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Knowledge, attitude, and practices (KAP) of foodservice providers, and microbial quality on food served in Kumasi

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ABSTRACT

Background Poor Knowledge, Attitude, and Practices (KAP) of food safety and hygiene by foodservice providers lead to food contamination and pose health threats to consumers. This study assessed the KAP on food safety and hygiene, and microbial quality of food sold by formal and informal foodservice providers in Kumasi, Ghana.

Methods Eighty-one (81) foodservice providers were conveniently selected from ten different foodservice establishments. KAP on food safety and hygiene practices was assessed with a structured-questionnaire, while practices were observed with a prepared checklist. Food samples were collected and analyzed for microbiological counts (aerobic and coliform) and the detection of Staphylococcus species.

Results About 58.7% of participants reported good knowledge versus 41.3% reporting little knowledge; 32.4% reported good attitude versus 67.6% bad attitude, and 54.6% reported good practices versus 43.4% poor practices. More informal foodservice providers (51.7%,34.5%,55.2%) had knowledge (p = .012), attitude (p = .798), and practices (p = .003) of food safety and practices below the 40th percentile than those of formal food service (23.1%,32.7%,19.2%) respectively. Food samples tested recorded high microbial counts for total aerobes and coliform counts and failed to meet ISO, GSA, and FDA safety standards. *S. aureus, E. coli, S. epidermidis*, and *E. faecalis* were identified in food samples. A weak, negative correlation (r = −0.231,p < .05) existed between attitude score and S. species present.

Conclusions Poor KAP and microbial contamination were observed among food providers although the informal food provision was poorer. Bad attitude by foodservice providers was associated with poorer microbial quality of tested food. Education, monitoring, and stringent enforcement of HACCP are recommended.

KEYWORDS
Food safety; hygiene; KAP; microbial load

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Supplemental data for this article can be accessed on the publisher's website.

Introduction

Foodservice industries constitute a key sector that provides meals for nourishment outside the home. They have become dominant in recent times, due to the increasing opportunity cost of time and work pressures on people. Restaurant foods are increasingly relevant in urban cities as they conveniently offer energy-dense foods and make food accessible to working people who are unable to prepare food regularly at home (Ekta et al., 2016). The restaurant constitutes formal (fine dining, fast food) and informal (chop bars, street food vending) groups. In developing countries, the informal restaurants predominate, making up the 'chop bars' and street food vending (Ekta et al., 2016).

Food preparation passes through various nodes in large-scale cookery, hence increasing chances of food contamination at each of these nodes. Hygienic and food safety practices among foodservice providers have been testified to be below standards (Addo et al., 2007; Feglo & Sakyi, 2012; Tomlins et al., 2002). Hygiene refers to behaviors that can improve cleanliness and lead to good health (Centre for Disease Control, 2016). Preventing foodborne disease outbreak in the foodservice industries need high standards of hygienic and food safety principles. A study by Greig et al. (2007) showed that about 97% of reported food poisoning cases are due to the improper handling of foods by both formal and informal foodservice providers.

Food safety is very important in the production of food as food contaminants may also cause numerous infectious diseases including deadly cancers (Fukuda, 2015). Food and waterborne diseases recorded an incidence rate of 50 per 100,000 in 2013 as reported by the Ministry of Health Malaysia (MOH) (2014). Besides, Carrasco et al. (2012) purported that cross-contamination may occur during processing, preparation, and service steps, of which the food handlers may be agents or cause of spreading microorganisms. Poor

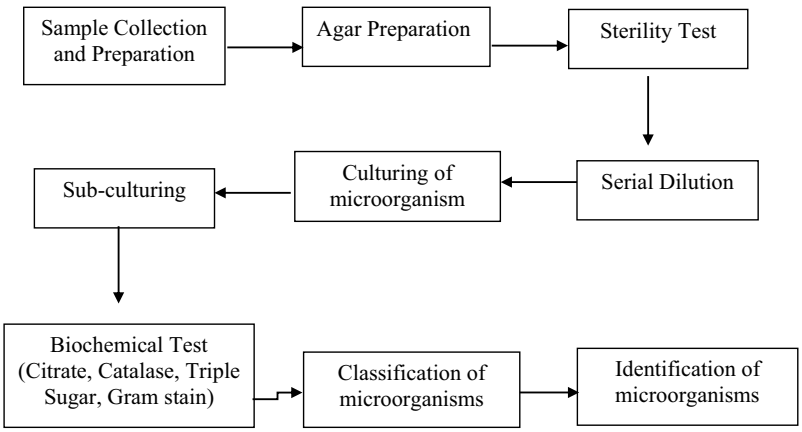

Figure 1. Flow diagram of microbial assessment (quantifying, isolating, and identifying microorganisms) (Fung, 2002).

environmental sanitation, insufficient safe water supply, and unhygienic food handling practices are also some of the factors that cause foodborne disease outbreak (Siow and Sani, 2011). In Ghana, most food vendors have been allowed to operate without any periodic checks of practicing proper food hygiene. According to King et al. (2000), among 160 street food vendors in Ghana, only three (1.85%) of them met the requirements for basic safety and hygiene based on a five-point check-list. Evidences reveal that foods displayed for sale by the roadside may become contaminated by pathogenic microorganisms due to poor hygiene practices (Food and Agricultural Organization (FAO), 1990; Bryan, 1988; Ashenafi, 1995).

Although there are a lot of institutions and laws governing the safety and hygienic practices in the industry. The laws governing food in Ghana include the Food and Drugs Act PNDCL 305B of 1992, which deals with food safety and handling requirements and penalties for flouting the law. The existing Hygiene Principles are not legally binding (Ghana Standard Authority, 2013) but these guidelines could be used in ensuring good food safety practices in the food industry.

The Food and Drugs Authority (FDA) is Ghana's regulatory body under the Ministry of Health is responsible for the implementation of the food policies, and to ensure the safety and healthiness of food for consumption. FDA's duties include inspecting, licensing, product registration, and monitoring, they also organize good hygiene practices training for food handlers. The Ghana Standard Authority (GSA) is in charge of developing and promoting international and locally acceptable standards for the industry. Agencies such as the Ministry of Agriculture, the Ghana Tourist Board, and the Environmental agency are supportive of the implementation of the laws. Directives have been given to the local authorities including metropolitan assemblies and their districts by the government to actively control and monitor food safety practices of food vendors selling ready to eat foods at nightclubs, beer bars, chop bars, cold stores, on the streets, hotels, and restaurant operators and bagged water processors. The Water and Food Hygiene unit of the Environmental Health Department of the districts is responsible for the health monitoring and certification of food vendors, which is subject to a yearly renewal (Ackah et al., 2011; Ababio & Commey, 2012; Tomlins et al., 2002)

Street foods account for 40% of the food budget in Ghana as of 2000 (Maxwell et al., 2000), whereas, 25% of food budgets in Indonesia and the Philippines, 16% in Bangladesh, 50% in Nigeria (Tinker, 1997). In Ghana, precisely the Greater Accra Region, the capital, has an estimated number of 60,000 vendors of ready-to-eat foods (Afele, 2006). Studies in Ghana concerning the foodservice industries have been around hotels, restaurants, and street food vendors mostly in the capital city, Accra (Ackah et al., 2011; Addo et al., 2007; Donkor et al., 2009). Hence, a dearth of information on the knowledge,

attitude, and practices of foodservice providers in other cities of Ghana including Kumasi.

Assessing and analyzing foodservice providers' hygiene and safety knowledge, attitudes, and practices (KAP) for serving consumers is relevant to educate and contribute to the provision of adequate nourishment and hygienic foods to customers. KAP studies are vital for evaluating nutrition-education and communication interventions (Marais et al., 2008). This study, therefore, sought to assess KAP on food safety and hygiene, and microbial quality of food sold by formal and informal foodservice providers in Kumasi.

Materials and methods

Study design and population

A descriptive, cross-sectional survey involving 81 foodservice providers within the Kumasi metropolis was used for the study. The study was carried out between January and July 2018. The foodservice providers included hotels, restaurants, guest houses, chop bars, and street vending. The participants included managers, chefs, cooks, waiting-staff, and street food vendors, from the ten (10) foodservice providers. Among the foodservice providers, fifteen (15) participants were from hotels, nineteen (19) from restaurants, sixteen (16) from guest houses, twelve (12) from chop bars, and nineteen (19) from street food vending.

Eligibility

The study included foodservice providers (managers, chefs, cooks, street food vendors, waiters, and waitresses) between the ages of 25–60 years and had worked for more than a year in the foodservice industry in Kumasi. Foodservice providers who refused to give consent were excluded.

Ethics

Ethical approval was obtained from the Committee on Human Research Publication and Ethics (CHRPE) of Kwame Nkrumah University of Science and Technology. (KNUST, Kumasi) with reference number (CHRPE/AP/558/17) and Ghana Tourism Authority Asante Region. Consent was also obtained from participants before the study.

Sampling

Ten (10) foodservice industries (formal and informal) were randomly selected from a list of Foodservice providers in Kumasi, obtained from the Ghana

Tourism Authority. A convenient sampling method was employed in selecting participants from the 10 foodservice providers. Foodservice industries were sampled based on the following criteria; (i) proximity to study site (ii) access and convenience.

Data collection

Data on socio-demographic and lifestyle behavior, knowledge, attitude, and practices (KAP) on food safety and hygiene practices were collected with a questionnaire. The KAP questionnaire is composed of 75 KAP Likert questions with five (5) possible responses, and 43 observational checklists on hygiene (personal, food, and kitchen) and food safety practices. Each of the KAP questions was scored ranging from 1 to 5 based on the five responses. The scores of the five responses on knowledge questions on food safety and hygiene were; 1 – strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, 5 – strongly agree. The five responses to knowledge questions were further categorized into; 1 – do not know at all, 2 – know little, 3 – fair, 4 – know much, 5 – know very much. Also, the scores of the five responses for questions on attitude and practices of food safety and hygiene were; 1 – not at all, 2 – less often, 3 – fair, 4 – often, 5 – very often. The scores of the five responses on attitude questions were regrouped as; 1 – very bad, 2 – bad, 3 – neutral, 4 – good, 5 – very good. The scores from the responses given by each participant on each of the knowledge, attitude, and practices questions on food safety and hygiene were summed up to get the total scores. In all, a total score of 1037 was obtained for knowledge, 649 for attitude, and 1129 for practice questions relating to food safety and hygiene. The KAP assessment scores were then grouped into percentiles; below 40^{th} percentile, 40–65^{th} percentile, and above 65^{th} percentile.

Food sampling and microbial assessment

A sample of the food served at the study sites was collected at the points of serving for microbial assessment. The foods consisted of rice (brown rice boiled with beans called *waakye*), poultry (grilled as kebab), and tomato stew/sauce. Other foods were *Shito* (a popular Ghanaian chili sauce which includes blended pepper, fried with oil and spices), vegetable salad (lettuce, cabbage tomatoes, onions carrots) spaghetti (boiled), *Gari foto* (dampened with water and stew), mayonnaise, tomato ketchup, baked beans, boiled white beans, fufu, and fufu water. All food components were used for microbial assessment.

Sample preparation

The food samples were put into sterile (small) sample bags and transported on dry ice to the laboratory before analysis at the Microbial Biotechnology

Laboratory of the Department of Biochemistry, KNUST. The diagram shows the flow of microbial assessment processes carried out;

Microbial assessment of food samples- isolation and identification

Food samples were prepared, cultured in their respective media, and incubated. The microorganisms were quantified, isolated, and identified, and their counts were compared to standard values of microbiological counts. The agars used were products of OXOID Laboratories, Basingstoke Hampshire, England. They included Plate Count Agar (PCA) used for the isolation of total viable count; Mannitol Salt Agar (MSA) for isolation of *Staphylococcus*, and MacConkey Agar (MCA) for the total coliform count.

Determination of total aerobic count

A spread plate technique was used to inoculate the microorganisms. An inoculum volume of 0.1 mL from each dilution was pipetted to their respective labeled Petri dishes of plate count agar plates. The glass spreader (hockey stick) was sterilized using ethanol and spread over a Bunsen burner. The solution was spread evenly over the agar plate using the 'hockey stick' while carefully rotating the Petri dishes underneath an angle of 45 degrees. The petri dish now containing the agar and evenly distributed sample solution was incubated at 37°C for 24 hr. The colonies of microbes that appeared were enumerated and recorded (Fung, 2002).

Sub-culturing

The sub-culturing was done to isolate microorganisms from a mixed culture to obtain a pure culture using streak plating. Single colonies of the microorganisms identified as unique isolates upon morphological observations were picked and streaked onto fresh nutrient agar plates and incubated for 24 hours to obtain pure isolates for further testing (Fung, 2002).

Biochemical test

The biochemical tests were done to confirm the identities of the isolated microorganisms. The biochemical tests described by Fung (2002) included; catalase, triple sugar iron (TSI), citrate, and gram staining.

Determination of staphylococcus aureus

Staphylococcus species were isolated and enumerated by the spread plate method and grown on Mannitol Salt Agar (MSA). Serial dilutions of 10^{-1} to

10^{-4} were prepared by diluting 10 g of sample into 90 mL of sterilized peptone water for stock dilution. One milliliter aliquot from each of the dilutions was inoculated into Petri dishes with already prepared MSA. The inoculum was evenly spread with a sterile bent rod and allowed to dry for 15 minutes at room temperature. The plates were inverted and incubated at 35°C for 24 hours. After incubation yellow colonies were counted and recorded as Staphylococcus counts.

Determination of total coliform count (TCC)

The TCC was carried out by a spread plate method on MacConkey Agar (MCA). Serial dilutions of 10^{-1} to 10^{-6} were prepared by diluting 10 g of sample into 90 ml of sterilized peptone water for the stock dilution. One milliliter aliquot from each of the dilutions was inoculated into Petri dishes with already prepared MSA. The inoculum was evenly spread with a sterile bent rod and allowed to dry for 15 minutes at room temperature. The plates were inverted and incubated at 35°C for 24 hours.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) (version 25, Illinois, USA) was used for all statistical analyses. All continuous variables were translated into categorical variables for sociodemographic and lifestyle behavior, and KAP assessment on food safety and hygiene, and was presented as absolute and relative frequencies using descriptive statistics. Foodservice providers were grouped into formal and informal, and an independent t-test was used to compare the mean scores of microbial loads between them. Values were reported as means ± standard deviation. Chi-square (Fisher's exact test) cross-tabulation was performed to compare proportions on knowledge, attitude, and practices of food safety and hygiene among formal and informal foodservice providers. Bivariate correlation was performed to determine the association between KAP assessment on food hygiene and safety and microbial load on food samples. All analyses were 2-tailed, and p-values <0.05 were considered statistically significant.

Results

Sociodemographic and lifestyle characteristics of participants

Table 1 presents the sociodemographic and lifestyle characteristics of participants at foodservice providers. More females (67.9%) than males (32.1%) participated in the study, 45.7% of the participants were between ages 26 and 40 years. About two-thirds of the participants (88.9%) had at least

Table 1. Sociodemographic and lifestyle characteristics by type of foodservice providers.

Variable	Total N (%) (N = 81)	Formal food service, N = 50	Informal food service N = 31
Age (years)			
Less than 25	17 (21.0)	8 (47.1)	9 (52.9)
26–40	37 (45.7)	24 (64.9)	13 (35.1)
41–59	21 (25.9)	14 (66.7)	7 (33.3)
≥60	6 (7.4)	4 (66.7)	2 (33.3)
Mean age	32.9 ± 9.7 years		
Gender			
Male	26 (32.1)	18 (69.2)	8 (30.8)
Female	55 (67.9)	32 (58.2)	23 (41.8)
Education level			
None	9 (11.1)	3 (33.3)	6 (66.7)
JHS	24 (29.6)	12 (50.0)	12 (50.0)
SHS	28 (34.6)	18 (64.3)	10 (35.7)
Tertiary	20 (24.7)	17 (85.0)	3 (15.0)
Marital status			
Single	37 (45.7)	23 (62.2)	14 (37.8)
Married	31 (38.3)	16 (51.6)	15 (48.4)
Divorced	7 (8.6)	6 (85.7)	1 (14.3)
Widowed	6 (7.4)	5 (83.3)	1 (16.7)
Job position			
Manager	11 (12.3)	10 (90.9)	1 (9.1)
Chef	22 (27.2)	15 (68.2)	7 (31.8)
Cook	32 (40.7)	12 (37.5)	20 (62.5)
Waiter	16 (19.8)	13 (81.3)	3 (18.8)
Lifestyle factor			
Smoking			
Yes	6 (7.4)	1 (16.7)	5 (83.3)
No	75 (92.6)	49 (65.3)	26 (34.7)

Data are presented as frequency (percentage), JHS: Junior High School, SHS: Senior High School.

education up to JHS level, 45.7% were single, and 40.7% served as cooks in their foodservice. Generally, participants at formal foodservice providers (85.0%, 90.9%) had higher educational attainment, better job position than those at informal foodservice providers, respectively (15.0%, 9.1). Fewer participants at formal foodservice providers (16.7%) than those at informal foodservice providers (83.3%) currently smoke.

Knowledge, attitude, and practices of food safety and hygiene

Table 2 presents the participants' knowledge of questions relating to food safety and hygiene. In total, 40.0% of the foodservice providers had low knowledge of food safety and hygiene, but a significant proportion (60%) had good knowledge of food safety and hygiene. Relating to particular knowledge questions, the majority (80.2%, 54.3%) of the participants had low knowledge on the questions 'food prepared in advance reduces the risk of food contamination' and 'defrosted food should not be frozen again,' respectively.

Table 3 indicates the participants' attitude on questions about food safety and hygiene. In total, slightly over 6 in 10 (61.2%) of the participants had a bad attitude toward food safety and hygiene while 26.7% had a good attitude

Table 2. Food safety and hygiene knowledge.

	Low knowledge			High knowledge	
Respondents knowledge on food safety and hygiene	DNKAA n (%)	KL n (%)	F n (%)	KM n (%)	KVM n (%)
Washing of hand before handling food reduce food poisoning	5 (6.2)	4 (4.9)	1 (1.2)	9 (11.1)	62 (76.6)
Microbes are on the skin, in the nose and mouth of healthy food handlers	13 (16.0)	28 (34.7)	1 (1.2)	9 (11.1)	30 (37.0)
Sneezing in the kitchen is as dangerous as touching contaminated food	6 (7.4)	16 (19.7)	5 (6.2)	5 (6.2)	49 (60.5)
Wearing of prescribed clothing in the kitchen is important	14 (17.3)	16 (19.7)	4 (4.9)	5 (6.2)	42 (51.9)
Raw food should be kept or stored separately from cooked food	7 (8.6)	4 (4.9)	4 (4.9)	10 (12.3)	56 (69.3)
Improper thawing or reheating of food increase the risk of contamination.	11 (13.6)	4 (4.9)	2 (2.5)	11 (13.6)	53 (65.4)
Temperature plays a big role in bacterial growth	9 (11.1)	10 (12.3)	6 (7.4)	10 (12.3)	46 (56.9)
Defrosted food should not be frozen again	11 (13.6)	27 (33.3)	6 (7.4)	5 (6.2)	32 (39.5)
Eating and drinking in the workplace increase the risk of food contamination.	17 (21)	29 (39)	7 (9)	14 (17)	14 (17)
Using gloves while handling cooked food reduces the risk of food contamination.	9 (11.1)	8 (9.9)	10 (12.3)	17 (21.0)	37 (45.7)
Proper cleaning and sanitization of utensils decrease the risk of food contamination	17 (21.0)	7 (8.6)	26 (32.1)	5 (6.2)	26 (32.1)
Washing hands before work reduces the risk of food contamination.	5 (6.2)	5 (6.2)	12 (14.8)	20 (24.7)	39 (48.1)
Food prepared in advance reduces the risk of food contamination.	15 (18.5)	31 (38.3)	19 (23.4)	5 (6.2)	11 (13.6)
Total knowledge score	113	189	113	125	497
Total % score, N = 1037	10.9	18.2	10.9	12.1	47.9

DNKA: Do not know at all, KL: know little, F: Fair, KM: know much, KVM: Know very much. Data are presented in frequency (percentage).

Table 3. Attitude toward food safety and hygiene.

	Bad attitude			Good attitude	
Respondent attitude toward food safety and hygiene	VB (%)	B (%)	N (%)	G (%)	VG (%)
I tidy up working unit when cooking is completely done	47 (58.1)	11 (13.6)	9 (11.1)	7 (8.6)	7 (8.6)
Using gloves while handling cooked food reduces the risk of food contamination.	38 (47.0)	27 (33.3)	6 (7.4)	6 (7.4)	4 (4.9)
I believe good personal hygiene can prevent foodborne.	35 (43.2)	10 (12.3)	6 (7.4)	6 (7.4)	24 (29.7)
During infectious diseases of the skin, it is necessary to take leave from work.	47 (58.0)	8 (9.9)	12 (14.8)	3 (3.7)	11 (13.6)
It is necessary to check the temperature of refrigerators/freezers periodically.	25 (30.9)	25 (30.9)	11 (13.6)	8 (9.8)	12 (14.8)
The best way to thaw meat is in a bowl of cold water.	8 (9.9)	28 (34.6)	10 (12.3)	7 (8.6)	28 (34.6)
The health status of workers should be assessed before employment.	29 (35.8)	10 (12.3)	11 (13.6)	7 (8.6)	24 (29.7)
I practice high standard hygiene and safety principles	28 (34.6)	21 (25.9)	14 (17.3)	10 (12.3)	8 (9.9)
Total attitude score (N) = 649	257	140	79	55	118
Total % score	39.6	21.6	12.1	8.5	18.2

VB: Very bad, B: Bad, N: Neutral, G: Good, VG: Very Good, Data are presented in frequency (percentage).

toward food safety and hygiene. More specifically, 58.0% of the foodservice providers had a bad attitude toward '*tidying up working unit when cooking is completely done*,' 58.0% reported that they '*continued to work during skin infection*' while 47.0%, reported that they were not '*using gloves while handling cooked food to reduce risk of food contamination*.'

Table 4 presents the participants' practices on questions relating to food safety and hygiene by foodservice providers. More than 4 in 10 (44.8%) of the foodservice providers poorly practiced food safety and hygienic rules at their food facility while 55.2% did practice well. More specifically, 42.0% of the participants did not practice '*the use of hot water in washing utensils*' while, 39.5%, did not '*sterilized tools before using them*.'

Supplement Table 2 presents the relationship between knowledge, attitude, and practices (KAP) of food safety and hygiene and the foodservice providers. The KAP assessment scores were grouped into percentiles; below 40th percentile, 40–65th percentile, and above 65th percentile. More than 3 in 10 of the participants at foodservice providers had knowledge (33.3%), attitude (33.3%), and practice (32.1%) of food safety and hygiene below the 40th percentiles. Fewer proportions of participants at formal foodservice providers (23.1%) had knowledge of food safety and hygiene below the 40th percentile than those at informal foodservice providers (51.7%, $p = .012$). More participants at informal foodservice providers (34.6%) practiced food safety and hygiene below the 40th percentile than those at formal foodservice providers (32.7%, $p = .003$). More participants at informal foodservice providers (58.6%) had overall KAP assessment on food safety and hygiene below the 40th percentile than those at formal foodservice providers (19.2%, $p = .001$).

Microbial counts of food samples

The microbial counts recorded are presented in Supplement Table 3. There was a higher microbial load (total coliform count) in rice, salad, fufu, fufu water from both formal and informal foodservice providers when compared to ISO reference value. Additionally, the microbial load from the coliform count in rice, fufu, fufu water, gari foto, and spaghetti were significantly higher in food samples collected from informal foodservice providers than those from formal foodservice provider ($p < .05$).

Also, vegetable salad, fufu, and fufu water had a higher total aerobic count for microbes from both formal and informal foodservice providers when compared to ISO reference value. The formal foodservice providers had within the normal range of total aerobic microbes in food samples such as rice, beans, spaghetti, gari foto, and rice ball whereas, beans, rice ball, and kebab were within the normal range for informal foodservice providers. The total aerobic microbes in a vegetable salad, rice, gari foto, and spaghetti were significantly higher in informal foodservice providers than formal foodservice providers.

Table 4. Practices of food safety and hygiene.

	Poor practices			Good practices	
Practices on food safety and hygiene	NAT (%)	LO (%)	F (%)	O (%)	VO (%)
I wash fruits and vegetables thoroughly before using	2 (2.5)	8 (9.9)	7 (8.6)	23(28.4)	41(50.6)
I smoke while preparing food	60(74.1)	2 (2.5)	9(11.1)	4(4.9)	6(7.4)
I sneeze during food preparation	23 (28.4)	42(51.9)	7(8.6)	5(6.2)	4(4.9)
I choose separate working boards for different food items	14(17.3)	20(24.7)	9(11.1)	26(32.1)	12(14.8)
I taste food with wooden spoon	11(13.6)	5 (6.2)	9 (11.1)	38(46.9)	18(22.2)
I wash my hands every time before handling foods, after a toilet visit, sneeze, and getting cuts.	2 (2.4)	6 (7.4)	8 (9.9)	5(6.2)	60(74.1)
I sterilize tools before using them	14(18.4)	16(21.1)	9(11.8)	3 (3.9)	34(44.8)
I use sharp knife for cutting food items	5 (6.2)	8 (9.9)	8 (9.9)	10(12.3)	50(61.7)
I tidy up at intervals during food preparation	6(7.4)	14(17.3)	10(12.3)	20(24.7)	31(38.3)
I touch cooked foods using my bear hand.	11(13.6)	21(25.9)	14(17.3)	9(11.1)	26(32.1)
I use hot water in washing up utensils	27(33.3)	7 (8.7)	9 (11.1)	4(4.9)	34(42.0)
I purchase items from reliable source	4 (4.9)	9(11.1)	8 (9.9)	25(30.9)	35(43.2)
I store detergents, abrasives and food items separately in different rooms.	2 (2.5)	13(16.0)	12(14.8)	16(19.8)	38(46.9)
I discard dented and bloated cans	14(17.3)	9(11.1)	12(14.8)	18(22.2)	28(34.6)
Total practice score, N = 1,129	195	180	131	206	417
Total % score	17.3	15.9	11.6	18.3	36.9

NAT :Not at all, L O :Less often, F :Fair, O = Often, V O :Very Often, Data are presented in frequency (percentage).

However, total aerobic microbes in kebab and fufu water were found higher among formal foodservice providers than informal foodservice providers ($p < .05$). Identification of *Staphylococcus* species and association with KAP assessment

Table 5 presents a qualitative analysis of *Staphylococcus* species in food samples. Staphylococcus species such as *S. aureus, E. coli, S. epidermidis*, and *E. faecalis* were in food samples. Staphylococcus species were found in rice, vegetable salad, fufu, and fufu water from both formal and informal foodservice providers. There was no *Staphylococcus* species in beans and rice balls. Food samples such as spaghetti, gari foto had no *Staphylococcus* species from formal foodservice providers but were detected from informal foodservice providers. *Staphylococcus* species were detected in kebabs from formal foodservice providers but not from informal foodservice providers.

Table 6. Pearson correlation between study variables.

Variables	Knowledge score	Attitude score	Practices score	Overall KAP score
Knowledge score	1.000	−0.113	.251*	.702**
Attitude score	−0.113	1.000	0.205	.474**
Practices score	.251*	0.205	1.000	.725**
Overall KAP score	.702**	.474**	.725**	1.000
Aerobic count	0.116	−0.061	0.09	0.089
Coliform count	0.082	−0.068	0.088	0.063
Staphylococcus species	−0.088	−.231*	−0.026	−0.171

* Correlation is significant at the 0.05 level (2-tailed), KAP: Knowledge, Attitude and Practices.
** Correlation is significant at the 0.01 level (2-tailed). Data are presented as correlation coefficient, r. Bivariate correlation analysis.

Table 5. Qualitative assessment of *Staphylococcus* species in food samples from the foodservice providers.

Analysis code	Food sample	Formal (cfu/g)	Informal (cfu/g)
S1	Rice	Detected (+)	Detected (++)
S2	Vegetable salad	Detected (+++)	Detected (++)
S3	Fufu	Detected (++)	Detected (+++)
S4	Fufu water	Detected (+++)	Detected (+++)
S5	Beans	None detected	None detected
S6	Gari foto	None detected	Detected (++)
S7	Spaghetti	None detected	Detected (+++)
S8	Rice ball	None detected	None detected
S9	Kebab	Detected (+++)	None detected

Table 6 indicates the Pearson correlation between knowledge, attitude, and practices (KAP) of food safety and hygiene and microbial count of the food sample. Knowledge of food safety and hygiene was positively correlated with practices (r = 0.251, $p < .05$) and overall KAP (r = 0.702, $p < .001$) on food safety and hygiene. Participants' attitudes (r = 0.474, $p < .001$) and practices

($r = 0.725$, $p < .001$) of food safety and hygiene were positively correlated with overall KAP on food safety and hygiene. Attitude on food safety and hygiene had a weak, negative correlation with *Staphylococcus species* present in food samples ($r = -0.231$, $p < .05$).

Discussion

The knowledge of food safety and hygiene is necessary to ensure that food is prepared in a good hygienic environment (Adabankar et al., 2017). The study found that participants in the foodservice industry had good knowledge (60.0%) of food safety and hygiene but did not translate into practice (44.8%), and this might have lead to a higher proportion of the participants (61.2%) with a bad attitude toward food safety and hygiene. This implies that the foodservice providers were less likely to practice the acquired knowledge on food safety and hygiene, which is worrying. The bad attitude toward the practice of food safety and hygiene shown by the foodservice providers could negatively affect the quality and safety of the food sold to the public. Finding was inconsistent with studies by Adabankar et al. (2017) in Ghana and Ezenwoko et al. (2017) in Nigeria, which found that food-handlers had good knowledge about hygienic and food safety practices in the food industry. Another study by Clayton et al. (2002) showed that 63.0% of foodservice providers admitted they knew about food safety and hygiene but exhibited the wrong attitude during food preparation. Improper practices of food safety and hygiene by foodservice providers could be a vector in the spread of microorganisms that cause food-borne diseases (Lin et al., 2003). Improper washing of utensils and not sterilizing tools are all ways in which food pathogens can enter foods and cause life-threatening diseases to their consumers, as well as poses a public health threat. This bad attitude and poor practices of food safety and hygiene among foodservice providers are worrisome as it poses a risk of food contamination which can be detrimental to the health of people who eat from these places. It is evident from studies in Ghana and Nigeria that food hygiene knowledge and attitudes among food handlers do not usually influence food hygiene practices (Annor & Baiden, 2011; Clayton et al., 2002; Aluh & Aluh, 2017; Ezenwoko et al., 2017). This means that good knowledge of food safety and hygiene by the foodservice providers does not necessarily translate into strict food safety and hygiene practices, as observed in the current study. This is very much worrying because, in Ghana, there are institutions and laws governing bodies such as Food and Drug Authority, Ghana Standard Authority that ensure that all foods sold in Ghana operate under the appropriate food safety and hygienic rules. These institutions also inspect all food industries and ensure that food safety and hygienic rules are implemented before a certificate of operation is given to the foodservice provider (Ghana Standard Authority, 2013). The findings call for

continuous education, training, and motivation of food-handlers by these institutions to change the attitudes of some foodservice providers and ensure the appropriate practice of food safety and hygienic rules.

The relationship between knowledge, attitude, and practices of food safety and hygiene between formal and informal service providers were shown. The study found that participants at the formal foodservice providers were more likely to have a better knowledge ($p = .012$), and practice ($p = .001$) food safety and hygienic rules than those at informal foodservice providers. Similarly, participants at formal foodservice providers were more likely to have a better KAP percentile score on food safety and hygiene than those at informal foodservice providers ($p = .001$). The findings of this study confirm the perception that informal foodservice providers do not usually have professional skills and knowledge in the foodservice establishment and thus are more likely to lack knowledge, attitude, and practices on food safety and hygiene principles. This is a public health concern, because, in Ghana, the majority of the population is likely to eat from informal foodservice providers than formal food service; thus, it poses a serious threat to our public health system. It is necessary that stakeholders in the foodservice routinely provide knowledge and on-job training on food safety and hygiene to these groups and ensure that they practice all food safety and hygienic rules. The study also found that participants increase in knowledge ($r = 0.702$, $p < .001$), attitude ($r = 0.474$, $p < .001$), and practices ($r = 0.725$, $p < .001$) of food safety and hygiene would increase their overall KAP on food safety and hygiene. This confirms the need to ensure that knowledge, attitude, and practices of food safety and hygiene are all put into good use in the foodservice industries to ensure that food prepared and served is safe and free from pathogens.

The study found high microbial load (total coliform count, TCC) above the reference value (above 1.0×10^1 CFU/g according to ISO standard and FDA) in food samples; rice, salad, fufu, fufu water, from both formal and informal foodservice providers. Additionally, the microbial load from the coliform count in rice, fufu, fufu water, gari foto, and spaghetti were significantly higher in food samples collected from informal foodservice providers than formal foodservice providers ($p < .05$). Also, results of total aerobic count (TAC) assay indicated the presence of *Staphylococcus aureus, Escherichia coli*, and *Staphylococcus epidermidis* in the food samples and were above the acceptable limit ($1.0x10^4$ CFU/g according to ISO standard and FDA) in vegetable salad, fufu, and fufu water from both formal and informal foodservice providers. The presence of infectious microbes in food samples sold in the foodservice industry could be attributed to their wrong attitude and poor food safety and hygienic practices. This result also implies that food sold in the studied foodservice providers could be of low quality and likely to be contaminated with infectious microbes due to poor standards of food safety and hygienic practices observed at these foodservice industries. High levels of microbial

load are known to induce digestive, liver, and immune problems, including diarrhea, immune system dysfunction, allergic conditions, and may also alter the intestinal integrity preventing the absorption of nutrients (Mycotoxins-info, 2006). Although some food samples had no or less microbial load, the presence of microbes in foods sold by these foodservice providers becomes unwholesome for human consumption. The high microbial food contamination could be attributed to poor attitudes and practices of food safety and hygiene rules by participants. We observed a significant negative correlation ($r = -0.231$, $p < .05$) between attitude score and S. *species* present, indicating that a good attitude is associated with a lower occurrence of Staphylococcus species in the food sample and vice versa. The findings suggest that appropriate stakeholders should ensure the health safety of the population by ensuring that foodservice providers operate in a pathogenic-free environment.

Conclusions

Poor knowledge, attitude, and practices of food safety and hygiene were found among foodservice providers. The formal foodservice providers had a better KAP on food safety and hygiene than informal foodservice providers. Microbial contamination in the food served at these foodservice providers was also high. Participant's right attitude toward food safety and hygienic rules was associated with a lower presence of *Staphylococcus* species in food samples. Strict food safety and hygienic practices must, therefore, be followed by the foodservice providers, to prevent cross-contamination of foods served to consumers. Again, further large studies are encouraged on the national scale to establish the national trend of food safety and hygienic principles carried out in the formal and informal foodservice providers.

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Declaration of interest statement

The authors declare that they have no competing interests regarding the publication of this study.

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