

# Food Safety and Hygiene: A Review of Ghana's Paradigm

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## ABSTRACT

Food safety and hygiene are important worldwide, and ensuring food safety in Sub-Saharan Africa, particularly in Ghana, is crucial. This review provides an overview of the food safety situation in Ghana. By analyzing research papers using a desktop review method, the main sources of concerns regarding food safety and hygiene were identified. Many studies have focused on food contamination at the consumption stage, while only a few have addressed the healthiness of the production process. Issues such as improper food handling at local markets, poor hygiene practices at vending sites, and inadequate transportation and packaging systems were highlighted. A lack of education was identified as a significant factor contributing to food contamination, especially during consumption. Various microorganisms, including viruses, fungi, parasites, and bacteria, are responsible for food borne illnesses. These include rotavirus, hepatitis A virus, Lassa fever, noroviruses, and various types of bacteria. Chemical contaminants such as pesticide residues, lead, and mercury are also found in some foods. To address these concerns, it is essential to implement rigorous monitoring, evaluation, surveillance, and education programs. Regulatory agencies must enforce regulations effectively to prevent food contamination and food borne illnesses in the region.

**Keywords:** Food safety, hygiene, contamination, diseases, and pathogens.

## INTRODUCTION

Food safety is a major issue in both developed and underdeveloped countries. In the United States, for example, the World Health Organization (WHO) estimates that more than 5 billion dollars are lost due to food safety problems, especially food borne diseases<sup>1</sup>. Food safety is said to be as serious as that of other major diseases, such as tuberculosis, HIV/AIDS, and malaria. The World Health Organization (WHO) says that 98% of the burden of food safety issues is in underdeveloped nations, with Africa reporting a high number of deaths and hospitalizations.<sup>1,2</sup> The Food and Drugs Authority (FDA) is responsible for ensuring that food is safe for consumers in Ghana. They inspect food manufacturing and processing sites, license products, and provide training for food handlers.<sup>3</sup> The Ghana Standard Authority sets standards for the industry, and other agencies, such as the Ministry of Health and the Ministry of Agriculture, support these efforts.<sup>1</sup> The government of Ghana has directed local authorities to monitor the food safety practices of vendors who sell food in places such as caterers, nightclubs, and hotels.<sup>4</sup> The Environmental Health Department is responsible for monitoring and certifying these vendors. Traditionally, women in Ghana are responsible for food preparation, and many food handlers in the country have low levels of formal education.<sup>5</sup> According to the Ministry of Food and Agriculture and the World Bank, 1 in 40 Ghanaians suffer from serious food-related illnesses each year,<sup>3</sup> with 420,000 cases reported and 65,000 deaths annually, costing the government 69 million dollars.<sup>5</sup> This report could be an underestimate because the reporting rate is low, and in the calculation of cost in developing countries, only the cost borne by individuals through hospitalization and medication is considered<sup>6</sup>, while others in developed countries consider the cost to employers, institutional bodies such as laboratories,

surveillance, disability cost and cost from other family members who take care of the sick member and premature death.<sup>7</sup>

The FDA stated that in Ghana in 2006, approximately 594,279 days (equivalent to 19,809 months) were lost in productivity due to food-borne diseases, which could have a significant impact on the state's expenses. Research in the country has mostly focused on street foods in the commercial food sector, with reported cases of food poisoning in media from places such as schools.<sup>8,9</sup> Saba and Gonzalez-Zorn (2012) found that studies on microbiological food safety are decreasing and are mainly centered in the capital city. While all food hazards are harmful to consumers' health and require monitoring and control,<sup>9</sup> the current focus is on microbiological hazards in ready-to-eat foods and chemical hazards such as pesticides in agricultural products such as fresh fruits and vegetables. There is limited information on physical contaminants, food allergies, and injuries from these hazards, possibly due to a lack of awareness or public education.<sup>7,9,10</sup> The FAO/WHO 2005 regional report on food safety for Africa highlighted microbiological hazards as the main risk from street foods, as well as the danger of high levels of heavy metals such as lead, cadmium, arsenic, mercury, and copper and pesticide residues from utensils, raw materials, or transportation methods. This study examines food safety and hygiene reports in Ghana.

## METHODOLOGY

To establish the challenges confronting food safety and possible solutions in sub-Saharan Africa, especially Ghana, a systematic review of the literature was conducted. A desktop review of the literature was carried out. A search was conducted mainly using a Google search engine with phrases including 'food safety in Ghana', 'food hygiene in Ghana', 'food hygiene training Ghana', and 'list of food poisoning in Ghana'. The journals used included Food Control, internet Journal of Food Safety, Food and Nutrition Science, Food and Public Health, Food Science and Technology, Journal of Infection in Developing Countries, Journal of Urban Health, and African Journal of Food Agriculture Nutrition and Development. Professional sites included the World Health Organization (WHO), Ghana Health Services, and TEPHINET library. Media sources were used for individual cases of food poisoning in homes and for commercial and institutional setups. The data used ranged from 2010 to 2022. After all these rigorous processes, 100 papers were ultimately found to be eligible for the review, but there were too many; hence, a random selection of 40 papers was used. With respect to the desktop review technique, all the documents ultimately chosen were then printed, stapled, and coded for the study.

## RESULTS AND DISCUSSION

### Food Safety in Sub-Saharan Africa

The Sub-Saharan Africa region faces economic growth challenges due to a lack of technology in agriculture and mineral processing.<sup>10,11</sup> Despite having the resources needed for agriculture, such as fertile land and good labor, the agricultural sector struggles with obstacles such as rainfall, fertilizers, skilled labor, and input supplies.<sup>12</sup> One of the main issues contributing to food insecurity in sub-Saharan Africa is food contamination.<sup>5</sup> This is a result of a significant amount of food being wasted at farms and throughout the production chain.<sup>13</sup> The improper disposal of waste in the region has led to various health effects on the population. In Nigeria, for example, there are concerns about food poisoning due to the use of calcium carbide as a fruit ripening agent.<sup>14,15</sup> While calcium carbide is effective in ripening fruits, it also has harmful effects on human health. As a result, it is not recommended for fruit ripening.<sup>5,14</sup>

To address these issues, all levels of society need to adopt integrated waste management systems and proper waste disposal practices.<sup>15</sup> Additionally, efforts should be made to improve access to farm inputs such as fertilizers and water for crops. By addressing these challenges, Sub-Saharan Africa can work toward achieving food security and sustainable agricultural practices. Moreover, the population of SSA in 2018 exceeded 1 billion, and its GDP was over 1.6 trillion.<sup>9,16</sup> The production sector is unable to meet the growing population as a result of its inability to solve the problem of food safety. Many countries in this region, such as Ghana, pay less attention to food contamination and food borne illness, which are major contributing factors to food insecurity.<sup>17</sup>

## Food Safety issues in Ghana

Every year, Ghana has more than 626,000 cases of food poisoning, with approximately 298,100 people needing hospital treatment.<sup>18</sup> This accounts for more than 48% of all reported food poisoning cases.<sup>19</sup> Over 90,000 people die from food poisoning each year in Ghana, accounting for approximately 14% of all hospitalizations.<sup>2,19</sup> The government loses more than 70 million US dollars every year in efforts to reduce foodborne diseases.<sup>20</sup> Many families have suffered physically and financially from outbreaks such as cholera and typhoid fever.<sup>7,21</sup> Cholera and typhoid outbreaks occur yearly in cities such as Cape Coast.<sup>22</sup> Despite good food production, these outbreaks have been a major setback for Ghana. There are various ways to contaminate food in Ghana, including cooking in unclean conditions, improperly storing food, and using inappropriate ingredients in drinks.<sup>23</sup> Some food and drink sellers use additives to attract customers or boost alertness, which can be harmful. Poor personal hygiene among food handlers and unsanitary cooking environments also contribute to the spread of foodborne illnesses. Chemical agents from microbes, such as toxins such as Shiga toxins, can cause food poisoning when present in food, leading to illness in animals or humans. Several studies in Ghana have shown the presence of harmful substances such as lead and arsenic.<sup>5,10,23</sup> These contaminants come from water and pesticides used in crop production, especially fruits and vegetables. Studies on fresh produce have also found pesticides and other chemicals in salad, vegetables, and fruits.<sup>1,2,23</sup> Fertilizers and manure, including untreated animal and human waste used in farming, can also lead to contamination. Additionally, microbial toxins from bacteria such as *Staphylococcus aureus*, *Escherichia coli*, *Campylobacter*, and *Listeria* have been found in food.<sup>24,25</sup> Markets and food handling practices are identified as major sources of potential contamination. Farming methods are the main sources of physical and chemical contamination.<sup>26</sup>

## Level of Education, Attitudes, and Knowledge of Food Vendors and Handlers in Ghana

Studies on sanitation concerning food vendors and other catering services have documented low standards of food hygiene practices among them.<sup>18,19,28</sup> Low education has also been a great deterrent to food borne illness for the Ghanaian government.<sup>29</sup> Some of the workers responsible for handling food in the food preparation process have little or no knowledge about food poisoning, contamination, and even hygiene as a whole.<sup>30,31</sup> A study conducted directly on the education level of food vendors in Ghana provided beyond doubt results that significantly show that most food vendors have little or no education at all on food hygiene, appropriate food handling, appropriate food processing coupled with the right techniques, and others.<sup>32</sup>

Moreover, 2 studies documented that most food vendors do not practice the basic hygiene required per the standards of the food regulations in the country.<sup>33,34</sup> The study shows that pressure on food vendors leads to many of them not being concerned about the safety of food, especially at most fast-food joints. Vegetables and other fresh produce,<sup>24,26,35</sup> local and exotic chickens,<sup>20</sup> kebab joints, and chemical contamination.<sup>3</sup> It can be concluded here that many food vendors and handless people are yet to accept and practice the basic hygiene principles of food in Ghana. Studies have documented numerous etiological agents isolated from the Ghanaian currency, which include the Ghana cedi<sup>30</sup>. Other studies, such as<sup>18,32</sup>, also show that over 80% of food handlers and vendors receive cash and use the same hands without washing to serve food (bare hands 89%) to customers.<sup>32</sup> Food hygiene practices have been a challenging issue in regard to food vendors due to a lack of education and most unwillingness to adhere to such rules.<sup>34</sup> However, for the safety of Ghanaians, all efforts must be made to ensure that they are educated and practice what they have learned.

## Microbial Contamination of Food Cases in Ghana

Numerous bacteria cause food contamination and can lead to poor-quality food and, in some cases, food poisoning. Numerous bacterial pathogens have been isolated from both Ghana and Nigeria. Studies conducted on the microbial quality of salads in Kumasi, Ghana, revealed the presence of Enterobacteria, Salmonella, Shigella, E. coli, Campylobacter, Listeria, and other pathogens that are not even of bacterial origin.<sup>17,41,35</sup> Parasites have also been found to be associated with food in the Ashanti region of Ghana, especially Kumasi. A study at Pankrono Kumasi revealed the presence of numerous parasites in local and exotic chickens sold in marketplaces.<sup>17,35</sup>

Numerous studies in Ghana have shown the presence of pathogenic agents responsible for causing several food borne diseases. Notably, a study<sup>35</sup> conducted in the capital city of Ghana reported that the percentage of mesophilic bacteria was approximately 69%, the percentage of *Staphylococcus aureus* was 31%, the percentage of *Bacillus cereus* was 5.5%, and the percentage of Enterobacteriaceae was 33%.

Similarly, reports from Cape Coast indicated bacterial contamination of meat pie, fried fish, banku with stew, khebab, and others.<sup>36</sup> These bacteria included dangerous *Escherichia coli* from human fecal matter, and some fungi were also found in the food, such as *Aspergillus flavus*, *Aspergillus candidus*, *Aspergillus niger*, *Cladosporium herbarum*, *Penicillium citrinum*, and *Necrospora crassa*.

Rhizopus, Mucor, and Fusarium species". In 2010, *Shigella* spp., *Escherichia coli*, *Salmonella* spp., and Enterobacteriaceae were also found in most foods sold in Ghana, especially in Accra, with a contamination rate of 52%. These values were quite above the acceptable levels recommended by the WHO.<sup>37</sup>

### Ready-to-eat (RTE) foods and processed foods; A source of food contamination

Researchers have revealed varying microbiological contamination levels of selected foods for hazard analysis (Addo et al. 2007; Feglo & Sakyi, 2012; Mensah et al., 2002; Tortoe, Johnson, Ottah- Atikpo & Tomlins, 2013). Food from hotels sampled in Accra showed acceptable levels, while street food from the same city had detectable levels of enteric pathogens. Most ready-to-eat foods, including vegetables, fruits, ice-kenkey, "fufu," macroni, salad, and others, are highly contaminated with enteric bacteria, which are capable of producing Shiga toxins for poisoning the food.<sup>38</sup> Additionally, the presence of coliform bacteria such as *Staphylococcus aureus*, *Escherichia coli*, yeast, and aerobic mesophilic molds in some foods sold in Tema and Accra, especially ice-kenkeys, has been confirmed.<sup>39</sup> Another study in 2014 revealed that some vegetable products, such as salad, sold in Kumasi Ghana demonstrated increased levels of pathogens, such as rotavirus.<sup>30</sup> Similar studies were conducted in Accra, which also revealed contamination levels of 35% for *Escherichia coli*, 33% for *Staphylococcus aureus*, 17% for *Klebsiella* spp., and 15% for *Bacillus* spp.<sup>40</sup> Numerous pathogens have been found in foods in Ghana and have been isolated. A review highlighted that these isolates are strongly linked to food-borne illnesses in the country and hence the need for food safety actions.<sup>17</sup>

Recently, a study established the existence of dangerous mycotoxins and pesticides in food sold in Ghana.<sup>27</sup> In 2017, Darko performed a similar study in Accra, and mycotoxins were still found in foods, indicating that food vendors had done nothing or little to control the contamination of food with mycotoxins.<sup>28</sup> The presence of Shiga toxin-producing *Escherichia coli* and *Shigella* spp. in foods in Ghana indicates that such foods should be contaminated with these toxins.<sup>29,88</sup> Additionally, heat-stable toxin-producing *Staphylococcus aureus* is associated with several foods sold on the streets of Ghana and in restaurants.<sup>30</sup> Reports on the outbreak of Listeriosis in South Africa cautioned Ghanaians and the government to put measures in place to prevent the outbreak of this disease in Ghana. The etiological agent of Listeriosis is *Listeria monocytogenes*, a bacterium capable of producing highly fatal and extremely poisonous toxins.<sup>23,40</sup> A study also revealed *Salmonella* to be associated with fresh milk in Ghana.<sup>31</sup> This pathogen has been isolated from Ghanaian foods and is therefore a cause for alarm. Kenkey, due to its low pH, was reported to be a low-risk food in terms of microbial load, and wakye (cooked rice and beans mixed) had a similar effect, but both could be contaminated with lead above the acceptable level of 0.2 mg/kg due to the use of informally manufactured pots that could have lead levels as high as 419 mg/kg (Tortoe et al., 2013), causing cumulative harm. Due to its preparation method, Fufu contains *Escherichia coli* and detectable *Staphylococcus aureus*. Similar reports were made on high-risk street foods in Kumasi. The food studied included ice kenkey, cocoa drinks, fufu, ready-to-eat red pepper sauce, salad, and macaroni. Bempah et al. (2011) reported the presence of monitored pesticides in fruit-based drinks sampled to be above the maximum required limits, which is a safety issue considering that children are the target consumers in the country. The safety and quality of meals from institutional catering units in the country have not been reported.

### Demographics and effects of food handlers

Ababio and Adi (2012), Ababio et al. (2012), Feglo and Sakyi (2012), and Tomlins et al. (2002) found that food handlers in Kumasi and Accra had low levels of education. They also noted that there were few food



safety management systems in the country, especially among locally owned businesses, which were mostly small and microenterprises that struggled to meet international standards. On the other hand, international food manufacturers and processors have established food safety management systems to comply with regulations and meet customer needs. Rheinlander, Bakang, Takyi, Konradsen, and Samuelson (2008) observed that while there was some awareness of food safety and hygiene in Kumasi, actual food handling practices did not always reflect this knowledge. They mentioned that both consumers and food handlers often base their food choices on superficial factors such as appearance, price, and proximity rather than on important hygiene practices such as hand washing and kitchen cleanliness. There was also a concern about the lack of emphasis on documentation and quality assurance in food production, possibly due to the absence of required qualifications for those preparing food for sale, leading to substandard practices. While it is a public health policy for food handlers to undergo screening before preparing food for sale, a study by Ackah et al. (2011) revealed that only 40% of sampled food handlers had health certificates, with no regular screening in the capital city. Similarly, Ababio and Adi (2012) noted higher levels of screening but a lack of renewals in Kumasi in the Ashanti Region.

## CONCLUSIONS

Food safety remains a major challenge in sub-saharan Africa including Ghana. Research have found that the food industry has plenty of room for improvement. The study reviewed existing literature on food safety concerns in Ghana. This study showed that food safety challenges go beyond food poisoning to include postharvest losses, food contamination, poor weather conditions, financial limitations, and weak food regulations. Poor food handling at local markets and street vendors is a major cause of food contamination. The literature reviewed in this study revealed that the most common harmful agents found in Ghanaian foods include *Enterobacter* spp., *Pseudomonas* spp., *Campylobacter* spp., *Escherichia coli*, *Staphylococcus* spp., *Aspergillus flavus*, and *Aspergillus niger*. It is however recommended that, encouraging advancements in technology, along with proper education and good personal hygiene practices can help address food safety challenges in sub-Saharan African countries. It is important to regulate and enforce good hygiene principles. Food safety regulatory agencies like the Food and Drug Authority (FDA), Ghana Standard Authority (GSA) need to strengthen their policies and take decisive action against those producing unsafe food products.

Small and medium-sized enterprises require government support through training, awareness campaigns, and other forms of assistance. Public awareness of good hygiene practices and food safety is crucial to increasing demand for safe and high-quality food. Future research should consider food safety in the rural areas as majority of research focused on urban areas in Ghana.

## REFERENCES

1. King T, Cole M, Farber JM, et al. Food safety for food security: relationship between global megatrends and developments in food safety. *Trends Food Sci Technol.* 2017;68:160-175. [[Google Scholar](#)]
2. WHO. World Health Organization: Global Status Report on Food Safety 2015. World Health Organization; 2015. [[Google Scholar](#)]
3. WHO. Investing to Overcome the Global Impact of Neglected Tropical Diseases: Third WHO Report on Neglected Tropical Diseases 2015. Vol. 3. World Health Organization; 2015. [[Google Scholar](#)]
4. Unnevehr L, Hirschhorn N. Food Safety Issues in the Developing World. The World Bank; 2000. [[Google Scholar](#)]
5. Wunsch N-G, ed. Global food safety testing market from 2017 to 2025, by food type (in million U.S. dollars). 2022. Accessed March 23, 2022. <https://www.statista.com/statistics/1286148/global-food-safety-testing-market-by-food-type/>.
6. Chaves R et al. Food Safety, in *Current Developments in Biotechnology and Bioengineering*. Elsevier; 2017:245-259. [[PMC-free article](#)] [[PubMed](#)] [[Google Scholar](#)]
7. Mercado G, Hjortsø CN, Honig B. Decoupling from international food safety standards: how small-scale indigenous farmers cope with conflicting institutions to ensure market participation. *Agric Human Values.* 2018;35:651-669. [[Google Scholar](#)]

8. Bicaba Z, Brixiová Z, Ncube M. Can extreme poverty in Sub-Saharan Africa be eliminated by 2030? *J Afr Dev.* 2017;19:93-110. [[Google Scholar](#)]
9. Lokpobiri H. Nigerian Agriculture Promotion Policy 2016–2020: toward a new paradigm for domestic food security and Foreign Exchange earnings in agricultural production. *Public Policy Adm Res.* 2019;9:47-57. [[Google Scholar](#)]
10. Kyei S, Appiah E, Ayerakwa EA, Antwi CB, Asiedu K. Microbial safety implications of in-use topical diagnostic ophthalmic medications in eye clinics in Ghana. *J Optom.* 2019;12:263-271. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
11. Udomkun P, Wiredu AN, Nagle M, Bandyopadhyay R, Müller J, Vanlauwe B. Mycotoxins in Sub-Saharan Africa: present situation, socioeconomic impact, awareness, and outlook. *Food Control.* 2017;72:110-122. [[Google Scholar](#)]
12. Adeyeye SAO. The role of food processing and appropriate storage technologies in ensuring food security and food availability in Africa. *Food Sci Nutr.* 2017;47:122-139. [[Google Scholar](#)]
13. Druilhe Z. Fertilizer subsidies in sub-Saharan Africa. 2017. [[Google Scholar](#)]
14. van Ittersum MK, van Bussel LG, Wolf J, et al. Can sub-Saharan Africa feed itself? *Proc Natl Acad Sci.* 2016;113:14964-14969. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
15. Akuu JA, Danyi D, Dapaah C. Factors associated with poor food safety compliance among street food vendors in the Techiman Municipality of Ghana. *Afr J Food Sci.* 2017;11:50-57. [[Google Scholar](#)]
16. Akabanda F, Hlortsi EH, Owusu-Kwarteng J. Food safety knowledge, attitudes and practices of institutional food handlers in Ghana. *BMC Public Health.* 2017;17:40. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
17. Balali GI, Yar DD, Afua Dela VG, Adjei-Kusi P. Microbial contamination, an increasing threat to the consumption of fresh fruits and vegetables in today's world. *Int J Microbiol.* 2020;2020:1-13. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
18. Ababio PF, Lovatt P. A review on food safety and food hygiene studies in Ghana. *Food Control.* 2015;47:92-97. [[Google Scholar](#)]
19. Quansah JK, Kunadu APH, Saalia FK, Díaz-Pérez J, Chen J. Microbial quality of leafy green vegetables grown or sold in Accra metropolis, Ghana. *Food Control.* 2018;86:302-309. [[Google Scholar](#)]
20. Alemu A. Microbial contamination of currency notes and coins in circulation: A potential public health hazard. *Biomed Biotechnol.* 2014;2:46-53. [[Google Scholar](#)]
21. Addis M, Sisay D. A review on major food borne bacterial illnesses. *J Trop Dis.* 2015;3(4):176-183. [[Google Scholar](#)]
22. Magna EK, et al. Determination of heavy metals and potential health risk assessment of honey harvested from the tamale metropolis of Ghana using atomic absorption spectrophotometer (AAS). *Pollution.* 2018;121:51522-51525. [[Google Scholar](#)]
23. Owusu-Kwarteng J, Wuni A, Akabanda F, Jespersen L. Prevalence and characteristics of *Listeria monocytogenes* isolates in raw milk, heated milk and nunu, a spontaneously fermented milk beverage, in Ghana. *Beverages.* 2018;4:40. [[Google Scholar](#)]
24. Duedu KO, Yarnie EA, Tetteh-Quarcoo PB, Attah SK, Donkor ES, Ayeh-Kumi PF. A comparative survey of the prevalence of human parasites found in fresh vegetables sold in supermarkets and open-air markets in Accra, Ghana. *BMC Res Notes.* 2014;7:836. [[PMC-free article](#)] [[PubMed](#)] [[Google Scholar](#)]
26. Tortoe C, et al. Systematic approach for the management and control of food safety for the street/informal food sector in Ghana. *Food and Public Health.* 2013;3:59-67. [[Google Scholar](#)]
27. Futagbi G, et al. Microbial quality of mangoes from selected markets in Accra, Ghana. *New York Sci J.* 2016;9:32-37. [[Google Scholar](#)]
28. Blankson GK, Mill-Robertson FC. Aflatoxin contamination and exposure in processed cereal-based complementary foods for infants and young children in greater Accra, Ghana. *Food Control.* 2016;64:212-217. [[Google Scholar](#)]
29. Darko S, Mills-Robertson FC, Wireko-Manu FD. Fungal contamination of foods prepared in some hotels in the Kumasi metropolis. *Int Food Res J.* 2017;24:860-867. [[Google Scholar](#)]

30. Adinortey CA. Antibiotic Resistance, Phylogenetic Grouping and Virulence Potential of *Escherichia coli* Isolated From Clinical and Environmental Samples From the Cape Coast Metropolis of the Central Region of Ghana. University of Cape Coast; 2014. [[Google Scholar](#)]
31. Saba CKS. Identification and Molecular Characterization of Bacteria Isolated From Human, Animal, and Food Origins From the Northern Region of Ghana. Universidad Complutense de Madrid; 2013. [[Google Scholar](#)]
32. Kunadu AP-H, et al. Microbiological quality and antimicrobial resistance characterization of *Salmonella* spp. in fresh milk value chains in Ghana. *Int J Food Microbiol.* 2018;277:41-49. [[PubMed](#)] [[Google Scholar](#)]
33. Acheampong BE. Assessment of Food Hygiene Practices by Street Food Vendors and Microbial Quality of Selected Foods Sold. A study at Dunkwa-On-Offin, Upper Denkyira East municipality of the central region. 2015. [[Google Scholar](#)]
34. Ababio PF, Taylor KD, Swainson M, Daramola BA. Effect of good hygiene practices intervention on food safety in senior secondary schools in Ghana. *Food Control.* 2016;60:18-24. [[Google Scholar](#)]
35. Malik BA. Assessing the Food Safety Knowledge of Food Handlers of the Ghana School Feeding Programme in Tamale Metropolis, Ghana. 2018. [[Google Scholar](#)]
36. Mensah P, Yeboah-Manu D, Owusu-Darko K, Ablordey A. Street foods in Accra, Ghana: how safe are they? *Bull World Health Organ.* 2002;80:546-554. [[PMC-free article](#)] [[PubMed](#)] [[Google Scholar](#)]
37. Annan-Prah A, et al. Street foods: handling, hygiene and client expectations in a World heritage Site Town, Cape Coast, Ghana. *Afr J Microbiol Res.* 2011;5:1629-1634. [[Google Scholar](#)]
38. Yeboah-Man D, Kpeli G, Akyeh M, Bimi L. Bacteriological quality of ready-to-eat foods sold on and around University of Ghana campus. *Res J Microbiol.* 2010;5:130-136. [[Google Scholar](#)]
39. Feglo P, Sakyi K. Bacterial contamination of street vending food in Kumasi, Ghana. *J Med Biomed Sci.* 2012;1:1-8. [[Google Scholar](#)]
40. Atter A, Ofori H, Anyebuno GA, AmooGyasi M, Amoa-Awua WK. Safety of a street vended traditional maize beverage, ice-kenkey, in Ghana. *Food Control.* 2015;55:200-205. [[Google Scholar](#)]
41. Pesewu GA, et al. Bacteriological assessment of the quality of raw-mixed vegetable salads prepared and sold by street food vendors in Korle-Gonno, Accra Metropolis, Ghana. *J Health Sci.* 2014;2:560-566. [[Google Scholar](#)]
42. Yeleliere E, Cobbina SJ, Abubakari ZI. Review of microbial food contamination and food hygiene in selected capital cities of Ghana. *Cogent Food Agric.* 2017;3:1395102. [[Google Scholar](#)]