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A Study Into Microbial Quality Of Ready To Eat Foods Sold In The Sunyani Municipality of Ghana

Addo Henry Ofosu (Corresponding Author)
M. Phil Scholar: Faculty of Public Health and Allied Sciences
Catholic University College of Ghana, Fiapre
Dzigbede Bridget Adzoa
BSc (Hons): Faculty of Public Health and Allied Sciences
Catholic University College of Ghana, Fiapre
Agidi Joy Eva Love
BSc (Hons): Faculty of Public Health and Allied Sciences
Catholic University College of Ghana, Fiapre
Adjei Jennifer
BSc (Hons): Faculty of Public Health and Allied Sciences
Catholic University College of Ghana, Fiapre
Koranteng Augustine
BSc (Hons): Faculty of Public Health and Allied Sciences
Catholic University College of Ghana, Fiapre

Abstract

For this study the microbial quality of ready to eat foods sold in the Sunyani Municipality of Ghana was assessed. It was done through experiments of culturing selected food samples on various media. Laboratory analysis was done for the enumeration, isolation and identification of bacteria. It was also descriptive, focusing on the factors that are associated with food hygienic practices. Simple random sampling technique was used to select 120 respondents. A total of 10 different food samples were examined for aerobic bacteria (total counts), enterobacteriaceae and fungi presence. Mesophilic bacteria were identified in all food samples (100%); and fungi, and enterobacteriaceae were found in 1 (11.1%) and 8 (88.7%), respectively. The microbial quality of most foods was within acceptable limits, that is <5.0 $\log_{10}$ cfu/g for total counts, <3.0 $\log_{10}$ cfu/g for Enterobacteriaceae. In the total counts, only salad, macaroni and "waakye" exceeded their acceptable limits, 5.34 $\log_{10}$cfu/g, 5.54 $\log_{10}$cfu/g, 5.4 $\log_{10}$cfu/g respectively. Common sources of direct or cross contaminations include: mode of handling the food, items in which the food is served for final consumption, mode of conveying the food to the vending point among others. Lack of knowledge of diseases like diarrhoea and cold (Catarrh) is as much one of the factors possible for the introduction of harmful microbes into the ready to eat foods. The occurrence of indicator microorganisms in most of the foods indicated a need for vendors to be educated on general sanitary conditions on improving the environment. Vendors should therefore receive education on food hygiene.

Keywords: Ready-to-eat foods, microbial quality, food hygiene, food borne illness.

1.0 Introduction

Food forms part of the daily life of a Ghanaian. In fact food forms part of the culture of many Ghanaian societies. The emergence of ready to eat foods on the Ghanaian streets nowadays poses a big threat to this. The purchase of cooked foods from food vendors in Ghana is increasing in the Ghanaian societies everyday (Sonou, 2011). Therefore the quality of food is key to its acceptability and marketability.

The microbial quality of food is essential to ensure a safe product for the consumer but preventing contact with microorganisms is nearly impossible as food from food vendors are exposed to a wide range of microbes. The carry-over of potential pathogens from food vendors is also influenced by many environmental factors including the microbial load present in the water used for cooking, type of food and a host of other single or interacting factors (Johnston *et al.,* 2006). Also, the mishandling and disregard of hygienic measures on the part of the food vendors again may enable microbes to contaminate food (WHO, 2009). With an estimated one in forty Ghanaians suffering each year from serious foodborne diseases, poor food safety measures poses an important drain on the economy (Mensah *et al.,* 2002).

Ready to eat foods are most often called street foods. They are often prepared and sold in public places, sometimes in the full glare of people. In Ghana, the most commonly occurring foodborne diseases from ready to eat foods are typhoid, cholera and diarrhea (Moreau, 2009). Statistics available from the Sunyani Municipality indicate that seventeen (17) cases of typhoid had been recorded so far from the mass screening of food vendors (Environmental Protection Agency, Sunyani Municipality, 2014). Diarrhea and cholera statistics were also 3,693 and 221, respectively (Ministry of Health, 2009). The annual report of the Sunyani Municipal Hospital (2008) indicated that there had been an annual increase in the number of reported foodborne diseases and attributed this to the proliferation and the consumption of street foods. The problem stems from the fact that in the Sunyani Municipality, the washing of hands, utensils and dishes is often done in buckets or bowls since running water is not readily available (Sunyani Municipal Assembly, 2010). Also, the same water is used in washing so many bowls and this water is hardly changed. Besides, the bowls are only dipped into the rinsing water and then removed with disinfection not usually carried out. Furthermore, toilets and adequate

washing facilities are rarely available. Most ready to eat foods sold on the streets are left uncovered and are not adequately protected from flies.

Microbial contamination of food poses a serious threat to public health. The origin of microbial contaminant may either be environmental, natural or technological. To control the environmental or technological sources of microbial contamination, hygiene and cleanliness of food are two of the most important factors to consider (Riener *et al*., 2010).
The state of many Ghanaian urban food vendors currently poses a health risk to all who come into contact with the food (Barnes & Taylor, 2012). The problem here is that food vendors with defective personal hygiene facilitate the transmission of pathogens via the food to consumers. This is because Ellis (2012) indicated that enteropathogens can survive on the hands for three hours or longer and diarrhoea pathogens on the hands of the food vendors can be transmitted to the consumers.

Street foods have low economic values so their activities are largely unregulated. Some of the authorities regard food vendors on the street as generally undesirable and causing problems for the municipality such as increasing the prevalence of food borne diseases.

This study therefore sought as its objective to assess microbial quality of ready to eat foods sold in the Sunyani Municipality and hygienic practices of food vendors.

2.0 Methodology

The research was designed partly under the quantitative paradigm. This was through experiments of culturing selected food samples on various media. Microbial growth on these media were counted and analyzed. It was also descriptive (qualitative paradigm) the factors that are associated with poor food hygienic practices.

2.1 Study Area

The study is conducted at the Sunyani Municipality. The Sunyani Municipality lies between latitude 7º 19´N and 7º 35´N and longitudes 2º 08´ W and 2º 31´ W. It shares boundaries with Wenchi Municipality to the North East, Tain Municipality to the North, Berekum and Dormaa East to the West, Sunyani West Municipal to the South East and to the Eastern boundaries of the Municipality are Tano North and Ofinso North Municipality. Sunyani Municipality has a total land area of 1,658.7 square kilometers. The population density of the municipality is 122 persons per square kilometre (Sunyani Municipal Assembly Computation, 2010). In comparing this to the population density of the region which is 45.9/sq.km and that of the nation of 76/sq.km, the municipality is densely populated resulting in pressure on social facilities.

2.2 Study population and Sample collection

The target population for the study comprised all food vendors in the Sunyani Municipality. Although there were other segments of the food service industry, this segment attracted attention, because for far too long few researches have been conducted among this group.

The sampling was purposive based on availability of street vended food and prepared on site in the major roads of Sunyani. The research targeted the Sunyani Municipal area. Five areas in the Sunyani Municipality, which have high numbers of street food vendors, were chosen for interview.

A food vendor was randomly selected using the simple random sampling method. This method was thought to be most suitable because the chop bars had become homogenous after the stratification. Every food vendor in the two categories had an equal chance of being selected. All regulatory bodies involved in food safety monitoring were purposively selected to check on the roles each plays and militating factors in the execution of their duties. A structured non participant observation of food handling practices of food vendors preceded the administration of questionnaire. Structured interview schedule was developed to verify and clarify practices that were observed and also to address the issue of researcher bias. There were two sets of interview schedule - one for food vendors, and the other set for the regulatory agencies. The questionnaires were administered to ascertain the role played by regulatory agencies to ensure food quality; a questionnaire was also developed to investigate the specific roles played by each of the agencies involved. The other intention was to verify responses given by the food vendors and vice versa.

Cooked food samples were obtained from vendors in the morning and in the evening and sent to the laboratory for analysis to find out the level of contamination and to help establish the relationship between sanitation of a food premise and the safety of the food produced. Photographic records of vending areas and fungal growth on petri plates were also used as part of the data. The following ten common cooked food items were obtained from the study area: (stew, salad, macaroni, fufu with light soup, kenkey with stew and waakye); ‘Waakye’ that is rice and beans boiled together; ‘Fufu’ (boiled and pounded mixture of cassava and plantain); Fufu soup; Kenkey; and Macaroni.

2.3 Microbial quality of foods test

2.3.1 Preparation of media

2.3.1.1 Brilliance E. coli/Coliform Selective Agar

Twenty eight point one (28.1) grams of Brilliance E. coli were dissolved in 1L distilled water. It was autoc1aved at 121°C for fifteen minutes. It was cooled to approximately 50°C, mixed well and poured into Petri dishes.

2.3.1.2 Plate Count Agar

Seventeen point four (17.4) grams of tryptone were dissolved in 1L distilled water. It was dissolved by boiling with frequent stirring, mixed and nine millilitres aliquots were dispensed into screw-capped bottles and autoc1aved at 121°C for fifteen minutes.

2.3.1.3 Nutrients agar

Blood agar 40 grams and 1L distilled water were used. Ten percent (10%) sheep blood were thoroughly dissolved in the distilled water by heating over a water bath. The dissolved medium was divided into 200ml portions and put into 500ml conical flasks, plugged with non-absorbent cotton wool and autoclaved at 121°C for fifteen minutes and poured into Petri dishes and allowed to cool to approximately 50°C.

2.3.1.4 Potato Dextrose Agar

Thirty nine (39) grams of the medium were dissolved 1L of distilled water. The powdered medium was thoroughly dissolved in the distilled water by heating. The pH was corrected to 5.8 at 25°C. Two hundred millilitres portions of the medium were dispensed into 500ml conical flasks, plugged with non-absorbent cotton wool and autoclaved at 121°C for fifteen minutes.

2.3.1.5 Salmonella Shigella agar

Salmonella Shigella agar 46g; water lL were used in preparing the media. It was dissolved by boiling with frequent stirring for a minute. It was not autoclaved.

2.3.1.6 MacConkey agar

MacConkey agar (Merck brand), 40g; water lL were used. MacConkey agar was suspended in the water to soak for fifteen minutes and simmered to dissolve. Two hundred milliliters was dispensed into 500ml conical flasks, plugged with non-absorbent cotton wool and autoc1aved at 121°C for fifteen minutes.

2.4 Preparation of samples for plating

Ten grams of food sample were weighed and macerated in a sterile bottle containing 90ml of sterile peptone water to obtain a 1:10 dilution. Further, a tenfold serial dilution of up to 10^{-4} of the mixture were made and examined by means of the pour plate method.

2.4.1 Plating of food samples

One millilitre aliquot of the 10^{-4} of dilution was placed into petri plates and ten millilitres of molten media added, rnixed well and allowed to set. There were three replicate petri plates for each food sample, using nutrients agar (for bacteria), potato dextrose agar (for fungi) and MacConkey agar (for enterobacteria).

2.4.2 Incubation and recording of results

Petri plates of nutrient agar were incubated at 30°C for twenty-four hours; Potato Dextrose Agar petri plates was incubated at room 29° ± 3°C temperature for five to seven days whilst petri plates of MacConkey agar were incubated at 30°C for twenty-four hours. Total bacterial counts were made by means of plate count agar (Oxoid CM463). Counts of Enterobacteriaceae, Staphylococcus aureus, and Bacillus cereus were made using violet red bile lactose agar (Oxoid CM107), Baird–Parker agar (Oxoid CM275) and B. cereus selective agar (Oxoid CM617 and SR99), respectively.
Microbial growth and load on selected food samples was also determined and analyzed to buttress some of the observations made. After appropriate incubation, dilutions with 30–300 colonies were selected and counted. Colony forming units were recorded for bacteria on nutrient agar, enterobacteriaceae on the MacConkey agar and fungi on Potato Dextrose Agar.

3.0 Results

The socio-demographic characteristics of the study were obtained from the 120 food vendors. Out of this, females formed 85% and 15.0% were males. On food preparation, 57.5% of the respondents prepared the food at home and then transported it to the vending site, 41.7% also prepared the food at the vending site while 0.8% of them took the food from a mass producer (Table 1). On food handling practices of vendors, the results indicated that, 42.5% handled the food with their bare hands, 10.0% used a hygienic way of handling the food with gloves and 47.5% covered their hands with a polythene bag (Table 2). Table 3 reveals a significant association between level of education and means of conveying food to vending site, training on food preparation, type of food sold, frequency of medical examinations, source of water for cooking, mode of water treatment, action on leftover, cleaning of hands before touching food, action on hair when cooking and mode of washing plates.

3.1 Hygiene practices observed by food workers

Table 1: Food Hygiene Practices observed during food preparation

Variable	Category	Frequency	%
Place of preparation of food	At home	69	57.5
	At the vending point	50	41.7
	Taking from mass producer	1	0.8
Source of water for cooking	Well	21	17.5
	Borehole	8	6.7
	standing pipe	88	73.3
	Stream/pond/dugout	1	0.8
	Rain harvest	2	1.6
How water used for cooking is treated	No treatment	102	85.0
	Boil	11	9.2
	Allow it to stand for sometime	5	4.2
	Filter	2	1.6
Duration of prepared food items ahead of service	30 - 60 minutes	54	45.0
	Above 1hr	14	11.7
	Less than 30 minutes	23	19.2
	Not sure	27	24.1
How prepared food is kept before service	In warmers	32	26.7
	In the pans on fire	38	31.7
	In pans but not on fire	37	30.8
	In a glass container	13	10.8
Wound during food preparation	Yes	87	72.5
	No	33	27.5
How wound was managed	Covered it and worked	73	60.8
	Did not work at all	16	12.4

Table 2: Food handling practices during serving

Variable	Category	Frequency	%
How do you handle cooked food	with bare hands	51	42.5
	With gloves	12	10.0
	Any other (with polythene bag on my hand)	57	47.5
Items used for serving food	Earthenware bowls	24	20.0
	China plates	7	5.8
	Melamine plates	13	10.8
	Plastic plates/bowls/cups	90	75.0
	Stainless steels	15	12.5
	Ceramics	6	5.0
	Calabash	6	5.0
	Leaves	5	4.2
	News prints	9	7.5
	Polythene	114	95.0
Cleaning of hands before touching food	Yes	67	55.8
	No	53	44.2

One traditional way of serving food was identified in this modern technological world which is the use of some specific leaves of plants. This method was found to have been represented by 4.5% of the vendors sampled. Vendors (7.5%) were also found to be using newspapers in serving food. Polythene bags popularly known as "Take away rubbers" was the commonest means of packaging food found among almost all the vendors.

3.2 Possible sources of food contamination

Contamination of food is associated with unsanitary conditions, poor food handling practices and poor personal hygiene of food handlers.

3.2.1 Level of education of vendors to the hygienic practices

Table 3: Chi-square computations between level of education and sources of possible contaminations

INDICATORS	Chi-Square Value (X^2)	Degree of Freedom (df)	P-Value
Level of education * means of conveying food to vending site	28.800	12	0.004
Level of education * Training on food preparation	17.090	4	0.002
Level of education * Type of food sold	52.689	44	0.173
Level of education * Frequency of medical examinations	37.367	24	0.040
Level of education * source of water for cooking	14.882	20	0.783
Level of education * mode of treating water	21.044	16	0.177
Level of education * Action on Leftover food	28.312	16	0.029
Level of education * Cleaning of hands before touching food	8.641	4	0.017
Level of education * Action on hair when cooking	30.863	16	0.014
Level of education *mode of washing plates	36.103	16	0.003
Level of education * Mode of keeping plates	52.759	16	0.000
Level of education * Regularity of washing napkins	7.368	12	0.832

There was enough evidence to reject the hypothesis that level of education, vending site, training on food preparation, type of food sold, frequency of medical examinations, source of water for cooking, mode of water treatment, action on leftover, cleaning of hands before touching food, action on hair when cooking and mode of washing plates, is independent since the p-value is less than 0.05 (X^2 = 28.800 and p-value = 0.000; X^2 = 17.090 and p-value = 0.001, X^2 = 52.689 and p-value = 0.000 and X^2 = 37.367 and p-value = 0.000). The table also reveals a significant association between level of education and frequency of medical examination, effectiveness of vendors in a particular locality.

3.2.2 Knowledge of vendors on diseases

Table 4: Multiple regression computation between Level of education against knowledge of diarrhoea and knowledge of catarrh

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.280[a]	0.079	0.063	1.071

a. Predictors: (Constant), Knowledge of cold (Catarrh), Knowledge of diarrhoea disease

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.446	2	5.723	4.992	0.008[a]
	Residual	134.146	117	1.147		
	Total	145.592	119			

a. Predictors: (Constant), Knowledge of cold (Catarrh), Knowledge of diarrhoea disease

b. Dependent Variable: Level of Education

Coefficients[a]

	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1 (Constant)	3.324	.457		7.268	0.000	2.418	4.230
Knowledge of diarrhoea	-0.632	0.202	-0.284	-3.135	0.002	-1.031	-.233
Knowledge of catarrh	-0.053	0.236	-0.020	-0.223	0.824	-0.519	0.414

a. Dependent Variable: Level of Education

A multiple regression test was run to predict the dependent variable being: Level of education from the independent variable or Predictors: (Constant), Knowledge of cold (Catarrh) and Knowledge of diarrhoea disease. The table depicts an appreciable level significance based on the following indicators **F (2, 117) = 4.992, P<0.05, R^2 = 0.079.** All two variables significantly added to the prediction of P<0.05.

3.3 Describing the microbial qualities of ready to eat foods

Total Plate Count (TPC), or Standard Plate Count (SPC), represents the total bacterial load in a given sample. It is a test to detect all viable microorganisms that could grow aerobically on plate count agar (PCA) and potato dextrose agar (PDA) at appropriate incubation condition (usually 37°C, 48hrs). The values obtained for cfu/g of food were transformed into $\log_{10}$ values. Foods were classified as having no-to-low risk of transmitting pathogenic bacteria if the total count was less than 5.0 $\log_{10}$ cfu/g and if the counts of Enterobacteriaceae, *B. aureus* and *S. aureus* were less than 3.0 $\log_{10}$ cfu/g.

Table 5: Microbial loads of food samples

Sample	Total aerobic count	Total coliform count	Total fungal count
Salad	**TNTC**	**64**	**4**
Kenkey stew	**TNTC**	**9**	**5**
Waakye stew	**31**	**1**	**2**
Raw waakye	**TNTC**	**6**	**TNTC**
Fufu soup	**7**	**17**	**15**
Macaroni	**21**	**31**	**TNTC**
Fufu	**TNTC**	**22**	**TNTC**
Kenkey	**44**	**16**	**3**

Table 6: Colonial counts of microorganism in PDA and PCA

PDA	PCA		
Food Item	**Amount**	**10^{-1}**	**10^{-2}**
Salad	TNTC	TNTC	67
Macaroni	**31**	**23**	**3**
Fufu	**0**	TNTC	TNTC
Waakye	**0**	**0**	**0**
Light soup (meat)	**0**	**5**	**0**
Kenkey	**0**	1	0
Kenkey stew	TNTC	21	14
Waakye stew	**1**	4	1
Fried fish	**0**	0	0

Table 7: Mean $\log_{10}$ cfu/g (ml) ± standard deviation

Food Item	Frequency (n)	Total counts	Enterobacteriacea
Salad	10	5.34 ± 1.35	4.7±1.22
Macaroni	12	5.54.0±1.64	4.6±1.73
Fufu	10	4.2±1.57	4.2±1.56
Waakye	**10**	5.4±1.80	1.0±1.43
Light soup	**8**	0.3±0.88	<1
Kenkey	**11**	4.6.8±1.69	0.3±1.30
Kenkey stew	**9**	3.0±2.20	0.8±1.70
Fried fish	**8**	2.1±2.04	2.0±2.24

The table shows that the microbial quality of most foods was within acceptable limits, i.e. <5.0 $\log_{10}$ cfu/g for total counts, <3.0 $\log_{10}$ cfu/g for Enterobacteriaceae. In the total counts only salad, macaroni and "waakye" exceeded their acceptable limits. In the counts of enterobacteriaceae Salad macroni and fufu exceeded the normal microbial quality of <3.0 $\log_{10}$ cfu/g.

Table 8: *Enterobacteriaceae* isolated from foods

Food item	Bacteria and fungi isolated
Macaroni	*Shigella sonnei, Pseudomonas fluorescens/putida, Klebsiella pneumonia, Enterobacter sakazakii, Citrobacter freundii, Serratia liquefaciens, Enterobacter cloacae, Enterobacter agglomerans, Citrobacter diversus/amalonatica, Citrobacter spp*
Salad	*Pseudomonas aeruginosa, S. liquefaciens, E. sakazakii, E. cloacae, P. fluorescens/putida, C. freundii, E. coli, C. diversus/amalonatica*
Kenkey	*Pseudomonas sp., E. cloacae, K. pneumonia, Sterile mycelium, Aspergillus flavus*
Kenkey stew	*C. freundii, E. sakazakii, E.coli (enteroaggregative localized)*
Raw waakye	*E.coli (enteroaggregative diffuse), P. fluorescens/putida, Enterobacter, Acinetobacter sp., Erwinia sp., E. cloacae*
Waakye stew	*Klebsiella cloacae, K.. pneumoniae, E. cloacae, E.coli*
Fufu	*C. diversus, E. cloacae, E. sakazakii,* • Fungal isolated included *Aspegillus niger, Penicillium citrium,* yeast, *Clasdosporium herbadum, herbarum, Aspegillus* sp and *Fusarium sp.*
Light soup (meat)	*Salmonella arizonae*
Fried fish	*C. diversus, E.coli, C. luteola, P. Fluorescens putida, E. sakazakii, C. diversus/amalonatica,*

4.0 Discussion of Results

4.1 Hygiene practices observed by food workers

The vendors prepared the food at home on the average and conveyed to the vending point under unattractive conditions by means of public transport. From the place where the food is prepared, to the conveyance of the food to the sales point, there is the possibility of pathogenic microorganism getting into the food. The food is sold in the open usually by the roadside, in the middle of public places, markets and lorry stations. Openly displayed items like fried fish cannot be spared the presence of germs. It is disturbing to see clients standing right to bargain for such foods. During bargaining, there is a passage of saliva onto food which brings onto the food a load of microbial substances. The findings of the present study agreed with previous studies Mensah *et al.* (2002) and Barro *et al.* (2006) which indicated that the traditional processing methods that are used in preparation, in appropriate holding temperatures and poor personal hygiene of food handlers are some of the main causes of contamination of street-vended food. Vendors who use napkins washed them daily in cold water and detergent without disinfectant. Napkins were also not ironed and utensils were not sterilized. A few, however, claimed that they rinsed the plates in hot water. This finding is parallel to FAO (2011) which reported that hot water was never used for cleaning utensils ·and equipment and dishes. Mothers handling their babies and removing their diapers may not wash their hands before serving a client with food. This is what Fairman and Yapp (2013) termed as food service workers coming to the workplace with their own ways of doing things owing to their belief system and living standards. It is also very common to see food vendors using their bare hands to collect and exchange money whilst using the same hand to serve other clients. This can easily transfer whatever microbes present on the money to the food and the unsuspecting buyer would be the worst affected.

4.2 Microbial qualities of ready to eat foods

Ready to eat foods and food preparation surfaces may be reservoirs for microbial contamination. This finding conforms to the studies by Mankee *et al.* (2005); Ghosh *et al.* (2007) and Christison *et al.* (2008). Pepper sauce may be contaminated from bowls in which they were served and more because the bowls were uncovered. “”Fufu was also probably contaminated during pounding and the turner’s hands. This finding is line with the study by WHO (2009) and Mensah *et al.* (2002) that street foods can also be sources of several groups of enteropathogens. There was also unacceptable contamination of “waakye”. The possible high contamination of “waakye” might have occurred during the process of transferring them from the cooking vessels into another bowl. These foods were normally scooped with the hand and at times broken into smaller particles with the fingers. The waakye contained a high fungal colony counts. This finding is also similar to the report by FAO (2006) that street foods in some African countries have various microorganisms of public health concern, including faecal coliforms.

Macaroni and salads carried the greatest risk of transmitting diarrhoeal pathogens. Serving was performed using bare hands as this food was slippery and the use of a spoon or fork might have been difficult. The high levels of contaminants in salads were not unexpected. 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 and Sunyani is no exception. The scooping of rice and waakye into bowls or polythene bags was a major influence in the contamination of these foods. *Staphylococcus aureus* are present on human hands and other parts of the skin, sores, spots, etc., nose and throat (Foskett *et al*., 2003). Therefore using the bare hand to dish out food increases the susceptibility of the food to contamination by *S. aureus.* Soups and sauces appeared to be contaminated with *E. coli*, which were isolated from tomato stew and shito.

4.3 Possible Sources of Contamination

4.3.1 Level of education of vendors to the hygienic practices

According to the chi-square table the possible sources of contamination of ready to eat foods has a significant association between level of education and means of conveying food to vending site or to the point of sale, training on food preparation, type of food sold, frequency of medical examinations, source of water for cooking, mode of water treatment, action on leftover, cleaning of hands before touching food, action on hair when cooking and mode of washing plates.

Thus, the researchers have enough evidence to reject that level of education, vending site, training on food preparation, type of food sold, frequency of medical examinations, source of water for cooking, mode of water treatment, action on leftover, cleaning of hands before touching food, action on hair when cooking and mode of washing plates, is independent since the p-value is less than 0.05 (X^2 = 28.800 and p-value = 0.000; X^2 = 17.090 and p-value = 0.001, X^2 = 52.689 and p-value = 0.000 and X^2 = 37.367 and p-value = 0.000). The table also reveals a significant association between level of education and frequency of medical examination, effectiveness of vendors in a particular locality.

In view of that, the researchers have enough evidence to fail to reject that level of education, vending site, training on food preparation, type of food sold, frequency of medical examinations, source of water for cooking, mode of water treatment, action on leftover, cleaning of hands before touching food, action on hair when cooking and mode of washing plates. Since the p - value is less than 0.05 (X^2 = 14.882 and p-value = 0.783; X^2 = 21.044 and p-value = 0.177, X2 = 28.312 and p-value = 0.029). Poor perceived quality of microbial content of ready to eat foods, lack of education on the part of vendors were however not found to have association with the microbial quality of ready to eat foods.

4.3.2 Knowledge of vendors on diseases

A basic hygienic practice in the reduction of diarrhoea in developing countries is washing of hands. Diarrhoea and cholera statistics (Ministry of Health, 2009), indicate 3,693 and 221 respectively. From the annual report of the Sunyani Municipal Hospital (2008) However in this study, the knowledge of vendors on this but very common disease was sought for and was found out that there is a significant test of association ($P<0.05$) of diarrhoea to level of education. Catarrh (Cold), as one of the diseases highlighted by this study was found to have statistical significance with level of education a

strong determinant. With ($P<0.05$), from the multiple regression, with have a strong evidence to say that vendors consciously or unconsciously

5.0 Conclusion

Out of the ten samples from the selected areas, Mesophilic bacteria were identified in all food samples (100%), and fungi and enterobacteriaceae were found in 1 (11.1%) and 8 (88.7%), respectively. Generally, the microbial quality of most foods was within the acceptable limits for total counts and enterobacteriaceae. In the total counts, only salad, macaroni and "waakye" exceeded their acceptable limits. In the counts of enterobacteriaceae, salad, macaroni and fufu exceeded the normal microbial quality of $< 3.0\log_{10}$ cfu/g. Also, 33.3% of the samples collected from food vendors showed positive for *E. coli.*

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