similarly, Guedes (2009) reported that 75% of hospital kitchen handlers in Brasília lacked complete uniforms, and 25% lacked valid health certificates.

Mozambican food legislation (DHA, 2012) explicitly mandates hair coverings, clean uniforms, trimmed unpolished nails, regular hand hygiene, absence of jewelry, valid health certificates, and the avoidance of high-risk behaviors (smoking, eating, coughing over food). The high non-compliance rate (66.7%) highlights serious gaps in regulatory enforcement and food safety knowledge.

3.2. Facility Hygiene and Sanitation

For facility sanitation, 53.7% (29/54) of units met compliance thresholds, whereas 46.3% (25/54) failed. Key non-conformities included inadequate or absent toilet and changing facilities, cobwebs on walls and ceilings, non-washable wall surfaces, poor solid waste management, and an absence of staff training plans.

Clean preparation environments prevent cross-contamination. Deficient sanitation creates harborage sites for pathogenic microorganisms and vectors, inducing biological hazards (Cassimiro, 2021). Lippert (2016) observed similar structural issues in food service businesses, including inadequate handwashing signage, insufficient changing rooms, and cracked surfaces. Guedes (2009) also noted that 37.5% of evaluated commercial kitchens had defective waste management systems, attracting urban pests.

Mozambican guidelines (DHA, 2012) require washable, non-absorbent floors and walls, proper lighting and ventilation, functional drainage, segregated restrooms, potable water access, and formal sanitation control records—requirements unfulfilled by nearly half of the surveyed units.

3.3. Equipment and Utensil Cleanliness

In this domain, 64.8% (35/54) of units were compliant, while 35.2% (19/54) were non-compliant. Observed issues included dirty or dusty food contact surfaces, difficult-to-clean materials, and exposed, unprotected storage of clean utensils.

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Inadequate cleaning of food contact surfaces promotes cross-contamination and biofilm formation (Lepesqueur et al., 2021). Lippert (2016) similarly reported non-compliance rates up to 33.3% driven by dirty preparation equipment. Food safety standards mandate smooth, corrosion-resistant, non-toxic, easy-to-sanitize contact surfaces (DHA, 2012).

3.4. Raw Material Storage

Regarding raw material storage, 61.1% (33/54) of units were non-compliant. Identified infractions included expired ingredients, co-storage of food items with toxic cleaning chemicals, and simultaneous storage of raw meats with bottled soft drinks or alcoholic beverages in the same refrigeration units.

Cross-contamination during cold storage poses severe biological and chemical hazards. Storing raw meat with ready-to-consume beverages allows drip contamination from meat-borne pathogens (*Salmonella*, *E. coli*). Chemical contamination can also occur when cleaning agents share storage space with ingredients (Vasconcelos & Melo Filho, 2010).

Guedes (2009) similarly reported high storage non-compliance (62%), finding unlabeled products and expired meats in hospital kitchens. Lippert (2016) also documented poor temperature monitoring and inadequate raw material tracking. Official guidelines (DHA, 2012) dictate that ingredients must be unexpired, stored on raised pallets off the floor, separated by food category, and kept strictly isolated from non-food chemicals and ready-to-drink beverages.

3.5. Vector Control

Vector control yielded the worst compliance rate: 88.9% (48/54) of units were non-compliant, presenting live pests (flies, cockroaches, rodents) or visible signs of infestation (e.g., rodent droppings). Only 11.1% (6/54) showed no evidence of vector activity.

Pests are biological vectors for severe infectious diseases, including leptospirosis (*Rattus* spp.), cholera, typhoid fever, shigellosis, and giardiasis (*Musca domestica* and *Blattodea*) (ANVISA, 2012). Guedes (2009) and Messias et al. (2013) similarly reported ineffective pest control in 50% of evaluated food establishments due to open entry points and poor structural proofing. National regulations strictly forbid pest activity in food processing areas and mandate active preventive exclusion measures (DHA, 2012).

4. CONCLUSION

This evaluation reveals widespread non-compliance with Mozambican Food Hygiene Legislation in meal preparation units at Limpopo Market. The most severe vulnerabilities involve

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vector control (88.9% irregular), food handler hygiene and health certification (66.7% irregular), and raw material/cold storage management (61.1% irregular).

Future studies should perform microbiological testing of food samples, food contact surfaces, water supplies, and food handlers' hands to correlate observed physical non-conformities with actual pathogen loads.

Based on the findings, unit operators must mandate proper attire, prohibit jewelry, enforce medical screening, ensure segregated food/chemical storage, and seal structural gaps for pest control. Concurrently, Xai-Xai municipal authorities must conduct unannounced sanitary inspections, enforce regulatory sanctions, and provide mandatory vendor training on food safety. Ultimately, the municipality must upgrade basic market infrastructure, prioritizing continuous potable water supply, efficient drainage networks, regular waste collection, and adequate public restrooms.

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