



FOOD SAFETY HAZARDS AND CONTROL STRATEGIES IN NIGERIA'S STREET FOOD SECTOR

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ABSTRACT :

Background: Hawking of foods on the streets has been a significant aspect of the Nigeria's social, economic and cultural life since time immemorial because of its cheap and easily accessible foods and also opens employment and business opportunities for the poor. However, the sector has been characterized by increased informality, and this has contributed to increased food safety risks that have led to regular incidences of food borne diseases.

Method: This review systematically searched the literature on street food safety in Nigeria using databases such as Google Scholar, PubMed and Scopus. The research articles from 2018–2024 were included for analyzing the risks and risk management measures based on the available evidence. The review applied the Hazard Analysis and Critical Control Points (HACCP) approach to assess current practice and make recommendations.

Findings: The research revealed the following hazards of Nigerian street foods: Microbiological hazards, chemical hazards and the environmental risks. Microbiological contamination including *E. coli* and *Salmonella* were associated with hygiene practices while chemical contamination included heavy metals and pesticides from unsafe cooking practices and raw materials respectively. Adverse environmental effects were attributed to poor hygiene conditions of vending places and unavailability of clean water. Control measures embraced vendor's training, environmental sanitation, and regulation measures grounded on HACCP. However, these measures experienced some difficulties such as weak implementation and the nature of the sector as mainly informal.

Conclusion: Although the HACCP-based strategies developed for the improvement of food safety in the Nigeria street food sector are promising, more integrated approach including the improvement of regulations, vendors and the public health promotion campaigns is required. Closing these gaps is possible to minimize health risks and support the further development of the street food business.

Keywords: Street food, Food safety, Nigeria, HACCP, Microbiological hazards, Chemical hazards, public health.

INTRODUCTION

Background Information

Food hawking in the streets of Nigeria has been identified as a part of the country's social, economic and cultural fabric in the provision of cheap foods for most citizens. Such foods and beverages – hawker foods or street foods, ready to eat foods and drinks – consist of the following: These are traditional Nigerian foods, snacks, and drinks easily accessible in almost all urban and rural areas (Mazi et al., 2023). The characteristics of street food have changed because of the population increase, increasing urbanization, and shifting customer preferences (Fusté-Forné, 2021).

The consumption of street foods is not only on convenience and cheap food prices but also on the importance of the income source, especially for low-income women, who are mainly engaged in this sector (Adeosun et al., 2022). It offers an opportunity to make employment for thousands of people who could otherwise not be in a position to start formal business. Furthermore, the street foods act as means of daily food requirement to the widespread populace especially the urban poor (Birgen et al., 2020). Furthermore, sale of street foods helps tourism industry by reminding the foreigners of Nigeria's food culture and practices (Ma et al., 2019). But there are negative impacts on health which are associated with street foods since they are related to food hygiene.

In the global context, food safety continues to be a concern especially in LMICs whose food safety regimes are either poorly developed or dysfunctional. According to the WHO, foodborne illness is estimated to occur in 600 million people per year, with 420,000 fatalities. Foodborne illnesses, including those in Nigeria, Africa, are estimated to be 91 million per year, and the deaths are 137,000 per year (Rakha et al., 2022). A significant number of the street foods sellers work in unhygienically conditions that are hard to control due to their illegitimate business structures (Afolabi et al., 2021).

This study revealed that the cause of foodborne illnesses in Nigeria is as a result of poor hygiene during food preparation and handling, poor sanitation and the use of substandard raw materials as pointed out by Akinbo et al., 2020. Many sellers in the streets do not undergo training in food hygiene so they contribute to the spread of contamination at different levels of food handling. Some of these pathogens include *Escherichia coli*, *Salmonella* spp., *Shigella* spp., *Campylobacter jejuni*, *Clostridium perfringens*, *Bacillus cereus* and *Staphylococcus aureus* are normally associated with street foods, resulting from poor handling, inadequate cooking and poor temperature control, according to Birgen et al., 2020 and Sarkar et al., 2022.

The vending environment is most of the time a significant source of food safety risks. Vendors primarily locate at places such as markets, and bus terminals where there is inadequate waste disposal and sanitation structures (Akinbo et al., 2020). Such environments make food vulnerable to other contaminants such as airborne diseases' causing germs, flies, and rats that act as carriers of food diseases (Ogunbanjo et al., 2020). In addition, food preparation can be done under very poor hygiene standards, and without proper protection from dust, flies or any other pollutant (Olajide & Williams, 2018).

Proper raw materials are difficult to come by, most of them are substandard, hence the preparation of the street food is equally compromised. Most suppliers acquire their products from the informal markets, and most of them come from places with lax hygiene practices. Food is prepared using water and many a time's water available is not fit for drinking as vendors may use contaminated water for washing utensils, washing vegetables, fruits etc., or even to prepare beverages (Chaudhury et al., 2018; Shittu et al., 2021). A study done in Lagos showed that out of the water samples that vendors used, 90% of them had bacterial coliforms and *E. coli* contamination (Oluwaseun et al., 2019).

Inadequate food storage and handling also leads to the outbreak of food borne diseases. Inadequate food storage and handling also leads to the outbreak of food borne diseases. Most of the street foods are cooked and then left to cool before they are sold, conditions that bacteria thrive in (Chung et al., 2020). Reheating practices are usually substandard because vendors may not apply enough heat to kill bacteria that grow at storage conditions (Harrison & Thompson, 2020). Again, the reusing of cooking oil and washing utensils without clean water also increases cross contamination.

Unsatisfactory personal hygiene among vendors is another shocking concern. Most food sellers on the streets lack the basic hygiene amenities such as hand washing facilities (Lee & Kim, 2020). As a result, contaminated bacteria may be spread from the hand of the food handlers to the food hence increasing the incidence of food borne diseases (Anderson & Smith, 2020). A cross-sectional study carried out among street food vendors in Kano, Nigeria established that only the half of the respondents displayed good hygiene; this was due to poor handwashing standard.

The street food sector remains an informal sector and this comes with its own challenges to the regulatory agencies such as NAFDAC and SON in their attempt to ensure that all foods sold in the market are safe for human consumption. The informal economy is extensive and poorly regulated, and vendors lack the licenses or permits necessary for authorities to enforce compliance (Ndubisi et al., 2020). Lack of supervision means that there is poor compliance to food hygiene standards which is worse in rural and hard to reach regions (Olajide & Williams, 2018).

Problem Statement

Food safety continues to be an emerging problem worldwide and more so in LMICs like Nigeria due to weak policies and limited resources in implementing those that exist. According to the WHO, foodborne diseases affect 600 million people in the world each year, and 420,000 of them die, and Africa is no exception. Being the largest country in Africa, Nigeria has a great problem with food safety, especially in the context of street food which is mostly represented by informal sector joints (Rakha et al., 2022).

Street food vending is a core component of Nigeria's economy that avails convenience nutrition to millions of the Nation's populations daily in both the urban and rural areas. However, because this sector is informal and largely uncontrolled, many of the vendors and operators supplying products to the population are not sufficiently trained and equipped to ensure cleanliness; the sanitary conditions are poor, food is not processed properly, and raw materials are often contaminated (Afolabi et al., 2021). This situation leads to food borne diseases like *Escherichia coli*, *Salmonella* spp., and *Staphylococcus aureus*. A study shows that more than half of the street vendors in Nigeria are not practicing appropriate measures to avoid cross contamination (Akinbo et al., 2020).

Others are environmental factors which include; poor disposal systems and poor access to clean water and sanitation. Most of the street foods are exposed to pollutants and pathogens because many food vendors work in congested environments such as the markets and bus terminals (Ogunbanjo et al., 2020). While there have been measures put in place by the NAFDAC and the SON, the compliance is still very low because the sector is informal, and enforcement capacity is very low (Ndubisi et al., 2020).

Since high incidence of foodborne illnesses have been attributed to the consumption of street foods in Nigeria, there is the need for multifaceted control and better and efficient regulation. Mitigating these hazards prevents the spread of diseases and nurtures the development of the street food industry which has significant contributions to Nigeria's economy and local culture (Mazi et al., 2023).

Justification of the Review

Previous research on the Nigerian street food industry has been centered on microbiological and chemical risks; challenges such as *Escherichia coli*, *Salmonella* spp., heavy metals, and pesticide residues because of poor hygiene and lack of policies (Afolabi et al., 2021; Birgen et al., 2020). However, most of the research work is limited to specific areas, especially the large cities such as Lagos and lacks a proper national survey of the identified hazards and the measures to mitigate them (Olajide & Williams, 2019). This review is therefore useful in filling this gap by providing an overall evaluation of street food hazards in Nigeria, the current measures of control and areas of weakness. It combines microbiological, chemical and environmental hazards, offering practical advice on how to improve food safety through legislation, training and structural changes to help other public health goals.

1.4 Objectives of the review

1. To identify the hazards associated with Nigerian street foods
2. To identify the control strategies and measures applied in street food handling in Nigeria

1.5 Methodology

This review used a systematic review of the literature analysis method, focusing on articles published within the period of 2018 to 2024. In the course of this study, the following databases were searched: Google Scholar, PubMed, Scopus, Science Direct and the keywords used were “street food safety,” “food borne illness in Nigeria,” and “food control measures.” Out of 100 articles that have been identified, 30 were selected that are related to Nigeria, provide empirical data, and are involved in the management of food safety interventions. The strategies currently in practice and the common hazards were discovered through the critical evaluation of these articles. The results obtained were further grouped to give a systematic and comprehensive view of the risks involved in the street food sector and the measures put in place in Nigeria.

2.0 Result and Analysis

2.1 The hazards associated with Nigerian street foods

The economic and nutritional values of street foods in Nigeria are enormous but the health risks associated with food preparation, environment, and handling are also enormous. These hazards are discussed in this empirical review and highlighted as microbiological, chemical, and environmental risks, with reference to current literature.

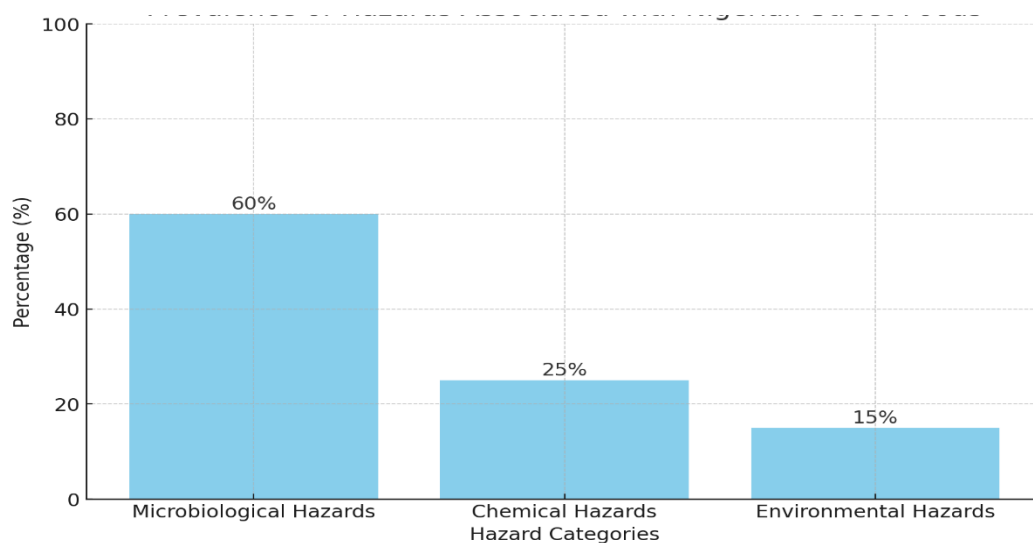


Figure 1: Prevalence of hazards associated with Nigerian Foods

Microbiological Hazards

Microbiological contamination continues to be the most dominant and significant health risk factor of street foods in Nigeria. Studies by Ogunbanjo et al., 2020 and Afolabi et al., 2021 frequently identifies pathogenic bacteria including *Escherichia coli*, *Salmonella spp.*, *Shigella spp.*, *Staphylococcus aureus*, and *Clostridium perfringens*. These pathogens are usually brought in through contamination by poor hygiene standards during food processing. Other research has indicated that the processing of food and washing utensils using the water impregnated with these bacteria and microorganisms spreads them further (Chaudhury et al., 2018, Adegoke et al., 2016).

For instance, a survey done in Lagos showed that more than 30% of the sampled street foods were positives for *E.coli* due to the vendors lack of proper hand and utensils washing, (Adegboye et al., 2019). In a similar way, another study found *Salmonella spp.* in 20% of fried meat samples, attributed to the vendors' failure to maintain food temperatures while cooking and storing the food (Fusté-Forné, 2021). These studies show that poor hygiene practices and poor handling practices play a major role in microbiological risks in Nigerian street foods.

Besides, jollof rice, beans, and stews are food dishes that are normally left at room temperature for several hours; therefore, supporting the rapid growth of bacteria like *Bacillus cereus* and *Staphylococcus aureus* (Chung et al., 2020). Respondents in a survey in Port Harcourt revealed that around 45% of vendors had no proper storage facilities; this was responsible for high bacterial contamination (Oluwaseun & Ibrahim, 2023).

Chemical Hazards

Chemical pollution is another major hazard, which can result from the application of low quality and unsuitable materials and inadequate processing conditions. Research shows that most of the Nigerian street foods are contaminated with lead and cadmium heavy metals and pesticide residues which have been found to cause carcinogenic and other long-term effects on human health (Sarkar et al., 2022). For example, studies carried out in Lagos revealed that 20% of street foods with lead above the legal standards due to the use of contaminated water and preparation of foods in unsuitable utensils (Okeke, 2021).

Subsequent research indicated that most vendors employ aluminum and plastic receptacles since they are cheap, these products emit dangerous chemicals into food particularly when heated or utilized with acidic meals. It is known that such practices increase the likelihood of neurological disorders, kidney diseases, and, in some cases, cancer in consumers who often consume products containing such contaminated foods (Ankar-Brewoo et al., 2020; Patel et al., 2019).

Pesticide residues are also a problem, especially in vegetables that are consumed in the preparation of street foods. Research revealed that about 15 % of the sampled vegetables had pesticide residues above the acceptable level set by the World Health Organization due to uncontrolled farming and poor usage of chemicals in farming activities (Sarkar et al., 2022). These chemical hazards explain why there is need for strict control measures for the vendors and equally why the vendors should be trained appropriately on how to handle and store foods.

Environmental Hazards

It was also found that environmental conditions are a major influence in the contamination of street foods. Most street vendors work in places with poor sanitation; these are areas that have high influx of people involving markets, transport stations and other congested areas, where there is poor access to clean water and inadequate, and very often non-functional disposal system for wastes (Ogunbanjo et al., 2020; Akinbo et al., 2020). Such environments expose foods to dust, flies, rodents and airborne diseases causing pathogens that enhance food borne diseases.

A study done in Ibadan showed that more than half of the street food vendors sold food in places with no adequate disposal of wastes; most of the foods were prepared close to dumpsites and or stagnant water sources that attract flies and other insects (Shittu et al., 2021). This contamination route increases the propensity of foodborne pathogens such as *Salmonella* and *Shigella* to be present in food served (Olajide & Williams, 2018). Lagos had the highest percentage of vendors using water that did not meet WHO quality standard, as many of the samples collected had high fecal contamination (Chaudhury et al., 2018). This finding re-emphasizes the need to have access to clean water in order to minimize on the occurrences of environmental risks.

However, another significant factor of contamination is airborne contamination. Those vendors based in busy areas are often prone to dust and emissions from vehicles, which may lead to contamination of uncovered foods, and higher concentration of airborne fungus spores such as *Aspergillus* and *Penicillium* (Smith et al., 2021). Researches agree that vendors who do not wear gloves or cover their food put consumers at a higher risk of being contaminated.

2.2 The control strategies and measures applied in street food handling in Nigeria

In view of the above, the following control measures and strategies have been implemented as part of the control measures of street foods in Nigeria following the HACCP system. HACCP is an effective method that is aimed at assessing and controlling hazards from the time food products are prepared up to the time they are consumed. This empirical review analyses the measures and actions taken, including training, legal mechanisms, environmental controls, and vendors.

Application of Hazard Analysis and Critical Control Points (HACCP) Principles in Street Food Handling

HACCP principles are gradually being implemented in Nigeria's street food sector as the public health department and international organizations work collectively to address the increasing prevalence of food borne diseases. The HACCP framework involves seven key principles: The seven principles include: risk assessment, determining CCPs, setting critical limits, monitoring CCPs, undertaking corrective actions, ensuring that the system functions, and documenting the process. The next subtopics provide a discussion of these principles as they relate to the handling of street foods in Nigeria.

1. HACCP stands for Hazard Analysis and Identification of Critical Control Points

The first procedure required in the practice of HACCP for the Nigerian street food handlers is to accomplish the particular hazard assessment which involves the evaluation of risks at several phases of foods handling. The research shows that microbial risks, including *E. coli* and *Salmonella* spp., are common because of poor hygiene, contaminated water, and wrong food storage (Ogunbanjo et al., 2020; Oluwaseun & Ibrahim, 2023). At this stage compounds that are recognized as chemical hazards including heavy metals and pesticide residues are also detected, mostly resulting from the utilization of substandard raw materials or improper cooking utensils (Sarkar et al., 2022; Okeke, 2021).

Critical control points are identified after this, and they encompass processes that can be managed or removed to eliminate or reduce risks. In the street food context, CCPs refer to activities such as storage of food, preparation of food, reheating of food and handling of food. For instance, proper temperatures that should be used in cooking and washing hands are highlighted as critical control points where effective measures to minimize pathogen existence can be instituted (Adegboye et al., 2019).

2. Setting up CCPs Critical Limits and Monitoring

To enhance the effectiveness of the control measures at CCPs, a critical limit is set. These are restrictions of temperature in cooking and storage to minimize bacterial growth, and the cleanliness of the vendors. For example, preparing meat products like suya requires that the products get to a certain minimum temperature to kill bacteria like *Salmonella* and *Clostridium perfringens* (Akinbo et al., 2020).

It is important to monitor these CCPs because monitoring entails observing and measuring the CCP's compliance with the critical limits. Some have also noted that some monitoring systems in Nigeria are for instance carried out by health officials whereby they go to the streets to check the temperature and hygiene standards of the vendors. However, the coverage and frequency of such inspections remain inadequate because of the lack of funds and the structural irregularity of the sector (Olajide & Williams, 2019). This means that the current monitoring mechanisms are inadequate to monitor the vendors' compliance to food safety standards.

3. Correction Procedures and Validation Processes

Corrective actions are taken when there are variances with the critical limits. In Nigeria, the local government bodies including the National Agency for Food and Drug Administration and Control (NAFDAC) is charged with the responsibility of implementing the corrective actions. For instance, if the vendors are using contaminated water or failure to maintain the appropriate temperatures for the foods, the authorities will close them pending compliance

(NAFDAC, 2022). However, the efficiency of such measures is hampered by the high level of non-formality of the sector and the lack of sufficient powers to control violations.

The measures used in the HACCP system to verify that the control measures are indeed effective are important in the process. According to research, verification in the Nigeria street foods sector involves physical check and sampling of the foods for test on contaminations (Oluwaseun et al., 2019). This is accompanied by cooperation between local health departments and other international bodies such as WHO which promote technical and financial support in the diets' safety programs. Verification procedures are still inadequate and not standardized and generalized and should be improved and implemented systematically in both urban and rural areas (Birgen et al., 2020).

4. Training of the Vendor and Capacity Building

Probably the most effective way to improve food safety in Nigeria's street foods sector is to educate the vendors on proper hygiene practices and proper food handling practices. The training sessions organized with the help of the directors of the public health agencies and NGOs require vendors not only to provide their clients with potable water and adhere to the hygiene norms but also to manage the required temperature while cooking and storage (Rawat and Gautam, 2020). Many of these programs involve HACCP principles, showing vendors how to assess risks and monitor CCPs properly.

For example, training sessions in Lagos and Abuja have revealed that vendors adhere to proper hand washing, proper storage of raw materials and other appropriate protective measures including gloves and aprons (Mazi et al., 2023). However, these training programs are not common and the call has been made to expand such interventions to affect vendors in the remote and other less privileged areas where awareness of food safety is still very poor (Olajide & Williams, 2019).

5. The topic that has been selected for the study is: Regulatory Frameworks and Policy Implementation

HACCP can only work well in street food vending if there are the relevant regulatory measures in place. In Nigeria, NAFDAC and SON, have come up with food safety standards that are in conformity with the principles of HACCP. These regulations set the acceptable hygiene levels that vendors should display besides setting the acceptable conditions of the cooking environment (Adegboye et al., 2019).

However, even with these, regulation is hard to enforce because of the informal structure of the street vending business. Many vendors work without licenses, which makes it challenging for the authorities to regulate their compliance systematically (Ndubisi et al., 2020). This gap shows the need to find new ways of bringing informal vendors into compliance with the law, for example, through rewards for legal activity or easing the requirements for obtaining a license.

6. Environment Management Techniques

Environmental control measures are another important element of HACCP measures implementation. In Nigeria, attempts have been made to supply portable water and sanitation amenities in the markets and other concentration vending zones. For instance, there are some alliances of local government with health organizations that have adopted potable water stations and waste management systems close to street foods selling centers (Chaudhury et al., 2018). These interventions seek to avoid risks of contamination by water borne diseases and poor disposal of wastes.

However, available research reveals that such facilities are scarce especially in the rural areas and small towns (Ogunbanjo et al., 2020). These environmental controls have to be extended to cover all vendors across the country in order to provide sanitation infrastructure that will decrease environmental risks in food production.

Conclusion

The evaluation of the hazards and control measures in the street food sector of Nigeria show that the situation is not as simple as it is painted; there is a combination of cultural factor, economic factor and health factor to consider. Streets foods, which include cheap sources of nutrition and economic revenue, are associated with high health risks because of poor hygiene standards and practice of environments rudiments, and compensational shortages. It has also been deemed that the implementation of hazards analysis and critical control point principles may offer promise in reducing such exposures as a result of adherence to the four-step system of coping with hazards, application of critical control point techniques, and vendor training as well as regulation compliance. However, issues like inadequate implementation, lack of funds, and the highly informal nature of the sector suggest that there is much more to be done on a broader and coordinated basis. The above challenges require intervention for the enhancement of food safety, the promotion of health and the development of sustainable street food sector in Nigeria.

Recommendations

To enhance food safety in Nigeria's street food sector, the following recommendations are proposed:

1. The government through institutions such as NAFDAC and SON should improve the legislation in support of HACCP that would be relevant to the informal sector vendors. Rubber stamping systems and giving rebate where wanted are other methods that may be used to make vendors adhere to food safety standards.
2. Government and non-governmental organizations should increase their efforts in offering training to the population in matters concerning handling of food, identification of risks, and hygiene. These programs should also be made available to the rural and other areas that lack the influence of urban regions; more so making sure that all food vendors in Nigeria are educated and empowered to vend safe food.

3. Local governments should ensure that they put up structures in terms of provision of clean water supply stations and provision of proper waste disposal in markets and other densely vending areas. It will also be important to guarantee that such facilities are in adequate supply outside large cities, so as to reduce contamination risks and enhance the general cleanliness of street food settings.
4. There is also a need for regulatory agencies to step up their activities in terms of the number of inspections conducted as well as expand their field coverage to include rural regions of the nation. This can be done with a help of the local CHWs, who are aware of the identity of the vendors and their working conditions. Pressure on legal compliance in areas related to food safety will be checked and balanced by regular inspections and follow-ups.
5. The public health organizations and media should launch campaigns to educate the vendors and the consumers. Such campaigns should therefore concentrate on the hazards resulting from unsanitary food handling, the significance of cleanliness, and the way the people can go shopping and prepare food safely. This dual approach will enable consumers to call for safer street foods while at the same time, the vendors will ensure they stick to best practices.

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