PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (12B Supplementary) 4311-4320 Dec. 2024

Demographic Characteristics of Food Vendors, Training, Hygiene Practices, Environmental Conditions, Microbiological Quality and Safety of Fast Foods in Cape Coast, Ghana

AGYIRIFO, DS

Department of Molecular Biology and Biotechnology, University of Cape Coast, Ghana

Corresponding Author Email: dagyirifo@ucc.edu.gh
ORCID: https://orcid.org/0000-0003-2517-0893
***Tel:** +233544974451*

ABSTRACT: Fast foods, including street foods, are essential for tourists and have become increasingly popular in urban areas due to their convenience and affordability compared to home-cooked meals. Consequently, the objective of this paper was to investigate the demographic characteristics of food vendors, their training, hygiene practices, environmental conditions and microbiological quality and safety of fast foods in Cape Coast, Ghana using appropriate standard techniques by collecting food samples such as fried rice, fried chicken, coleslaw, and pepper sauce (*Shito*), from seven areas within the Cape Coast municipality and analyzed for microbial load and temperature. The study revealed a high prevalence of foodborne pathogens. Most of the food vendors obtained training either through a vocational institute (29.2 %) or apprenticeship (41.7%) and 75% of them had medical examination once a year. The highest temperature for a packed meal was 78.5 ^{o}C while the least was 23.3 ^{o}C. Coleslaw had the highest coliform count (49.5 x 10^{7} cfu/g) and *Salmonella* sp count (20.1 x10^{3} cfu/g). The fried chicken had the least count. *Aspergillus* sp was the most isolated from the packed meal. Despite 91.7% of vendors being licensed and most having some knowledge of food hygiene practices, the findings emphasize food safety and hygiene practices inadequacies among street food vendors. This study contributes to the broader understanding of food safety challenges in developing urban settings and the need for improved regulatory frameworks to safeguard local consumers and tourists.

DOI: https://dx.doi.org/10.4314/jasem.v28i12.46

Cite this Article as: AGYIRIFO, D. S. (2024). Demographic Characteristics of Food Vendors, Training, Hygiene Practices, Environmental Conditions, Microbiological Quality and Safety of Fast Foods in Cape Coast, Ghana. *J. Appl. Sci. Environ. Manage.* 28 (12B Supplementary) 4311-4320

Dates: Received: 22 October 2024; Revised: 20 November 2024; Accepted: 08 December 2024; Published: 31 December 2024

Keywords: Street Food; Food Hygiene; Fried Rice; Microbiological Quality; Coliforms

Fast foods, characterized by their reasonable price, quick preparation, and availability, are a convenient alternative to home-cooked meals (Calloni, 2013). The term "street foods" often overlaps with fast food, referring to ready-to-eat foods and beverages sold and sometimes prepared in public places such as streets. While similar to fast foods in their cost-effectiveness compared to restaurant meals, street foods differ significantly in variety, environment, marketing techniques, and ownership (Muinde and Kuria, 2005). Street foods typically reflect local cultural traditions and exhibit various raw materials and preparation methods. Vendors usually operate outdoors or under accessible shelters, offering low-cost seating facilities. Individuals or families typically own and operate these businesses. In contrast, fast food outlets generally specialize in a narrower range of foods, often prepared by frying, such as hamburgers, chicken, chips, and pizza (Boafo *et al.*, 2021, Mensah *et al.*, 2002). Urbanization has also spurred the development of informal food supply systems. Resource-poor groups have developed livelihood

Corresponding Author Email: dagyirifo@ucc.edu.gh
ORCID: https://orcid.org/0000-0003-2517-0893
***Tel:** +233544974451*

strategies with limited capital assets to meet urban opportunities, exemplified by the rise in ready-to-eat food sold by street vendors. Innovations in transportation and refrigeration enable mass production and rapid distribution of food across countries and continents (Nayak and Waterson, 2019). This global distribution increases the risk of widespread foodborne illnesses. Contamination originating in one area can spread to distant places, causing illness in large numbers of people (DeWaal and Brito, 2005, Fung *et al.*, 2018). Studies in developing countries indicate that up to 20-25% of household food expenditure is spent outside the home, with some populations relying entirely on street foods (Ruel *et al.*, 2017). This trend is a consequence of rapid urbanization, where millions lack access to kitchens or cooking facilities. Many students in both secondary and tertiary, single workers without families and a floating population that commutes for work depend on street foods for daily sustenance (Smart, 2023, Smith *et al.*, 2013). While street food vending can provide low-cost nutrition to urban populations, it also poses health risks, particularly for vulnerable groups like the young, elderly, and those with HIV/AIDS (Ruel *et al*, 2017).

Microbial contamination is a significant concern in food safety. Studies show that even minimal contamination of surfaces with organisms like *E. coli*, *Salmonella*, and *Staphylococcus aureus* can transfer sufficient numbers to pose infection risks (Gourama, 2020, Nhlapo *et al.*, 2014). Fresh produce can also be contaminated if washed or irrigated with contaminated water. Poor hygiene practices, such as washing vegetables and fruits in dirty water, exacerbate this problem (Faour-Klingbeil *et al.*, 2016). The potential dangers of street and fast food consumption often go unnoticed (Hilmi, 2020). These street food vendors are frequently unlicensed, untrained in food hygiene and sanitation, and work under crude, unsanitary conditions (Oseyemi, 2023). Studies in Africa show that the rapid and unregulated growth of street food vendors has placed significant strain on city resources such as water and sewage systems, interfered with city planning through congestion and littering, and adversely affected daily life (Chukuezi, 2010, Mukhola, 2015, Muyanja *et al.*, 2011). In Ghana, common fast food items include cheeseburgers, hotdogs, spring rolls, hamburgers, French fries, pizzas, fried rice, chicken, milkshakes, omelettes, yam balls, fried plantain and beans, beverages, and pastries (Mensah *et al*, 2002). Increasingly, more people are purchasing ready-to-eat food and eating out in cafés and restaurants, reflecting a lifestyle change that offers new food choices but also creates new problems. In Ghana, recent reports suggest that several people were hospitalised after consuming fast food from food joints and restaurants in Accra. Analysis of samples of the food revealed unacceptable levels of microbial pathogens (Boafo *et al*, 2021). About 1,914 Ghanaians suffered from various forms of food poisoning and an estimated thirty-six people lost their lives between 2013 and 2021(Madilo *et al.*, 2023). It is reported that a student of the University of Cape Coast died after suffering from food poisoning (Adjei and Adjei, 2022). Given Cape Coast's status as a historic town and tourist destination, it is crucial to ensure that fast foods meet the Ghana Food and Drugs Authority (FDA) regulations to protect both locals and tourists. Therefore, the objective of this paper is to investigate the demographic characteristics of food vendors, their training, hygiene practices, environmental conditions, microbiological quality and safety of fast foods in Cape Coast Ghana.

MATERIALS AND METHODS

Sampling Sites and Food Sampling: Cape Coast municipality was selected for this study due to its status as a major tourist and educational centre, necessitating the provision of safe food for diverse groups of people. Seven areas within the municipality, known for their increasing fast food joints, were surveyed. These were the University of Cape Coast, Kingsway, Kotokuraba, Abura, Tantri, Adisadel, and Cape Coast Technical University. Fast food vendors in these areas were interviewed with a guided questionnaire, and their food was sampled for analysis. The fast food vendors usually operate over a six to eight-hour period. The business period usually starts from 9:00 am to 4:00 pm or 12:00 noon to 8: 00 pm each day. A package of food sampled from the vendors contained fried rice, fried chicken, coleslaw and pepper sauce (*Shito*). The fried rice and chicken are stirred and mixed with vegetables and accompanied with deep-fried chicken. *Shito* is a sauce prepared by frying dried pepper, ginger, and fish in cooking oil. The coleslaw is a mixture of chopped vegetables such as cabbage, lettuce, onions, carrots, and cucumber. The food samples were bought from randomly selected vendors, placed in an ice chest to maintain temperature, and later analyzed in the laboratory. Food samples were collected both at the beginning of the selling period (M) and toward the end of the selling period (E). Each vending site was sampled on four different occasions over four months.

Four milling equipment for grinding pepper, onion, tomatoes, ginger and dried fish to make *Shito* were randomly sampled from the study area. The milling

equipment was sampled early in the morning (M) before their operators started using the equipment for the day and another sample was taken mid-day (A) during operating hours. To collect samples from the milling equipment, 200 mL of sterile distilled water was poured into the collecting pan of the machine, allowed to drain through the system, and then collected through the nozzle. The pH, temperature, moisture content, microbial load of total bacteria, coliforms, *Salmonella* sp. and fungi species were determined.

Methods of Sterilization, Sample Plating and Incubation: All glassware, spatulas, crucibles, forceps, and knives were washed with liquid soap, rinsed with clean tap water, dried, and sterilized at 160°C for six hours in a SIBATA THERMOTEC SPF-450 oven. Workbenches were cleaned with 4% Dettol before and after use. Culture media were sterilized at 121°C for 15 minutes in an autoclave (Model Shimodzu KY-23D). Each sample was homogenised and 2g was dissolved in 9 mL peptone water for serial dilution. An aliquot of the 10^6 diluents for each food sample was plated on Plate Count Agar (PCA), Maconkey Agar, SS Agar and Sabourand Agar. MacConkey and SS Agar media were used for isolating coliforms and *Salmonella* species respectively. Plate Count Agar was used for total viable bacteria, and Sabouraud Agar for isolating fungi. Each sample plating was replicated three times. The bacteria culture plates were incubated at 38 ± 1°C for 24-48 hours, while the fungi culture plates were incubated for 96 hours. The colony-forming units (CFUs) were enumerated and the mean of the replicates is presented in table format.

Statistical Analysis: Responses from food vendors were analyzed using SPSS 13.0 software, with results presented in a frequency table. To assess significant differences in the means of microbial loads across various food samples and sampling locations, ANOVA was conducted using MINITAB 15.0 software.

RESULTS AND DISCUSSION

Demographic data: The study revealed that most vendors were predominantly the youth between the ages of 15 and 30 years. There were more males (41.7%) as compared to females (37.5%). The majority of vendors (95.8%) had formal education. The vendors received training from various sources, with the largest group being apprenticeships (41.7%), followed by vocational institutes (29.2%), and a small percentage having no formal training (12.5%). Involving highly skilled individuals in the fast food business could enhance service quality and ensure food safety techniques (da Cunha, 2021). Training vendors on the Hazard Analysis Critical Control Points (HACCP) principles is likely to effectively reduce foodborne illnesses and improve public health, as most of these vendors have formal education (Ahmed *et al.*, 2024). Most vendors operated their business under big umbrellas (54.2%), netted kiosks (33.3%), and enclosed structures (12.5%). Most of these vending joints were positioned near choked drainage gutters. This exposed the food and utensils to house flies, other flying insects and dust. The exposure of food in uncovered structures and bad environmental conditions makes the food prone to pathogenic contamination (Mohammad *et al.*, 2018). The vendors obtained their food ingredients from the local market and most of them (91.7%) washed the vegetables with salt solution, while some (8.3%) used only water to wash their food items. However, a bad hygiene practice of washing all the vegetables in a single salt solution resulted in cross-contamination of subsequent vegetables (Maffei *et al.*, 2017). It emerged from the study that not all the food prepared is sold out, some vendors (54.2%) indicated that leftover food is mostly given away to people freely, while others (41.7%) will refrigerate it and reheat and sell it the following day. Improper reheating of food can lead to food poisoning (Mohammad *et al*, 2018). The study revealed that most of the vendors (91.7%) were licensed, while only 8.3% of the vendors were operating without a license. Seventy- five per cent of the vendors had medical examinations once a year, with few of them doing so every 6 months (12.5%), others had it every 5 years (4.2%), and some vendors (8.3%) never had any form of medical examination. Since an infected vendor can cross-contaminate food, a routine medical examination is most appropriate so that infected vendors will be treated to prevent contaminating the food (Nabwiire, 2023). Though most of the food vendors (87.5%) had some level of knowledge of food hygiene practices, and only a small percentage (12.5%) did not know food hygiene practices (Table 1), they did not fully practice these hygiene principles.

The fast food industry has emerged as a thriving sector, significantly contributing to employment, particularly among the youth. The convenience offered by fast food vendors is evident, with the University of Cape Coast campus, Kotokuraba, Abura and Cape Coast Polytechnic campus being prominent locations with high population density. The study reveals that fast food vendors are strategically located in densely populated areas such as university campuses, where students and staff, constrained by busy schedules, frequently opt for quick meal solutions provided by these vendors (Roy *et al.*,

2019). The study revealed that the vendors' average annual income of approximately $55,110 underscores the economic viability of this business and encouraging youth participation in fast food vending can generate substantial employment opportunities and reduce societal vices (Habanabakize, 2020). The study highlights the industry's potential to engage young people productively. The involvement of both males and females equally indicates a shift in traditional gender roles, with men now participating in an occupation once dominated by women. The study found that many vendors infrequently change the water used for washing vegetables and utensils, leading to cross-contamination. Sanitation issues at vending sites, such as the lack of proper cleaning agents and protective clothing, further exacerbate these risks (Birgen *et al.*, 2020, Negassa *et al.*, 2023).

Table 1: Demographic characteristics of food vendors

	Characteristic	Frequency (Percentage)
Age		
15-30	Female	9 (37.5%)
15-30	Male	10 (41.7%)
31-45	Female	3 (12.5%)
31-45	Male	2 (8.3%)
Formal Educational Status	None	1 (4.2%)
	Basic	8 (33.3%)
	Secondary	9 (37.5%)
	Postsecondary	4 (16.7%)
	Tertiary	2 (8.3%)
Place of Training in Food Preparation	SSS	3 (12.5%)
	Vocational	7 (29.2%)
	Apprentice	10 (41.7%)
	None	3 (12.5%)
	Tertiary	1 (4.2%)
Nature of Fast Food Vending Facilities	Under an umbrella	13 (54.2%)
	Netted Kiosk	8 (33.3%)
	Enclosed structure	3 (12.5%)
Source of Raw Food Items	Market	23 (95.8%)
	Farm gate	1 (4.2%)
Methods of Washing Vegetables	Water	2 (8.3%)
	Salt solution	22 (91.7%)
Treatment of Left-Over Food	Given to people freely	13 (54.2%)
	Reheated	1 (4.2%)
	Refrigerator	10 (41.7%)
Licensing of Fast Food Vendors	No	2 (8.3%)
	Yes	22 (91.7%)
Medical Examination Regularity	Once in six months	3 (12.5%)
	Once a year	18 (75%)
	Once in five years	1 (4.2%)
	None	2 (8.3%)
Knowledge of Food Hygiene	No	3 (12.5%)
	Yes	21 (87.5%)

Temperature: The mean temperature in food at the beginning of selling at each site ranged from a low of 38.2°C (California) to a high of 78.5°C (Finger licking) and this is significantly different ($p<0.05$) from the mean temperature taken towards the end of selling period at each site ranging from a low of 23.3°C (Adom) to a high of 61.8°C (Finger licking). It was generally observed that vendors that had high food temperatures in the morning also had high food temperatures in the evening (Table 2). They maintained their warm temperatures through periodic heating. The study found that food samples that had high temperatures had reduced bacterial loads, as seen with fried rice and chicken. However, as the food cools, and optimum conditions are available, bacteria growth increases, highlighting the need for maintaining appropriate temperatures throughout the selling period (Valero *et al.*, 2016, Xiao *et al.*, 2024). High temperatures inactivate the microorganism's metabolic activities (Cortese *et al.*, 2016, Nema *et al.*, 2022). Temperature control is crucial in preventing bacterial growth in food.

Moisture Content of Food Samples: Moisture content is generally higher in the evening than in the morning for most food items across the different vending sites. This could be due to differences in storage conditions, and activities during the selling period and also the vapour in the food condenses back into the food. Food samples that have high moisture content are prone to microbial proliferation (Wang *et al.*, 2023). Fried chicken had the lowest moisture content overall generally in the 50-60% range (Table 2). During the deep frying chicken process, moisture within the chicken evaporates making the final chicken product crispy for longer storage (Kassama and Ngadi, 2016). For most food items, the pH values tend to be lower in the morning compared to the evening, suggesting the food becomes less acidic over the day. There were notable differences in pH values across the different vending sites, even for the same food item. (Data not shown).

Total Bacteria isolated from food samples: The total bacterial counts vary significantly ($p<0.05$) across the different food items and vending sites. This suggests there may be differences in food preparation, handling, and hygiene practices. Food samples sampled towards the end of the selling period had significant ($p<0.05$) higher microbial load than the morning counts for the same food items at the same locations. This could indicate bacterial growth or contamination over the day through cross-contamination resulting from poor hygiene practices (Maffei *et al*, 2017). Coleslaw had the highest

microbial counts reaching over 49.5 x 10^7 CFU/g at the Adom location in the evening. Fried chicken generally had the lowest bacterial counts, with many sites without microbial contamination, especially in the morning when the fried chicken was generally hot. The *Shito* condiment also shows high variability, with some samples without any microbial isolations, while others had over 15.0 x 10^7 CFU/g. The Helenus, Adom, and Good Shepherd locations seem to have some of the highest overall bacterial loads across multiple food items. In contrast, the Finger Licking location appears to have very low bacterial counts, with several items without any microorganism contamination. The Unity and D'taste catering sites have relatively low bacterial numbers compared to many of the other locations (**Fig. 1**). Over the selling period, the frequent exposure of *shito* to spoons used in dishing out the *shito* might have contributed to a high microbial load in *shito* towards the end of the selling period similar to a study by (Alves *et al.*, 2021) noted, that exposure to poor hygiene conditions during processing, storage, and distribution contributed to the increase in foodborne pathogens.

Table 2: Moisture content (%) and temperature (^{o}C) of sampled food at different vending sites.

Vending Site	Fried rice	Fried chicken	Coleslaw	*Shito*	Morning Temp (^{o}C) of fried rice	Evening Temp (^{o}C) of fried rice
Adom	70.9 ±1.7	58.7 ±1.4	61.7 ±2.6	79.6 ±2.1	40.7 ±0.9	23.3 ±0.4
Akwaaba	70.1 ±2.8	60.9 ±0.8	62.3 ±2.3	84.2 ±3.0	64.0 ±1.3	38.4 ±0.4
California	70.1 ±2.6	59.9 ±4.3	66.1 ±0.4	81.5 ±1.9	38.2 ±0.5	26.1 ±0.5
Check Check	69.8 ±0.6	55.9 ±1.1	70.6 ±0.2	79.7 ±1.0	49.4 ±0.3	30.0 ±0.6
Chicago	69.5 ±0.8	55.2 ±2.0	63.9 ±1.1	77.1 ±1.5	58.2 ±0.8	29.0 ±0.6
D'taste catering	68.9 ±2.1	58.1 ±2.5	66.9 ±1.4	82.3 ±1.2	64.5 ±0.9	41.2 ±0.7
Finger licking	70.1 ±0.8	63.9 ±0.7	66.8 ±2.2	81.4 ±2.4	78.5 ±0.3	61.8 ±0.4
Friends'	70.7 ±2.0	62.3 ±3.3	63.7 ±0.4	79.3 ±1.4	58.9 ±0.7	36.9 ±0.5
God's grace	69.5 ±2.1	60.3 ±3.2	61.7 ±3.7	83.9 ±3.2	59.7 ±1.4	36.2 ±0.6
God's Love	70.3 ±1.5	56.8 ±1.9	66.1 ±1.4	80.3 ±2.2	55.0 ±0.4	36.6 ±0.4
Good Shepherd	70.6 ±1.2	55.2 ±1.4	61.3 ±2.4	78.8 ±0.6	45.4 ±0.4	25.2 ±0.4
Helenus	68.5 ±0.5	56.6 ±0.7	62.4 ±1.0	74.6 ±2.6	48.7 ±1.0	35.1 ±0.6
Idaric	68.4 ±1.0	55.1 ±0.7	63.3 ±1.4	82.8 ±3.0	70.2 ±0.5	48.0 ±0.6
Majestic	69.1 ±3.0	56.7 ±2.2	67.5 ±1.5	82.9 ±1.6	59.6 ±1.5	34.3 ±0.5
Nyame Adom	67.3 ±2.5	58.8 ±2.1	67.2 ±0.5	79 ±2.7	50.5 ±0.5	29.5 ±0.4
Obaapa	68.3 ±2.1	56.7 ±6.2	67.2 ±3.2	79.4 ±2.3	66.1 ±0.5	41.2 ±0.6
Silver Bird Corner	72.2 ±1.4	58.8 ±2.1	62.7 ±0.8	83.9 ±2.3	64.0 ±0.5	44.5 ±0.3
Singapore	72.3 ±0.1	54.2 ±2.4	62.5 ±1.0	77.7 ±4.6	51.2 ±0.6	32.1 ±0.5
Texas	68.9 ±1.1	57.3 ±0.7	62.7 ±1.5	77.4 ±2.0	58.6 ±0.5	30.4 ±0.7
Unity	68.9 ±1.9	54.9 ±2.9	62.2 ±0.8	77.1 ±2.4	57.9 ±0.6	40.1 ±0.7
Yanky's	72.4 ±0.9	56.0 ±0.5	69.5 ±3.4	77.4 ±2.4	53.4 ±0.7	31.3 ±0.9

Total Coliform isolated from food samples: Fried chicken consistently had the lowest coliform counts across all locations, with no microorganisms isolated in many vending sites. The coleslaw had high coliform levels, particularly at the Helenus (23.3x10^7 – 40.8 x 10^7 CFU/g), Check Check (16.1 – 25.7 x10^7 CFU/g), and Akwaaba (9.5 – 18.7 x10^7 CFU/g) locations in the evening. This observation was similar to (Osafo *et al.*, 2022) study, that indicated a high prevalence of human parasites on vegetables exposed to open-air markets in Accra. Total coliform loads in the evening samples were significantly ($p<0.05$) higher than morning loads for the same food items at the same locations, pointing to potential issues with food handling, storage, or hygiene practices during the selling period (**Fig. 2**). Helenus (49.5 – 80.8 x 10^6 CFU/g), Adom (4.6 – 28.3 x10^6 CFU/g), Good Shepherd (17.1 – 52.5 x 10^6 CFU/g), and Check Check (37.7 – 85.9 x10^6 CFU/g) had the highest coliform levels across multiple food items. In contrast, Finger Licking, Unity, and D'taste Catering seem to maintain relatively low coliform counts (**Fig. 2**). These vendors had relatively better environmental conditions and hygiene practices than the others. The variability between locations suggests differences in food safety standards, worker training, and/or facility sanitation. The high coliform counts, especially for coleslaw, indicate an elevated risk of foodborne illness at certain vending sites. In some other studies, adherence to proper farm hygiene practices has been demonstrated to reduce bacterial count and mould in raw milk (Lee *et al.*, 2017) while poor hygienic practices are a high-risk factor for microbial contamination of drinking water that could lead to diseases such as typhoid, dysentery and diarrhoea (Soboksa *et al.*, 2020).

Isolation of Salmonella sp in food samples: For most food items and locations, *Salmonella* was not isolated. However, the coleslaw samples had significantly ($p<0.05$) high levels of *Salmonella*. The evening coleslaw samples had higher counts compared to the morning samples, with some locations reporting counts as high as 20.1 x 10^3 CFU/g. Locations like Check Check, Akwaaba, and Majestic have particularly high coleslaw counts in the evening, ranging from 15.5 x 10^3 to 20.1 x 10^3 CFU/g. Helenus, Adom, Good Shepherd, and Check

Check, had higher *Salmonella* contamination for coleslaw compared to other vending sites. Locations like Chicago, Unity, Finger Licking, and Friend's maintain relatively low *Salmonella* contamination across all food items (**Fig. 3**). The presence of faecal bacteria like *Salmonella* in food samples indicates significant public health risks, necessitating regular medical examinations for vendors to prevent disease transmission (Ahmed *et al*, 2024). At room temperature, *Salmonella* species multiply rapidly due to the optimum conditions such as pH, water activity and exposure to poor hygiene practices (Olaimat *et al.*, 2020).

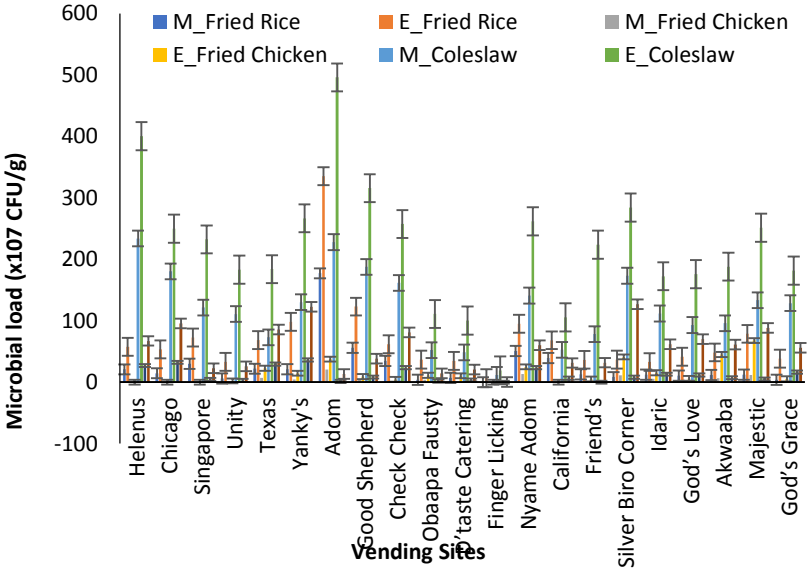

Fig. 1: The mean total bacteria load from food samples at different vending sites.

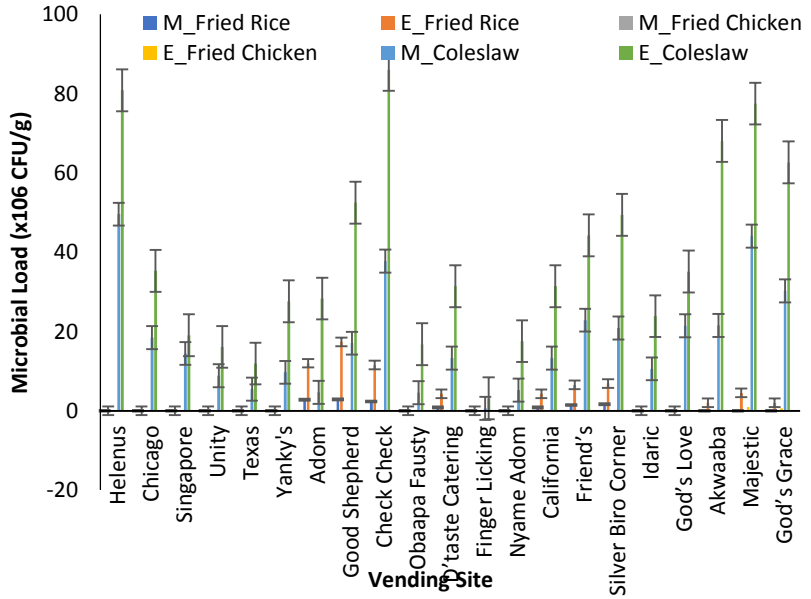

Fig. 2: The mean coliforms load from food samples at different vending sites.

Fungi species Population: Eight different fungal species, Yeast, *Aspergillus candidus*, *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus ochraceus*, *Cladosporium herbarum*, *Fusarium sp.*, *Penicillium sp.*, and *Rhizopus sp*. were identified per their growth characteristics on Sabourand agar medium. *Aspergillus niger* was the most dominant fungal species, with the highest population levels across all food items. The total fungi count ranged from 0 to 95 x 10^2 CFU/g across the different locations and time points. In general, the evening (E) fungal population is higher than the morning (M) population for most locations (Table 3).

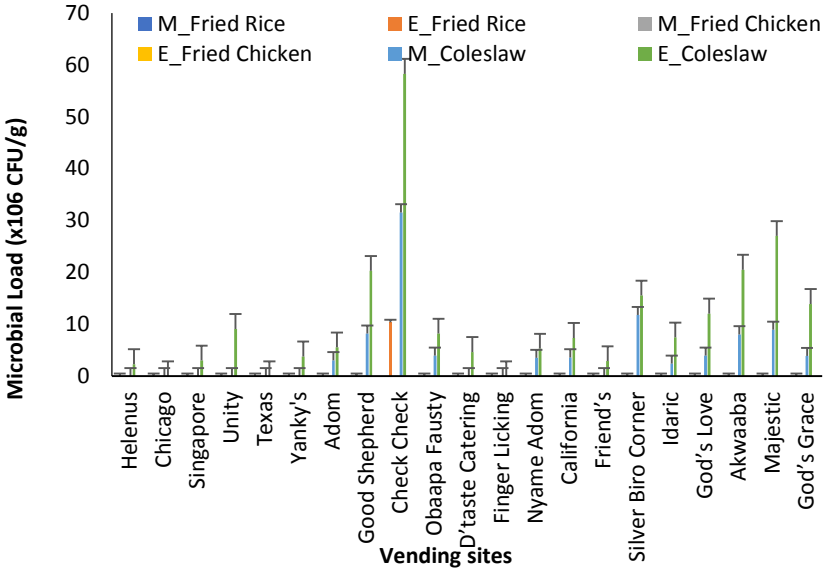

Fig. 3: Presumptive *Salmonella* species isolated from food samples at different vending sites.

This suggests that fungal growth and proliferation occur during the selling period, leading to higher counts in the evening samples. Yeast and fungi contamination in coleslaw products can lead to spoilage through several mechanisms, including the production of lytic enzymes such as proteases, lipases, and cellulases, which break down proteins, fats, and cellulose, respectively. This enzymatic activity results in changes to texture, flavour, and structural integrity. Microorganisms' proliferation is influenced by factors such as water activity, sugar content, pH, acidity, and temperature (van Lieverloo *et al.*, 2021). High water activity and sugar content typically support yeast growth. These interactions make it challenging to predict the extent to which yeast and other microorganism's growth and proliferation can be controlled leading to the spoilage of food (Alegbeleye *et al.*, 2023). The milling equipment had significantly ($p<0.05$) higher microbial load in the morning before the start of the day's work compared to the microbial load in samples taken during the day (Fig. 4). This situation is attributed to the overnight fallow period that created optimum conditions for bacteria multiplication. The operations of the milling equipment generate heat that could be responsible for the low microbial load during the period of operation as high heat will destroy most bacteria species by altering structural and cellular activities (Dash *et al.*, 2022). The presence of high microbial load and *Salmonella sp* in the milling equipment suggests the need for thorough cleaning with best hygiene practices before the start of the day's business and after every grinding session to prevent cross-contamination in food items (Cortese *et al*, 2016).

Table 3: Fungal population ($x10^3$ CFU/g) isolated from packed fried rice and chicken

Fast food vending site	Total fungi (M)	Total fungi (E)
Helenus	2	62
Chicago	0	59
Singapore	0	49
Unity	10	36
Texas	9	38
Yanky's	17	68
Adom	13	95
Good Shepherd	3	80
Check Check	1	56
Obaapa Fausty	13	95
D'taste catering	3	12
Finger licking	0	4
Nyame Adom	6	69
California	4	32
Friend's	2	57
Silver Bird Corner	17	53
Idaric	12	17
God's love	2	48
Akwaaba	17	76
Majestic	13	39
God's grace	6	50

The relatively high fungal population may suggest that the food preparation, storage, or serving conditions for fried rice and fried chicken are more conducive to fungal growth. Mould contamination, particularly from mycotoxins such as aflatoxin, poses another health hazard (Adeyeye, 2020). Proper storage conditions to prevent mould growth are essential, as is adherence to regulations monitoring toxin levels in food products (Luo *et al.*, 2018). Fungal species such as *Aspergillus* and *Penicillium*, thrive in high-moisture environments, highlighting the need for better food storage practices (Pouris *et al.*, 2024).

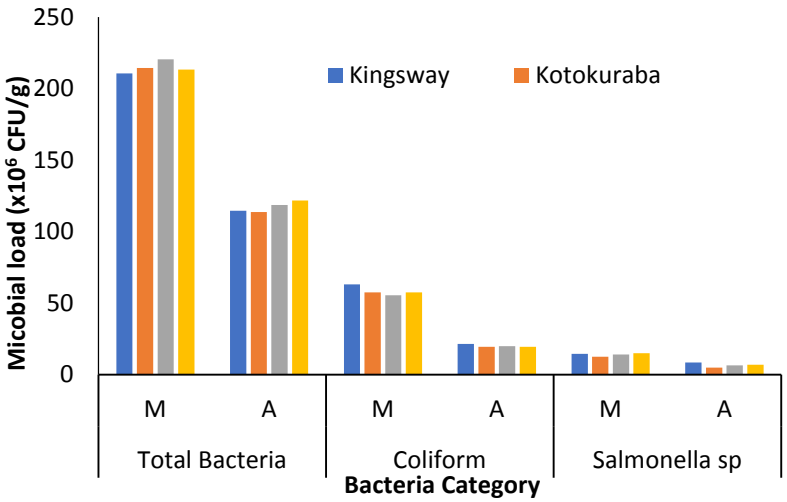

Fig. 4: The mean total microbial load of milling equipment used in milling vegetables for *shito*

Conclusion: In conclusion, while the fast food industry offers substantial economic benefits and employment opportunities, particularly for the youth, there are significant challenges related to food safety and hygiene. Addressing these challenges through targeted training programs, better enforcement of health regulations, and improved sanitation practices can enhance the industry's contribution to public health and economic development. Furthermore, improving food handling, storage, and preparation practices at the problem locations could help reduce microbial contamination.

Declaration of Conflict of Interest: The author declares no conflict of interest.

Data Availability Statement: Data are available upon request from the corresponding author or any of the other authors

REFERENCES

Adeyeye, SAO (2020). Aflatoxigenic fungi and mycotoxins in food: a review. *Crit. Rev. Food Sci. Nutr.* 60: 709-721

Adjei, GA; Adjei, F (2022). Assessment of food safety awareness and practices among university students in Ghana: using University of Cape Coast (UCC) students as a case study. *Wellb. Space Soc.* 3: 100100

Ahmed, MU; Hossain, MI; Maraj, MAA; Islam, MM (2024). Microbial Hazards in Street Foods: A Comprehensive Study in Dhaka, Bangladesh. *Int. J. Health Med.* 1: 1-15

Alegbeleye, O; Alegbeleye, I; Oroyinka, MO; Daramola, OB; Ajibola, AT, *et al* (2023). Microbiological quality of ready to eat coleslaw marketed in Ibadan, Oyo-State, Nigeria. *Int. J. Food Prop.* 26: 666-682

Alves, A; Viveiros, C; Lopes, J; Nogueira, A; Pires, B, *et al* (2021). Microbiological contamination in different food service units associated with food handling. *Appl. Sci.* 11: 7241

Birgen, BJ; Njue, LG; Kaindi, DM; Ogutu, FO; Owade, JO (2020). Determinants of microbial contamination of street- vended chicken products sold in Nairobi County, Kenya. *Int. J. Food Sci.* 20: 2746492

Boafo, J; Sarku, R; Obodai, J (2021). From the kitchen to fast food restaurants: The changing culture of food in urban Ghana. *Food Stud.* 10: 15

Calloni, M (2013). Street food on the move: A socio- philosophical approach. *J. Sci. Food Agric.* 93: 3406-3413

Chukuezi, CO (2010). Food safety and hyienic practices of street food vendors in Owerri, Nigeria. *Stud. Soc. Sci.* 1: 50

Cortese, RDM; Veiros, MB; Feldman, C; Cavalli, SB (2016). Food safety and hygiene practices of vendors during the chain of street food production in Florianopolis, Brazil: A cross-sectional study. *Food Contr.* 62: 178-186

da Cunha, DT (2021). Improving food safety practices in the foodservice industry. *Curr. Opin. Food Sci.* 42: 127-133

Dash, KK; Fayaz, U; Dar, AH; Shams, R; Manzoor, S, *et al* (2022). A comprehensive review on heat treatments and related impact on the quality and microbial safety of milk and milk-based products. *Food Chem. Adv.* 1: 100041

DeWaal, CS; Brito, GRG (2005). Safe Food International: a blueprint for better global food safety. *Food Drug L. J.* 60: 393-405

Faour-Klingbeil, D; Murtada, M; Kuri, V; Todd, EC (2016). Understanding the routes of contamination of ready-to-eat vegetables in the Middle East. *Food Contr.* 62: 125-133

Fung, F; Wang, H-S; Menon, S (2018). Food safety in the 21st century. *Biomed. J.* 41: 88-95

Gourama, H. (2020). Foodborne pathogens In *Food Safety Engineering*, pp. 25-49: Springer

Habanabakize, T (2020). Assessing the impact of interest rate, catering, and fast-food income on employment in the social services industry. *Int. J. Eco. Fin.* 12: 534-550

Hilmi, M (2020). Street food vendors' entrepreneurial marketing characteristics and practices from 12 countries: what lessons can be learnt for improving food marketing in BOP/Subsistence marketplaces. *Middle East J. Agric. Res.* 9: 321-348

Kassama, LS; Ngadi, M (2016). Relationship between oil uptake and moisture loss during deep fat frying of deboned chicken breast meat. *Adv. Chem. Engineer. Sci.* 6: 324-334

Lee, HY; Loong, SK; Khoo, JJ; Lim, FS; Chai, LC, *et al* (2017). Impact of hygiene intervention practices on microbial load in raw milk. *J. Pure Appl. Microbiol.* 11: 1281-1286

Luo, Y; Liu, X; Li, J (2018). Updating techniques on controlling mycotoxins-A review. *Food Contr.* 89: 123-132

Madilo, FK; Islam, MN; Letsyo, E; Roy, N; Klutse, CM, *et al* (2023). Foodborne pathogens awareness and food safety knowledge of street-vended food consumers: A case of university students in Ghana. *Heliyon* 9

Maffei, DF; Sant'Ana, AS; Franco, BD; Schaffner, DW (2017). Quantitative assessment of the impact of cross-contamination during the washing step of ready-to-eat leafy greens on the risk of illness caused by Salmonella. *Food Res. Int.* 92: 106-112

Mensah, P; Yeboah-Manu, D; Owusu-Darko, K; Ablordey, A (2002). Street foods in Accra, Ghana: how safe are they? *Bulletin of the World Health Organization* 80: 546-554

Mohammad, A-M; Chowdhury, T; Biswas, B; Absar, N. (2018). Food poisoning and intoxication: A global leading concern for human health In *Food Safety and Preservation*, pp. 307-352: Elsevier

Muinde, OK; Kuria, E (2005). Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *Afr. J. Food Agric. Nutr. Dev.* 5: 1-10

Mukhola, MS (2015). At the periphery of the mainstream economy: Reality of informal street vendors in South Africa. *Public Adm.* 50: 308-317

Muyanja, C; Nayiga, L; Brenda, N; Nasinyama, G (2011). Practices, knowledge and risk factors of street food vendors in Uganda. *Food Contr.* 22: 1551-1558

Nabwiire, L. 2023. *Assessing beef vendors' compliance with food safety standards in Kamuli district, Uganda, and consumers' beef handling practices in the US Virgin Islands*. Iowa State University. 87-97 pp.

Nayak, R; Waterson, P (2019). Global food safety as a complex adaptive system: Key concepts and future prospects. *Trends Food Sci. Technol.* 91: 409-425

Negassa, B; Anbese, AT; Worku, G; Areba, AS; Seboka, BT, *et al* (2023). Food hygiene practices and associated factors among street food vendors in urban areas of Gedeo Zone, southern Ethiopia. *Environ. Health Insights* 17: 11786302231168531

Nema, PK; Sehrawat, R; Ravichandran, C; Kaur, BP; Kumar, A; Tarafdar, A (2022). Inactivating Food Microbes by High- Pressure Processing and Combined Nonthermal and Thermal Treatment: A Review. *J. Food Qual.* 22: 5797843

Nhlapo, N; Lues, RJ; Groenewald, WH (2014). Microbial counts of food contact surfaces at schools depending on a feeding scheme. *S. Afr. J. Sci.* 110: 01-06

Olaimat, AN; Al- Holy, MA; Abu Ghoush, MH; Abu Hilal, HM; Al- Nabulsi, AA, *et al* (2020). Population dynamics of Salmonella spp. and Shigella spp. in ready- to- eat Mediterranean vegetable salads. *J. Food Saf.* 40: e12734

Osafo, R; Balali, GI; Amissah-Reynolds, PK; Gyapong, F; Addy, R, *et al* (2022). Microbial and parasitic contamination of vegetables in developing countries and their food safety guidelines. *J. Food Qual.* 22: 4141914

Oseyemi, FH (2023). Appraising the Knowledge and the Practice of Food Safety Procedure and Hygiene among Food Vendors in Akure South Local Government Area of Ondo State, Nigeria. *Am. J. Phys. Educ. Health Sci.* 1: 31-38

Pouris, J; Kolyva, F; Bratakou, S; Vogiatzi, CA; Chaniotis, D; Beloukas, A (2024). The Role of Fungi in Food Production and Processing. *Appl. Sci.* 14: 5046

Roy, R; Soo, D; Conroy, D; Wall, CR; Swinburn, B (2019). Exploring university food environment and on-campus food purchasing behaviors, preferences, and opinions. *J. Nutr. Educ. Behav.* 51: 865-875

Ruel, MT; Garrett, J; Yosef, S; Olivier, M. (2017). Urbanization, Food Security and Nutrition In *Nutrition and Health in a Developing World*, ed. S de Pee, D Taren, MW Bloem, pp. 705-735. Cham: Springer International Publishing

Smart, D (2023). The Reproduction of Urban Capitalism: Street Food and the Working Day in Colonial Mombasa. *J. Afr. Hist.* 64: 80-95

Smith, LP; Ng, SW; Popkin, BM (2013). Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies from 1965–1966 to 2007–2008. *Nutr. J.* 12: 1-10

Soboksa, NE; Gari, SR; Hailu, AB; Alemu, BM (2020). Association between microbial water quality, sanitation and hygiene practices and childhood diarrhea in Kersa and Omo Nada districts of Jimma Zone, Ethiopia. *PLoS One* 15: e0229303

Valero, A; Rodríguez, M-Y; Posada-Izquierdo, GD; Pérez-Rodríguez, F; Carrasco, E; García-Gimeno, RM (2016). Risk factors influencing microbial contamination in food service centers. *InTech. DOI.10.5772/63029*

van Lieverloo, JHM; Bijlaart, M; Wells-Bennik, MH; Den Besten, HM; Zwietering, MH (2021). Thermal inactivation kinetics of seven genera of vegetative bacterial pathogens common to the food chain are similar after adjusting for effects of water activity, sugar content and pH. *Microb. Risk Anal.* 19: 100174

Wang, H; Sun, C; Yang, S; Ruan, Y; Lyu, L, *et al* (2023). Exploring the impact of initial moisture content on microbial community and flavor generation in Xiaoqu baijiu fermentation. *Food Chem.* 20: 100981

Xiao, T; Li, Y; Zheng, Z; Hu, L; Zhu, S, *et al* (2024). High Pressure Sub-Zero Temperature Concepts for Improving Microbial Safety and Maintaining Food Quality: Background Fundamentals, Equipment Issues and Applications. *Food Rev. Int.*: 1-21