

## ORIGINAL ARTICLE

### Bacterial contamination of street vending food in Kumasi, Ghana

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Street vending foods are readily available sources of meals for many people but the biological safety of such food is always in doubt. The aim of this study is to ascertain bacterial isolate and determine total counts of bacterial species responsible for the contamination of the street vending food in Kumasi so as to determine the microbiological safety of such a food. This prospective study was conducted among street vending food at four bus terminals in Kumasi. From November, 2008 to February, 2009, 60 food samples comprising ice-kenkey (15), cocoa drink (15), fufu (5), ready-to-eat red pepper (normally eaten with kenkey) (5), salad (10) and macaroni (10) were purchased and analyzed. The food samples were purchased and transported to the laboratory in sterile plastic bags and analyzed for bacterial contamination. Serial dilution of each food was prepared in buffered peptone water and inoculated onto plate count agar (PCA), MacConkey and blood agar plates. Growths on PCA were counted; those on other agar plates were identified by their colonial morphology, Gram stain, biochemical and sugar fermentation methods. The mean bacterial counts in these foods expressed to log<sub>10</sub> CFU/ml were: fufu 6.36±0.47, cocoa drink 6.16±0.5, red pepper 5.92±0.64, ice-kenkey 5.58 ±0.52, macaroni 5.58±0.97 and salad 5.13±0.77. Most of these foods contained higher than acceptable contamination level of <5.0 log<sub>10</sub> CFU/ml. The isolates obtained were Coagulate negative *staphylococci* (23.7%), *Bacillus species* (21.5%), *Klebsiella pneumoniae* (18%), *Aeromonas pneumophila* (17.7%), *Enterobacter cloacae* (6.7%), *Staphylococcus aureus* (3.7%), *Escherichia coli* (2.2%) and *Pseudomonas aeruginosa* (2.2%). Most ready-to-eat foods in Kumasi were contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels. Food vendors therefore need education on food hygiene.

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#### INTRODUCTION

The street food industry plays a very important role in meeting food requirements of commuters and urban dwellers in many cities and towns of developing countries, as it feeds thousands of people daily with a large range of foods that are relatively cheap and easily accessible (Tambekar *et al.*, 2008). However, food borne illnesses

of microbial origin are a major health problem associated with street foods (Kaneko *et al.*, 1999; Mensah *et al.*, 2001; Mensah *et al.*, 1997; Mensah *et al.*, 2002). The traditional processing methods that are used in the preparation, inappropriate holding temperature and poor personal hygiene of food handlers are some of the main causes of contamination of ready to eat foods (Barro *et al.*, 2006; Mensah *et al.*, 2002). Also the food are not effectively protected from flies and dust (Bryan *et al.*, 1997; Bryan *et al.*, 1992 ). In Ghana, street food are mostly prepared and processed manually and sold to the public at various lorry terminals, by the roadside or by itinerant vendors (Mensah *et al.*, 2002).

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In Ghana, diarrhoea has been recognized as one of the major causes of hospital attendance and 16% of deaths in African children younger than five years are directly attributable to diarrhoeal diseases (Bruce *et al.*, 2005). This leads to a major ongoing campaign about hand-washing to reduce the incidence of diarrhoea. Despite the commitment and dedication of the Ghana Food and Drugs Board, improved food safety systems have not been widely implemented which raises more concern about the probable role street vending food play in food poisoning (Kosek *et al.*, 2003; Soyiri *et al.*, 2008). Therefore the aim of this study is to determine the level of bacterial contamination of selected street vending food in Kumasi.

## **MATERIALS AND METHODS**

### **Study sites**

The study was conducted in Kumasi at four bus terminals: Kejetia, Asafo, Race course and Bantama. These bus terminals are most often congested with heavy trucks, minibuses, and taxis. These vehicles are often seen of-flooding goods and passengers to the bus stops. These passengers are often food vendors who sell at any convenient space along the gutters. Various commuters, shoppers and passers-by can be seen at the bus terminals daily and all constitute a huge market for all kinds of goods. Common items sold include clothes, food stuffs and vegetables and snacks including many kinds of ready-to-eat foods which are sold along the walkways and under sheds and umbrellas. Common street food available here are cakes, potato chips, ice-kenkey, cocoa drink, yoghurt, bread, meat pie and different kinds of locally produced drinks. Stew, macaroni and salads (consisting mainly of cut tomato and onion mixtures and other ingredients such as vinegar, salt and spices), are usually packed in sieves and trays and carried around. As these itinerant vendors walk in between the vehicles they sell to the passengers waiting to be transported to their destinations.

### **Sample Collection**

Sample collection and analysis was from November, 2008 to February, 2009. The street vending foods were purchased randomly at the bus terminals, between mid-day and 1.00 pm when such foods are most patronized, without repetition from the same vendor. Food types analyzed were as follows: ice-kenkey, cocoa drink, fufu, ready-to-eat pepper (normally eaten with kenkey), salad and macaroni. These foods were packaged and needed no further processing before consumed. The samples were purchased and transferred into sterile Whirl-Pak bags (Nasco, USA). They were then placed in a cold-box with

ice packs and transported to the microbiology laboratory for analysis the same day. Information about how the food were prepared and packaged for sale were obtained from the vendors and presented in Table 1.

### **Sample Analysis**

Five milliliters (5 ml) of each liquid food were mixed with 45 ml of buffered peptone water and homogenized by manual shaking. Solid foods were diluted by adding five grams of food to 50 ml of buffered peptone water and then shaken vigorously to dislodge adhered bacteria. The liquid phase then forms the stock sample from which dilutions were made to obtain  $10^{-1}$ ,  $10^{-2}$ ,  $10^{-3}$  up to  $10^{-10}$  dilutions. After mixing each tube with the dilution, 0.1 ml of it was transferred onto a sterile plate count agar (PCA) (Oxoid Ltd, Basingstoke Hants, England) then spread on the agar surface and immediately placed in an incubator. The plates were incubated at 37°C overnight. The remaining stock samples were incubated at 37°C for 4 hours after which they were subcultured onto Blood Agar, MacConkey Agar (Oxoid Ltd, Basingstoke Hants, England) plates and incubated at 37°C overnight.

### **Viable Bacterial Count**

After overnight incubation, growth on the PCA showing 30-300 colonies was counted. Bacterial counts were expressed as the log of colony-forming-units per ml for liquid food or per g for solid food sample analyzed.

### **Bacterial identification**

The MacConkey and Blood agar plates were examined for bacterial growth. Growth characteristics and other colonial morphology such as lactose fermentation, formation of mucoid colonies of the bacteria were carefully recorded. Less than five identical colonies for a particular organism growing on a plate were ignored. When more than five similar colonies were counted on a plate, then five isolated identical colonies on either the blood agar or MacConkey agar plates were picked carefully, one by one and inoculated into buffered peptone water in sterile microtitre wells. Culture from each microtitre well was re-inoculated onto a Nutrient agar (Oxoid Ltd, Basingstoke, Hampshire, England) to obtain pure growth. Organisms which were identified to be the same from the microtitre wells were grouped as one isolate from the food sample analyzed. Bacterial identification was done using the pure culture on the nutrient agar plates.

### **Biochemical tests**

The first test was the Gram staining and the results were followed by the appropriate biochemical tests (catalase,

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coagulase, oxidase, sugar fermentation, indole, citrate utilization, urease production) and motility test.

The catalase test was performed on the Gram positive cocci. This was done by mixing a dense culture with two drops of H<sub>2</sub>O<sub>2</sub> and looking for bubbles. Organisms positive (produced bubbles) in the test were considered to be *Staphylococci*, while those negative were *Streptococci*. The *Staphylococci* were further tested with the coagulase test. The coagulase test was performed by mixing a dense suspension of the culture with plasma contained in a small test tube. The set up was incubated overnight, and then observed for fibrin clot. Those positive in the coagulase test were identified to be *Staphylococcus aureus*, and those negative were coagulase negative staphylococci.

The Gram negative organisms were also identified. Those organisms which were non-fermenters of lactose on the MacConkey agar were tested by the oxidase test using tetramethyl-*p*-phenylene-diamine hydrochloride reagent sticks. The oxidase stick was used to touch the organism on the nutrient agar plate. The development a blue/black colour on the stick in less than 10 seconds was considered positive for oxidase production. *Pseudomonas aeruginosa* is positive in this test, so the oxidase test and other tests (growth characteristics, pigment production and smell) were used to identify the organism.

Citrate utilization employed the Simon's citrate agar

(Oxoid Ltd, Basingstoke, Hampshire, England). The citrate agar was inoculated with growth on the nutrient agar and incubated overnight. *Klebsiellae* are positive in this test, so enabled it to be differentiated from *E. coli*.

Triple sugar iron (TSI) agar (Oxoid Ltd, Basingstoke, Hampshire, England), was used for the differentiation of the *Enterobacteriaceae*. Using a sterile straight wire the TSI was stabbed deep to the bottom and the surface of the agar slant was streaked with the test organism. By the different three sugar fermentation, gas accumulation and hydrogen sulphide production abilities the enterobacteria were identified.

The indole test was performed by inoculating peptone water (Oxoid Ltd, Basingstoke, Hampshire, England), and incubating it overnight. The detection of indole was by the addition of Kovac's reagent (Oxoid Ltd, Basingstoke, Hampshire, England). *E. coli* is positive (forms red ring) in this test, so was used to distinguish it from *Klebsiella*. Motility of the organism was tested by using a sterile loop to pick culture from the microtitre wells were placed on a microscope slide, covered with a cover slip and observed under the microscope for locomotion.

## RESULTS

The study was conducted between November 2008 and February 2009, when a total of 60 food samples were analyzed. Bacterial growth was observed in all the food

Table 1: Food type analyzed and its preparation

Food type	Ingredients	How prepared	How served
Salad	Leaves, fresh vegetable	No boiling	Served with spoon or hand
Macaroni	Wheat flour	Extruded wheat flour; Partial	Served with spoon or hand
Fufu	Cassava with plantain, cocoyam or yam	Boiling and pounding in mortar with pestle while turning it over with hand	Served by hand in bowls
Ice kenkey	Mixture of milled kenkey, milk powder and sugar	Mixing, with water milk, sugar; no boiling	Packaged into polythene bag by hand
Cocoa drink	Cocoa powder and sugar	Mixture of cocoa powder and water; No boiling	Packaged into polythene bags by hands
Red pepper	Pepper, onion, salt	Mashing/grinding, no heating	Served with spoon

samples tested. The 15 cocoa drinks had the heaviest level of contamination with 31 isolates, where 10(15) yielded *Aeromonas hydrophila*, 8(15) *Klebsiella pneumoniae*, 6(15) and 7 (15) yielded *Bacillus* species and coagulase negative staphylococci respectively. Other isolates were found in fewer samples of the cocoa drink. A total of 29 isolates were obtained from the 10 macaroni samples, where 8(10) of the macaroni samples had *Klebsiella pneumoniae* isolates. Both *Aeromonas hydrophila* and coagulase negative staphylococci were obtained from six of the macaroni samples. 15 ice-kenkey samples were analyzed with 10(15) yielded coagulase negative staphylococci, 8(15) yielded *Bacillus* species, 4(15) had *Aeromonas hydrophila* in them and 2(15) yielded *S. aureus* and then 1(15) yielded *Klebsiella pneumoniae*, *E.coli*, *Citrobacter freundii* and *Enterobacter cloacae*. There were 10 salad samples out of which six had *Klebsiella pneumoniae* and both *Bacillus* species and coagulase negative staphylococci were each isolated from three of the samples. Five samples each of fufu and red pepper were analyzed. All the fufu samples had coagulase negative staphylococci, but only 2(5) of red pepper had it, whilst 4(5) fufu and 3(5) red pepper had *Bacillus* species, but all other isolates were obtained from one sample each of fufu and red pepper. *Pseudomonas aeruginosa* was isolated from only macaroni and fufu, but not in the other food types. The most prevalent bacteria types were coagulase negative staphylococcus, *Bacillus* species *Aeromonas* species, and *Enterobacter* species. These bacteria appeared in every food type analyzed as shown in Table 2.

The isolates obtained and the mean bacterial count in the food items expressed as  $\log_{10}$  CFU/g or CFU/ml were as follows: ice-kenkey-5.58, cocoa drink-6.16, macaroni-5.48, salad-5.13, fufu-6.36 and 5.92 for red-pepper are as shown in Table 3. Samples of macaroni, salad and cocoa drink had mean contamination levels of  $> 5.0 \log_{10}$  cfu/ml as compared to the acceptable bacterial count in these foods of  $<5.0 \log_{10}$  cfu/ml.

## DISCUSSION

The results obtained for the various food types have been discussed below. High levels of bacterial contamination at varying degrees were detected in the food types tested. Samples of macaroni, salad, fufu and cocoa drink had levels of contamination higher than the acceptable reference figures of Ghana Standard Board which prescribe values of  $<5.0 \log_{10}$ cfu/g

### Fufu

The mean bacterial count in fufu was  $6.36 \log_{10}$ cfu/g which is higher than the national reference value of  $<5.0$

$\log_{10}$ cfu/g. This level of contamination is probably due to the mode of preparing this food. The preparation of fufu involved boiling the cassava and plantain, then pounding it in a mortar using a pestle while turning the resulting paste with the bare hands, which were occasionally washed in a container of water. This practice can promote the introduction of microorganism, and the organisms would multiply when the fufu is not eaten immediately. These processes may be responsible for this level of contamination in the fufu. A similar study (Mensah *et al.*, 2002) in Accra, observed similarly high bacteria count of  $6.2 \pm 1.57 \log_{10}$ cfu/g in fufu and the isolates found were *Citrobacter freundii*, *Enterobacter cloacae* and *Enterobacter sakazakii*. In this current study these same bacteria in addition to *Pseudomonas aeruginosa*, coagulase negative staphylococci and *Aeromonas hydrophila* were also isolated. Though, the level of contamination in fufu in this study was high, most of the isolates were coagulase negative staphylococcus, which are known to be normal flora on the skin (Koneman *et al.*, 1988) and *Bacillus* species which are ubiquitous organisms (found in soil, skin, water and dust) which can be found in a variety of foods (Bergdoll, 1981).

### Ice-kenkey

The level of contamination of ice-kenkey was  $5.58 \pm 0.52 \log_{10}$  cfu/ml as compared to the national standard of  $<5.0 \log_{10}$  cfu/ml (Adu-Gyamfi and Nketsia-Tabiri, 2007). *Escherichia coli*, *Staphylococcus aureus* and *Aeromonas hydrophila* were isolated from this food. The presence of *E. coli* in this food types is an indication of faecal contamination probably at one stage of preparation or from the materials used. *Staphylococcus* contamination on the other hand might have resulted from man's respiratory passages, skin and superficial wounds which are common sources of *Staphylococcus aureus* (Burt *et al.*, 2003). When *Staphylococcus aureus* is allowed to grow in foods, it can produce a toxin that causes illness. Although, cooking destroys the bacteria, the toxin produced by *Staphylococcus aureus* is heat stable and may not be destroyed even by heating, let alone by refrigeration the main process of keeping ice-kenkey prior to consumption. Contamination of ice-kenkey with *Staphylococcus aureus* could lead to food poisoning and this could be attributed first to non-adherence to standard hygienic practices employed during food preparation (Ghana Standard Board, 2003) and second to the type of water used in mixing the food which is often not clean (Muleta, 2001). There is relatively high level of coagulase negative staphylococcus contamination (7.4%) in the food, which was likely introduced during preparation. The manual mixing of this food, promotes contamination skin flora (Koneman *et*

al., 1988). *Bacillus* species were also introduced into the food during its preparation and packaging because the

entire process is performed in the open and dirty environment which promotes contamination as observed in

**Table 2: Bacterial isolates and their level of contamination in the street vending food in Kumasi**

Isolates	Ice-kenkey (n=15)	Cocoa drink (n=15)	Macaroni (n=10)	Salad (n=10)	Red pepper (n=5)	Fufu (n=5)	Total (n=60)
<i>Coag. neg. staphylococci</i>	10(7.4%)	6(4.4%)	6(4.4%)	3(2.2%)	2(1.5%)	5(3.7%)	32(23.7%)
<i>Bacillus sp.</i>	8(5.9%)	7(5.1%)	4(3.0%)	3(2.2%)	3(2.2%)	4(3.0%)	29(21.5%)
<i>Klebsiella sp.</i>	1(0.7%)	8(5.9%)	8(5.9%)	6(4.4%)	2(1.5%)	0(0.0%)	25(18.5%)
<i>Aeromonas sp.</i>	4(3.0%)	10(7.4%)	6(4.4%)	2(2.2%)	1(0.7%)	1(0.7%)	24(17.7%)
<i>Enterobacter sp.</i>	1(0.7%)	4(3.0%)	1(0.7%)	1(0.7%)	1(0.7%)	1(0.7%)	9(6.6%)
<i>Citrobacter sp.</i>	1(0.7%)	2(1.5%)	1(0.7%)	1(0.7%)	0(0.0%)	0(0.0%)	5(3.7%)
<i>S. aureus</i>	2(1.5%)	1(0.7%)	1(0.7%)	0(0.0%)	1(0.7%)	0(0.0%)	5(3.7%)
<i>E. coli</i>	1(0.7%)	1(0.7%)	0(0.0%)	1(0.7%)	0(0.0%)	0(0.0%)	3(2.2%)
<i>P. aeruginosa</i>	0(0.0%)	0(0.0%)	2(1.5%)	0(0.0%)	0(0.0%)	1(0.7%)	3(2.2%)
Total	28(20.7%)	39(28.8%)	29(21.4%)	17(12.6%)	10(7.4%)	12(8.8%)	135(100%)

**Table 3: Bacterial count in street vending food in Kumasi**

No.	Ice-kenkey	Cocoa drink	Macaroni	Salad	Fufu	Pepper
1	5.47	5.6	6.56	6.20	5.90	5.00
2	6.32	6.91	5.54	5.20	6.70	6.44
3	4.90	5.84	6.54	5.47	6.90	6.30
4	7.23	6.00	4.00	6.17	6.60	6.60
5	5.46	6.07	4.17	4.00	5.70	3.30
6	5.59	5.86	6.30	4.00	-	-
7	5.46	6.77	6.25	5.47	-	-
8	5.23	6.90	4.17	4.14	-	-
9	5.34	5.77	5.34	5.30	-	-
10	5.49	6.83	6.00	5.34	-	-
11	5.25	6.53	-	-	-	-
12	5.67	5.50	-	-	-	-
13	5.47	5.77	-	-	-	-
14	5.46	5.62	-	-	-	-
15	5.47	6.50	-	-	-	-
Mean	5.58±0.52	6.16±0.5	5.48±0.97	5.13±0.77	6.36±0.47	5.92±0.64

many reports from many parts of the world [(Black *et al.*, 1991; Bryan *et al.*, 1992 ; Burt *et al.*, 2003; Ghosh *et al.*, 2007).

### **Macaroni**

The mean bacterial count in macaroni samples analyzed was  $5.48 \pm 0.97 \log_{10}$  cfu/g. Though, this is higher than the national reference value of  $< 5.0 \log_{10}$  cfu/g, it was less than a value of  $6.0 \pm 1.64 \log_{10}$  cfu/g obtained in Accra (Mensah *et al.*, 2002) and similar to results observed in India (Olukoya *et al.*, 1991; Tambekar *et al.*, 2008).

*Klebsiella* species, *Pseudomonas* species, *Enterobacter* species and *Staphylococcus aureus* were the isolates obtained from macaroni. This food is often prepared by heating but gets cold by the time it is served because the sellers are not able to keep the food at a good holding temperature and therefore ambient temperatures provide a suitable condition for the growth of the microorganisms (Mensah *et al.*, 2002). *Shigella sonnei* was not isolated from macaroni in this study probably due to the relatively small sample size (10) as compared to 26 samples of macaroni studied in Accra, where *Shigella sonnei* was isolated (Mensah *et al.*, 2002). The contamination of this food was not surprising because after cooking the food, serving was performed with bare hands (Mensah *et al.*, 2002). The vendors sell and dish out food with bare hands and also simultaneously handle currency as they take money from the buyers, a common practice implicated in introducing pathogens into the food (Kubhekar *et al.*, 2001). It was also reported in Manila, Philippines that, the consumption of such food served with bare hands led to cholera outbreak (Barry, 2005).

### **Salad**

The level of contaminant in salads was  $5.13 \log_{10}$  cfu/g which is higher than the national reference value of  $< 5.0 \log_{10}$  cfu/g [12]. A previous study of this kind was carried out in Accra (Mensah *et al.*, 2002) and a total bacterial count of  $6.3 \pm 0.78 \log$  cfu/g was obtained, but a count of  $5.0 \log$  cfu/g was obtained in Johannesburg (Olukoya *et al.*, 1991).

The bacterial pathogens isolated in this study were: *Klebsiella pneumoniae*, *Escherichia coli*, *Citrobacter freundii*, *Aeromonas hydrophila*, *Bacillus species*, *staphylococcus* and *Enterobacter cloacae*. Contamination of salad with these bacterial pathogens conformed to previous finding in Ghana (Mensah *et al.*, 2002). *Escherichia coli* are significant diarrhoeal causing organisms usually found in localities of poor sanitary conditions (Umoh and Odam, 1999). It has

been associated with "travelers' diarrhoea" and hemorrhagic colitis. Therefore, consumption of this food could be associated to diarrhoeal diseases (Hanoshiro *et al.*, 2004 ). Furthermore, the presence of these pathogens indicates that, food hygiene and sanitation procedures were lacking during the preparation of this food (Ghana Standard Board, 2003).

This level of contamination was not unexpected with salad because, in Ghana, all types of water are used for watering vegetables, especially those grown in the cities, where there are not many natural bodies of water (Mensah *et al.*, 2002). Untreated manure is also usually used to fertilize many vegetables. The use of untreated manure to fertilize vegetable has led to isolation of *Salmonella* species, *Shigella flexneri* and *Escherichia coli* from lettuce and tomatoes in 2001 in Accra (Mensah *et al.*, 2001). Similar observations were also reported in the Annual Report of Ghana Health Service in 2007, where school children who were fed with rice, stew and salad, developed gastroenteritis attributed to cross-contaminated green vegetables.

### **Cocoa drink**

The mean bacterial count of cocoa drinks analyzed was  $6.16 \log_{10}$  cfu/ml much higher than the national acceptable reference of  $< 5.0 \log_{10}$  cfu/ml. This level of contamination could be due to the unhygienic production practices (Ghana Standard Board, 2003) as the preparation involves manual mixing of the cocoa powder with sugar and probable non-potable water collected from streams nearby when municipal water supply is interrupted. The isolates obtained from the food were *Aeromonas hydrophila*, *Klebsiella pneumoniae*, *Enterobacter cloacae*, and *Escherichia coli* organism are enteric pathogens (Adu-Gyamfi and Nketsia-Tabiri, 2007). Individuals who patronize this food product contaminated with enteropathogenic *Escherichia coli* are likely to develop "traveler's diarrhoea" and hemorrhagic colitis (Umoh and Odam, 1999) therefore the presence of the organisms in street food is also an indication of faecal contamination and constitutes food risk to the patrons. The predominant isolate obtained from this food was *Aeromonas species* which is a bacterium mostly found in water and resides in sinks and drain pipes (Koneman *et al.*, 1988) hence the possible sources of contamination of the cocoa drink. Coagulase negative staphylococci isolated normally found on the human skin.

### **"Red Pepper" eaten with kenkey.**

The mean bacterial count of the Red Pepper sauce analyzed was  $5.92 \log_{10}$  cfu/g, this level of contamination is

higher than the national reference level of  $<5.0 \log_{10}$  cfu/g. A previous study in Ghana (Mensah *et al.*, 2002) had a contamination level of  $5.1 \pm 1.73 \log_{10}$  cfu/g in this food. Similar findings were obtained, when a wide range of menu items including formula foods, soups and stews were examined in Peru (Kwakye-Akyea, 2007) and where contamination level of  $5.9 \log_{10}$  cfu/g were found. The isolates obtained from the red pepper analyzed in this study were *Klebsiella pneumoniae*, *Staphylococcus aureus*, coagulase negative staphylococcus and *Enterobacter cloacae*, *Bacillus* species and *Aeromonas hydrophila*. When *Staphylococcus aureus* is allowed to grow in foods, it can produce a heat stable toxin that causes illness (Koneman *et al.*, 1988), so such organisms in food constitute food poisoning risk to the consumer (Muleta, 2001). Moreover, sauces, such as red pepper normally eaten with kenkey, are made from fresh vegetables (pepper, tomato, and onion) and eaten without heating. All bacteria introduced in at the time of preparation, survive and multiply if held for long periods at ambient temperature (Ghana Standard Board, 2003).

Generally, this study indicates that most ready to eat foods sold on the streets of Kumasi are contaminated with various microbial types. The bacterial isolates were 23% coagulase negative staphylococci, 18% *Klebsiella pneumoniae*, 3.7% *S. aureus* and 2.2% *E. coli* were seen in the food samples maybe as a result of either wearing of dirty clothing, improper cleaning of dishes, unhygienic handling and serving practices or all of these. Other contributing factors may be the contaminated hands of vendor, and perhaps lack of knowledge of hygienic practices and safety of food products (Fang *et al.*, 2003). Unhygienic surroundings (where the foods were prepared and sold) like flowing sewage in open gutters, improper waste disposal system and inadequate water supply attracts houseflies or fruit flies, probably further increases food contamination (Chumber *et al.*, 2007). Also of concern is reluctant behaviour of the vendors to wash hands. The itinerant vendors carry small volumes of water along as they sell, but do not change the water and the washing is normally not done with soap. When municipal water supplies fail, the vendors resort probably resort to 'seemingly clean' water from nearby streams for the food production. Also many vegetable growers rely on such stream waters for irrigation of the crops and then washing of the harvested crops before they are sold, making them heavily polluted from the farm. Efforts must be made to wash harvested crops with clean potable water.

## CONCLUSION

This study has demonstrated that some of the most popular types of ready-to-eat foods that are sold on the streets

of Kumasi are contaminated, and do not meet the required quality and safety levels. Some of the bacteria isolated such as *Staphylococcus aureus* and *Escherichia coli* are potential enteric pathogens and are known to cause gastroenteritis. Street foods therefore pose a health threat to the patron and efforts to reduce level of contamination in the street vending food are recommended. Water for preparing such foods can be boiled, cooled and then used to prepare food like cocoa drink and ice-kenkey. Use of previously boiled water for washing vegetables may help reduce food contamination.

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