Assessment of food hygiene practices by street food vendors and microbial quality of selected foods sold.

A study at Dunkwa-On-Offin, Upper Denkyira East municipality of the Central Region.

by

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MASTER OF SCIENCE IN HEALTH EDUCATION AND PROMOTION

NOVEMBER, 2014
DECLARATION

I hereby declare that this project work is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

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The Head of Department  Signature  Date
ABSTRACT

Globally, the estimated amount of food found to be contaminated from street vendors particularly in developing countries is on the ascendancy. It is however unclear, the contribution unhygienic practices make to food contamination. This study sought to assess knowledge and practices of food vendors as well as the microbial quality of selected food sold by street food vendors in Upper Denkyira East Municipality in the Central region of Ghana.

The study was cross sectional and systematically recruited 423 food vendors using a systematic sampling method. A structured questionnaire was administered and an observational checklist was used to gather data on the environmental and personal hygiene status of food vendors. Data collected on 423 respondents were entered into an SPSS version 16.0 software, edited and subsequently used for multivariate analysis. The Student t-test was used to compare continuous variables and the Pearson Chi-square test for discrete variables. Logistic regression was done to establish association between variables and food contamination.

This study among other findings showed that there was a statistically significant association between considerations for choosing food stuff, where food is prepared, medical examination of food vendors, constant supply of water, use of food additives and microbial quality. There was also a significant association between place of storing cooked food, frequency of washing eating plates, frequency of changing water for washing plates and microbial quality. It was also observed that 84.0% of food vendors used the same hands to serve and collect money, 30.3% had not been given certificate to sell and 89% used their bare hands to serve or dish out food. The study revealed that of the 216 food samples collected, fecal coliforms were isolated in 128 (59.3%),
*Escherichia coli* in 90 (41.7%), *Salmonella typhi* in 26 (12.0%) and *Staphylococcus aureus* in 134 (62.0%).

The study confirmed that there was a problem with contamination of street foods within Dunkwa-On-Offin and regular training and medical examination of street food vendors within the municipality should be done to ensure food hygiene.
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- Study participants
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- the Ghana Standard Authority –Accra office
- Upper Denkyira East -Environmental Health Officers
- the KATH Research Unit
- the Laboratory Technicians at the Biological Science Department of Kwame Nkrumah University Technology
DEDICATION

This study is dedicated to my supervisor, Dr. Ellis Owusu-Dabo for providing me with the support and encouragement to complete the research work. I wish to gratefully thank the Lord God for all His blessings, generosity and mercy upon me.
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<tr>
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<tr>
<td>CDC</td>
<td>Centers for Disease Control</td>
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<tr>
<td>CPHP</td>
<td>Centre for Public Health Practice</td>
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<td>EHP</td>
<td>Environmental Health Practitioner</td>
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<tr>
<td>FAO</td>
<td>The Food and Agriculture Organization</td>
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<td>GHS</td>
<td>The Ghana Health Service</td>
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<td>GSA</td>
<td>The Ghana Standard Authority</td>
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<tr>
<td>HACCP</td>
<td>Hazard Analysis &amp; Critical Control Point</td>
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<td>HAM</td>
<td>Health Action Model</td>
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<tr>
<td>JHS/SHS</td>
<td>Junior High School/ Senior High School</td>
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<td>KAP</td>
<td>Knowledge, Attitude &amp; Practices</td>
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<tr>
<td>MOH</td>
<td>The Ministry of Health</td>
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<td>NGO</td>
<td>Non Governmental Organizations</td>
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<td>SFVs</td>
<td>Street Food Vendors</td>
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<tr>
<td>SPSS</td>
<td>Statistical Package for Social Solutions</td>
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<tr>
<td>UDE</td>
<td>Upper Denkyira East</td>
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<td>WHO</td>
<td>The World Health Organization of the United Nations</td>
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CHAPTER ONE

Introduction

"Tell me what you eat, and I will tell you what you are." (Brillat-Savarin, 1755). Food is a basic necessity of life without which man cannot survive. The total life of an individual from development to productivity and whether a person becomes ill or healthy depend on what he/she eats. Dr. Edith Clarke of the Ghana Health Service (GHS) puts it that, ‘the accessibility and availability of safe food is a basic human right. In addition to this, it leads to an improvement in the health of people, contributes to productivity and provides an effective basis for development and poverty alleviation (Clarke, 2005)’.

Industrialization, economic hardship and crave for money have resulted in people spending less time at home. This has led to many people eating mostly from street food vendors. Professor Patience Mensah, the Regional Advisor on food safety at the WHO Regional office for Africa also shares this view when she said “there’s a shift towards eating food prepared outside the home. Some people view it as a mark of affluence (WHO, 2006)”. This has made the food vending industry increase tremendously in terms of numbers. Apart from meeting the food demand of people, the food vending industry also offers a significant amount of employment often to persons with little education and training (FAO, 1997).

All kinds of food are sold by food vendors, presenting the options for variety and choice for customers. Foods sold by these food vendors have significant nutritional implications (nutritionally balanced diets, sufficient in quantity and quality) (FAO 1997).
According to studies done in Africa on food vending, their tremendous unlimited and unregulated growth has placed a severe strain on city resources, such as water, sewage systems and interference with the city plans through congestion and littering that adversely affect daily life.

It has been further stipulated that food vending raises concerns with respect to their potential for serious food poisoning outbreak due to improper use of additives, the presence of adulterants and environmental contaminants as well as improper food handling practices among food vendors. Some food vendors are often untrained in food hygiene and sanitation and work under crude unsanitary conditions (FAO 1996).

1.1 Statement of problem

The issue of food hygiene covers a broad area including the selection and handling of raw foodstuffs, personal hygiene of food vendors and sanitation of place of cooking, waste management and treatment of leftovers as well as prevention of contamination. It is an undisputable fact that every food can cause illness if it is contaminated with harmful microorganisms. It is a fact that there are always microorganisms in the environment. Food is therefore likely to be contaminated at every stage of its preparation and serving. This statement stands true considering the preparation of food for sale in open spaces.

Food safety has been declared a global concern and an increasing public health concern by international agencies such as the FAO (Food and Agriculture Organization) and the WHO (World Health Organization). However, the exact number of food poisoning and food borne diseases is not known since most incidences are not reported. It has been estimated that food and waterborne diarrheal diseases are leading causes of illness and death in less develop countries killing an approximately 1.8 million people annually.
(WHO, 2002). Thus, have the potential of seriously damaging the health status of the population and simultaneously creating an enormous social burden on the communities and their health system.

Most people go along way at home to protect themselves from food related threats. They practice proper refrigeration, wash fruits and vegetables among others. However, no matter how many precautions are put in place, food is vulnerable to contamination. The more food is handled, the more the opportunity for contaminants to be introduced. As many people eat more and more food prepared and sold outside their homes, they increase their risk of exposure to bacteria. It has recently been discovered that the food vending industry has become a greater contributor to the illness problem (Magee, 2007). The morbidity trends from food-related illnesses in Ghana reveal that “two of the food related illnesses reporting to health facilities namely diarrhea among children and tuberculosis in adults are among the five leading causes of death” (Clarke, 2005). Any ignorance or carelessness on the part of the handler would lead to the spread of infectious micro-organisms, such as Escherichia coli, Salmonella typhi, and Vibrio cholerae.

Poor food hygiene practices by food vendors can have a lot of effects on a substantial number of people who patronize their services. Talk of the spread of faeco-oral diseases like Typhoid fever, Cholera among others and the amount that the government and individuals spend on the treatment of these diseases. “Food, not water, is the source of most causes of diseases in developing countries. Most illnesses are due to preventable errors in food selection. In 1996, WHO recommended that member countries should ensure that street food vending is regulated and that measures are taken to ensure the education of street food vendors in hygienic food preparation principles (WHO, 1996).
The risks of illness may be reduced by taking measures to minimize contamination which may occur during preparation in the kitchen, transporting or during storage” (FAO, 2004, P1). Street foods are readily available, inexpensive, nutritionally-balanced and also provide a source of income for the food vendors (Dawson and Canet, 1991; Ekanem, 1998; Swanepoel et al., 1995).

Despite these benefits, concerns have been raised about their safety and quality because most of the vendors lack training in basic hygienic food practices concerning raw material acquisition, food preparation, storage, handling, and final delivery to the consumer (Moy et al., 1997; Bryan et al., 1988).

It is against this background that this study was conducted in Dunkwa-On-Offin to

1. assess the microbial content/quality of food sold on the various food selling markets (restaurant, mini restaurant, chop bar),
2. evaluate food hygiene knowledge among food vendors
3. observe food hygiene practices among food handlers in Dunkwa-On-Offin, Upper Denkyira East Municipality.

1.2 Research Questions

This research sought to answer the following questions:

- What is the estimated proportion of food vendors who have been trained in food safety?
- Does food sold by food vendors in Dunkwa-On-Offin actually contain disease causing microbes?
- What are the preventive measures of food vendors in Dunkwa – On- Offin with respect to food contamination?
Do food vendors appreciate the importance of personal hygiene such as hand washing, neat environment and food hygiene practices?

1.3 Main objective
This study was to investigate the microbial content of street food and hygiene practices among food vendors in relation to the food they sell.

1.4 Specific objectives
Specific objectives of the study were to;

- Assess the relevant background of street food vendors of Dunkwa –On- Offin.
- Assess proportion of food vendors who have been trained in hygienic food preparation.
- To identify means by which food got contaminated from cooking, selling till consumption.
- Observe the environmental conditions under which foods were being prepared and served.
- To determine the microbial quality of some selected foods sold by food vendors.
1.5 Conceptual Framework

Source: Author’s design of conceptual framework

1.6. The significance of the study

This study would:

- Contribute to knowledge especially in the dimension of Community Health.
- Influence policy decision regarding the regulation of food vending in the Upper Denkyira East Municipality.
- Help improve upon the quality of food sold by street vendors in the Upper Denkyira East Municipality.
- Help streamline food vendors activities in the Upper Denkyira East Municipality.
CHAPTER TWO

Literature review

All over the world, handling of street food is a major concern due to the number of people the industry serves and the fact that various researches work such as Rheinlander (2012), Nigusse and Kumie, (2012), etc into the microbial quality of these foods sold to these large numbers are increasingly becoming unfavorable to its patrons. The only way to reduce microorganisms in food to safe levels is to cook it to the required minimum internal temperature (Guilford County Department of Public Health, 2011). While cooking can reduce microorganisms, it will not destroy the spores or toxins they may have produced. For this reason, it is critical to handle food safely before it is cooked.

In this part of the report, various aspects will be reviewed, including contamination sources and routes, as well as how the quality assurance systems in general are used to ensure safe, wholesome and nutritious food. Also the current methods used to monitor hygiene in food processing establishments will be briefly reviewed.

2.1 Microbial quality

For decades and through various evolutions man has always made efforts to avoid diseases and find ways to cure existing ones in order to improve and prolong life. Various diseases have led to the loss of human life irrespective of age. Diseases especially those caused by our daily intakes and activities, such as food and hygiene, continue to be a threat to human health and life. It is obvious and globally acclaimed that unhygienic food and other forms of contamination of our daily consumables have led to the death of millions of people throughout the world, especially in Africa where lack of education, poverty, poor public health policies, lack of qualified personnel, poor
financing health system among other reasons have left Africa and for that matter Ghana at the mercy of every outbreak from unhygienic food (Dun-Dery, 2012). There should therefore be a paradigm shift from looking for food diseases to cure, to what the diseases are and how they are caused.

Globally, it is accepted and noticed that contaminated food and water causes serious health hazards to human and even animal life. It is therefore not surprising those diseases such as cholera, diarrhea, typhoid and hepatitis exist and are of great concern to public health professionals especially in West Africa where access to quality education on hygiene is merely a dream, especially for food vendors. Unclean, insufficiently or inadequately cleaned cooking equipment have been identified as a source of bacterial contamination in processed food. Containers, pumps or tanks used for holding or transporting unprocessed raw materials, have occasionally been used for processed products without any cleaning and disinfection. It is therefore necessary that equipment in the processing establishment, coming in contact with food, be constructed in such a way as to ensure adequate cleaning, disinfection and proper maintenance to avoid the contamination.

Transfer of microorganisms by personnel particularly from hands, is of vital importance. During handling and preparation, bacteria are transferred from contaminated hands of food workers to food and subsequently to other surface (Samakupa, 2003). Low infectious doses of organisms such as Shigella and pathogenic *Escherichia coli* have been linked to hands as a source of contamination (Snyder, 1998). Poor hygiene, particularly deficient or absence of hand washing has been identified as the causative mode of transmission.
Way side canteens and other food vendors undoubtedly are one of, if not the main source of contaminated food. In Ghana it is not uncommon to notice that most health centers are filled with patients of various ages suffering from different food related diseases. Contaminated or unhygienic food can lead to various complications and diseases.

From the food vendors' perspective, the variety, quality, preparation of foods and services are meant to just satisfy the needs of the consumer and not to waste resources and run at a loss. Street food vendors are known to contribute a significant amount of money to the economy. Dr. Paa-Nii Johnson, Head of Processing and Engineering Unit of the Food Research Institute, told the Ghana News Agency that the socio-economic survey of 334 vendors and a mini census indicated that street-vended foods made an important contribution to the economy of Accra. The street foods sector employs more than 60,000 people with an estimated annual turnover of about 100 million dollars and a profit of 24 million dollars (Agyei-Takyi, 2012).

A study conducted by Rheinlander (2012) found that although vendors and consumers demonstrated basic knowledge of food safety, the study did not emphasize on basic hygiene practices such as hand washing, cleaning of utensils, washing of raw vegetables, and quality of ingredients. Instead, four main food selection criteria could be identified and were related to (1) aesthetic appearance of food and food stand, (2) appearance of the food vendor, (3) interpersonal trust in the vendor, and (4) consumers often chose to prioritize price and accessibility of food—not putting much stress on food hygiene. Hence, consumers relied on risk avoidance strategies by assessing neatness, appearance, and trustworthiness of food vendor. (Rheinländer, 2012)
The study by Rheinländer, (2012) did not consider factors such as hand washing, washing of raw material and cleaning of utensils. This gap in their study is being taken care of as hygiene practices such as food vendors hand washing, and cleaning of utensils behaviors are considered in this study at Dunkwa-On-Offin.

In 1984, a joint FAO/WHO Expert Committee on Food Safety, in its report on the role of food safety in health and development, noted that: "It is not easy to maintain control over food handlers. There is often a rapid turnover and it may be difficult to keep track of them. Medical examinations are costly and do not guarantee the detection of more than a small proportion of carriers of pathogenic organisms. Also infections may occur after the examinations. Screening for pathogens in stool specimens from food-handlers is not cost-beneficial and is not recommended, and the identification of a carrier is not likely to make a significant contribution to the control of food borne diseases. A much more effective preventive measure, the education of food-handlers in hygienic practices, is most often neglected." These views were reinforced in 1987 by the second meeting of the WHO Regional Working Group on Food Safety, held in Kuala Lumpur, Malaysia, which questioned the relevance of the routine medical examination of such personnel.

Despite the conclusions of these meetings, the debate has continued among health professionals and public health authorities on the relative merits, costs and benefits of the health surveillance of food-handling personnel, and there is no uniformity in the procedures adopted by countries in undertaking such surveillance. It is still uncertain as to whether, and under what circumstances, routine medical examinations are cost-effective in preventing or at least minimizing food contamination. This study tried to looking at the various medical examinations that forms the basis for accepting
applicants to into the food vending industry, the number of times of each food vender would have to go through in a year and underscore the importance of going through medical examination.

New food borne pathogens (such as *Campylobacter* spp, *Vibrio cholerae* non-O 1, *Vibrio vulnificus*, *Escherichia coli* 0157:H7 and *Listeria monocytogenes*) have emerged in recent years and their significance needs to be examined in relation to their possible implications for the health surveillance of food handlers. The task of the consultation by FAO and WHO was therefore to review systematically those food borne diseases that may be transmitted by food-handling personnel via food to the consumer, and to determine the kinds of food contamination that can be prevented and the kind of health surveillance of such personnel necessary for the purpose. In view of the great importance of the education of food-handling personnel in preventing contamination of food, the consultation was also requested to consider ways and means of achieving this. This study tried isolating *E. coli* one of the new food borne pathogens in selected foods such as kenkey and pepper, fried rice, waakye, fufu and ice kenkey sold at Dunkwa-On-Offin.

### 2.1.1 The potential of food-handling personnel to transmit diseases via food.

The ability of food-handling personnel to transmit disease is related to the degree of contact that they are likely to have with particular sorts of food. The risks they pose clearly vary widely, which raises the question whether all such personnel should be treated in the same way.

Investigations of outbreaks of food borne disease throughout the world show that, in nearly all instances, they are caused by failure to observe satisfactory standards in the preparation, processing, cooking, storing or retailing of food (Nigusse and Kumie,
Organisms may be introduced into the food chain from a variety of sources, and at different stages. Gastrointestinal pathogens may be derived from animal sources, the environment or, occasionally, from humans (WHO, 1989). Many raw foods, particularly of animal origin, are heavily contaminated with organisms of various kinds and attempts to reduce microbial loads at various stages of production have generally been unsuccessful (WHO, 1989). The elimination of pathogenic organisms therefore depends largely on the correct application of processing technologies, such as pasteurization, irradiation, cooking, freezing and pickling at the industrial, retail and domestic levels. Thus the prevention of outbreaks of foodborne disease depends on the correct application of these technologies, especially in terms of time and temperature control, and on proper storage and the prevention of cross-contamination (WHO, 1989).

2.1.2. Classification of food-handling personnel according to the potential risk

The term food-handling personnel, in its broadest sense, include all those who may come into contact with part or all of an edible end-product at any stage from its source, e. g., the farm, to the consumer. This concept is embodied in the definition contained in the report on the WHO Working Group on Health Examinations of Food Handling Personnel: "... a person in the food trade or someone professionally associated with it such as an inspector who, in his routine work, comes into direct contact with the food itself in the course of its production, processing, packaging or distribution, including producers of raw milk for direct consumption." This definition recognizes that responsibility for the application and control of food-handling techniques extends from management to the consumer. Not all, however, actually come into contact with food; equally, those who do have such contact are not necessarily in a position to transfer pathogenic organisms from themselves to food in such a way that illness might result.
A distinction between those whose work could allow such transfer to occur and those for whom such a risk does not exist is in order.

Those who present a risk of transmitting pathogenic organisms in this way can be defined as persons whose work involves touching unwrapped foods to be consumed raw or without further cooking or other forms of treatment. This category will include people involved in such activities as the preparation of salads, sandwiches, and cooked foods to be served cold, and the handling of cooked meats and meat products and of certain dairy products, including fresh cream and egg-based foods. In the wider context, workers in water-treatment plants should also be included. Street vendors, common in both developing and industrialized countries, also fall into this group, and may present special problems related to their way of life and difficulties in determining whether they have complied with control measures.

The nature of the work that they are to carry out must be taken into account in the assessment of, and training provided to, food handlers. The food that is contaminated is not treated in such a way as to destroy the organisms before they reach the consumer. Either the number of organisms on the food constitutes an infective dose or the nature of the food or its conditions of storage are such as to allow the organisms to multiply and produce an infective dose or to produce toxins in quantities sufficient to cause illness (WHO, 1989).

2.1.3 Excretion of pathogens

Gastrointestinal pathogens are excreted, often in very large numbers, in the acute phase of disease and in decreasing numbers and for variable periods of time during and after convalescence. In some cases excretion starts in the incubation period, as with viral
hepatitis A, and may cease when the major clinical manifestations become apparent. Certain infections, such as typhoid fever, may not manifest themselves clinically at any stage but the organism concerned may be excreted for varying periods of time (WHO, 1989).

There is, therefore, a significant difference between those who are acutely ill from a gastrointestinal infection and carriers who continue to excrete the organism after the clinical illness is over. In the former case, the stools are characteristically loose and frequent, the concentration of organisms may be very high, and the organisms are likely to be easily and widely disseminated. Carriers, on the other hand, have recovered clinically, have normally-formed stools and excrete diminishing numbers of organisms as time passes. The potential risk of spreading organisms widely is clearly very much greater for those who are clinically ill than for carriers. It is therefore imperative for all food vendors to be screened to be able to eliminate the risk of spreading diseases through the food they sell to their patrons. This study sought to find out how comprehensive the medical examination is for food vendors within Dunkwa-On-Offin and also assess avenues through which transmission of these microbes are made possible.

2.1.4 Transmission of pathogens - Environmental hygiene

Primary food production should not be carried out in areas where the presence of potentially harmful substances would lead to an unacceptable level of such substances in food. Potential sources of contamination from the environment should also be considered by food vendors to safe food production. Dangerous microorganisms are widely found in soil, water, animal and people and these microorganisms are carried on
hands, wiping cloths and utensils, cutting boards and the slightest contact of these microorganisms to food can cause food borne diseases (WHO, 2012).

These following points are means of ensuring hygienic environment according to WHO (2010) and FAO (1999):

1. Protection of food and food ingredients from contamination by pests or by chemical, physical or microbiological contaminants or other objectionable substances during handling, storage and transport.

2. Waste must not be allowed to accumulate in food handling, food storage and other working areas and the adjoining environment. Waste stores must be kept appropriately clean.

3. Adequate drainage and waste disposal system and facilities should be provided. They should be designed and constructed so that the risk for contaminating food or the portable water supply is avoided. (FAO, Corporate Document Repository, 1999)

4. Water use for cleaning should be from a safe source or made safe.

5. Wash and sanitize all surfaces and equipment used for food preparation (WHO, 2010).

The hands are the most important vehicle for transfer of organisms from faeces, nose, skin or other sites to food. Epidemiological studies of *Salmonella typhi, non-typhi salmonellae, Campylobacter* and *Escherichia coli* have demonstrated that these organisms can survive on fingertips and other surfaces for varying periods of time, and in some cases after hand-washing (WHO, 1989). Staphylococci may well not be removed from the hands by washing when they form part of the resident flora (WHO, 2002).
The serving utensils used at the vending site are often contaminated with *Micrococcus spp.* and *Staphylococcus aureus spp.*, which may have originated from the vendors hands when they touched the food preparation areas, dishcloths, or the water during dish washing or hand washing which indicates cross contamination between dishwater, food preparation surfaces, and the food itself. It is reported that bacteria from dirty dish washing water and other sources adhere to the utensil surface and can constitute a risk during the food vending process (Rane, 2011).

### 2.1.5 Personal Hygiene

As a consequence of humans also containing microorganisms naturally or from the surrounding environment it is important to maintain an appropriate personal hygiene.

Important hygienic aspects related to Personal Hygiene includes:

1. Food vendors practicing hand washing before handling food and often during food preparation.
2. Food vendors washing hands after going to the toilet (WHO, 2010).
3. Food vendors’ drying hands after hand washing procedure.
4. Food vendors wearing clean protective clothing.
5. Food vendors wearing head covering.
6. Food vendors avoiding wearing of personal effects such as jewelry, watches, pins or other items in food handling areas.
7. Food vendors ensuring that cuts and wounds are covered by suitable waterproof dressings.
8. Food vendors avoiding personal behavior such as smoking, spitting, chewing or eating, sneezing or coughing over unprotected food
Food vendors not handling food if you know or suspect to be suffering from or to be a carrier of a disease or illness likely to be transmitted through food.

(FAO Corporate Document Repository, 1999)

2.1.6 Food and Quality

It is important to take caution when selecting raw materials for food preparation. These raw materials, including water and ice may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in damaged and mouldy foods.

Important hygienic aspects related to Food and Quality includes:

1. Food vendors should select fresh and wholesome foods to prepare food for sale.
2. Food vendors must choose food processed to reduce the risk associated with cooking raw foods for foods.
3. Food vendors should make ice from safe water (FAO Corporate Document Repository, 1999).
4. Food vendors should use safe water or treat it to make it safe (WHO, 2010)

Microbiological analysis of utensils surface and knives have the presence of Salmonella and Shigella (Rane, 2011). It is also reported that during the preparation of food, the raw material is cut and chopped using the same knife without in between cleaning and such knives are often invaded by flies (Rane, 2011).

A study conducted and published in 2011 on street foods: handling, hygiene and client expectations in Cape Coast, Ghana by Annan-Prah et. al. confirms the statement made
above. Handling, vending and hygienic quality of street foods available to local residents, internal and foreign tourists to Cape Coast, the most important tourism hub in Ghana, were investigated. Questionnaires assessed stakeholder commitment to and expectations of food hygiene. Laboratory analysis evaluated microbial contamination levels of the street foods. The study showed that both local residents and tourists, foreign tourists put the hygienic safety as the principal criterion over curiosity and price to patronize street foods. Although licenses had been given to 27 (54%) of the 50 investigated food vendors, only 15 (55.5%) of the licensed vendors had had medical examination (8 only once and 7 annually). Food vending premises visibly needed improvement in sanitation. The foods had the following bacterial contamination levels in colony forming units per gram (cfu/g): meat pie \((1.3 \times 10^5)\), khebab \((5 \times 10^4)\), rice with stew \((4.1 \times 10^5)\), fried fish \((8 \times 10^4)\), pepper sauce \((1.4 \times 10^5)\), etsew or banku \((3 \times 10^5)\), beans with gari \((2 \times 10^4)\), fufu \((1.6 \times 10^5)\) waakye \((6.6 \times 10^5)\) and dakua \((2.3 \times 10^5)\). The presence of *Escherichia coli* of faecal origin was detected in all investigated food samples. Khebab, fried fish and beans with gari had acceptable bacterial contamination levels of <5 log10 cfu/g.

The following major fungi were identified in the street foods: *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus candidus*, *Cladosporium herbarum*, *Necrospora crassa*, *Penicillium citrinum*, *Fusarium*, *Mucor* and yeast species. Yeasts were found in all investigated food items. The street foods were, therefore, found to have threatening unacceptable microbial contamination levels.

Street vended foods are not only appreciated for their unique flavors, convenience and the role which they play in the cultural and social heritage of societies, they have also become important and essential for maintaining the nutritional status of the populations. Besides offering business opportunities for developing entrepreneurs, the
sale of street foods can make a sizeable contribution to the economies of developing countries. In India, the National Policy for Urban Street Vendors/Hawkers stated that street vendors constitute approximately 2% of the population of a metropolis (Indian Street Food Policy, 2004). Street foods are perceived to be a major public health risk due to lack of basic infrastructure and services, and difficulty in controlling the large numbers of street food vending operations because of their diversity, mobility and temporary nature (Rane, 2011). A general lack of factual knowledge about the epidemiological significance of many street vended foods, poor knowledge of street vendors in basic food safety measures and inadequate public awareness of hazards posed by certain foods has severely hampered the deployment of a precise scientific approach to this very serious issue of public health and safety (Rane, 2011).

The epidemiological studies such as Mensah et al. (2002) which suggests that street foods contribute to a significant number of food poisonings are inadequate, due to paucity of data deficiencies in knowledge about important parameters in the food chain and host pathogen interactions; however, there have been several documented cases of food poisoning outbreaks due to street foods. Street foods were responsible for 691 food poisoning outbreaks and 49 deaths from 1983 to 1992 in Shangdong Province (China). FAO has implemented and supported several projects which aimed at improving various aspects of the street food sector in countries like Bolivia, Colombia, Ecuador, India, Zaire, etc. Malaysia, Philippines and India are the three countries which have regulations for protecting street vendors. Malaysia is the only country where licensed street vendors are provided facilities for conducting their trade. An initiative has been taken in Durban, Africa, where a coalition between local and national authorities, explored the food laws associated with street vending and developed strategies that could be used to control identified food hazards.
2.2 Source of food contamination

Simple measures such as washing and peeling the food may reduce the risk of contamination with microorganisms from raw food.

Also, proper cooking kills almost all dangerous microorganism, thus, studies have shown that cooking food to a temperature of 70°C can help ensure it is safe for consumption (WHO, 2006).

Microorganisms can multiply very quickly if food is stored at room temperature. By holding at temperature below 5°C or above 60°C, the growth of microorganisms is slowed down or stopped but some dangerous microorganism will still grow below 5°C (WHO, 2010).

Depending on the nature of the food operations undertaken, adequate facilities should be available for heating, cooling, cooking refrigerating and freezing food, for storing refrigerated or frozen foods, monitoring food temperatures, and when necessary, controlling ambient temperatures to ensure the safety and suitability of food (FAO, 1999).

Important hygienic aspects related to Food Safety as stated in WHO, (2010):

1. Separating raw meat, poultry and seafood from other foods.
2. Using separate equipment and utensils such as knives and cutting board for handling raw foods.
3. Storing food in containers to avoid contact between raw and prepared foods.
4. Washing fruits and vegetables, especially if eaten raw.
5. Removing outer leaves of leafy vegetables.
6. Cooking food thoroughly; make sure that the temperature has reached 70°C.
7. Reheating cooked food thoroughly.
8. Avoid leaving cooked food at room temperatures for more than 2 hours.

9. Refrigerating promptly all cooked and perishable food (preferably below 5°C)

According to WHO, food handling personnel play an important role in ensuring food safety throughout the chain of food production, processing, storage and preparation. Mishandling and disregard of hygienic measures on the part of the food vendors may enable pathogens to come into contact with food and in some cases to survive and multiply in sufficient numbers to cause illness in the consumer. Some food handlers may introduce biological hazards by cross contamination after handling raw materials when they suffer from specific diseases and physical hazards by careless food handling practices (Rane, 2011).

Most of the vendors pack the food in polythene bags for their customers. When packing these foods, they blow air into the polythene bags to open them, in this process a number of pathogens can be passed on to the consumer. WHO (1989) Health surveillance and management procedures for food handling personnel (WHO technical report series, 785. WHO, Geneva, 52 pp).

A study in Santa Fe de Bogota, Colombia showed that over 30% of a group of food handlers examined were carriers of pathogenic microorganism including *Salmonella typhi*, *Staphylococcus aureus*, *Salmonella enteritidis*, and *Shigella* (Buchanan and Whiting, 1998).
An important issue influencing food contamination and contributing to further increase in contamination is food storage temperature. The preparation of food long before its consumption, storage at ambient temperature, inadequate cooling and reheating, contaminated processed food, and undercooking are identified as the key factors that contribute to food poisoning outbreaks. Holding foods at high ambient temperatures for long periods of time have been reported to be a major contributor to the occurrence of food poisoning outbreaks (Rane, 2011). Foods are often held for several hours after cooking and this includes overnight holding at ambient temperatures, until sold, and thus can harbor high microbial populations. Besides, some of the foods are held in the pans in which they are cooked, until sold or reheated, which results in longer holding time, hence creating favorable conditions for the growth of food borne pathogens.

In foods which are held under high ambient temperature, the counts of *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus* and *Clostridium perfringens* are reported to be high (Rane, 2011). *B. cereus* was isolated from 42 (26.3%) samples of fried fish, tuwo, soup, boiled rice and moin moin suggesting that their spores survived the cooking process. The presence of this bacterium coupled with the storage of these foods at ambient temperatures (room temperature) for several hours under high temperature and high relative humidity showed that the product could be hazardous (Rane, 2011). *B. cereus* has been responsible for outbreaks of foodborne illness because it produces heat stable (emetic) and heat sensitive (diarrheal) toxins when foods are held under conducive conditions for several hours (Rane, 2011).

Kaul and Agarwal (1988), reported high microbial count in fruit chat sold by a street vendor in Chandigarh, India where the counts ranged between 106 and 108 cfu/g, and a further increase in count by 1–3 log cycles was observed after 16 and 24 hours of storage at room temperature. A number of pathogens, such as *Escherichia coli*,...
Salmonella typhimurium, Salmonella gallinarum, Shigella dysentriae, Pseudomonas fluorescens and Klebsiella pneumoniae were also found to be present in these samples.

Mensah et.al (2002) conducted a study on the safety of street foods in Accra to purposely investigate the microbial quality of foods sold on streets of Accra and factors predisposing to their contamination. Structured questionnaires were used to collect data from 117 street vendors on their vital statistics, personal hygiene, food hygiene and knowledge of foodborne illness. Findings from the study indicate that most vendors were educated and exhibited good hygiene behavior. Diarrheal was defined as the passage of 53 stools per day) by 110 vendors (94.0%), but none associated diarrhea with bloody stools; only 21 (17.9%) associated diarrhea with germs. The surroundings of the vending sites were clean, but four sites (3.4%) were classified as very dirty. The cooking of food well in advance of consumption, exposure of food to flies, and working with food at ground level and by hand were likely risk factors for contamination. This study by Mensah et.al is similar to this study since the same parameters will be assessed to find out the similarities and differences in factors that affect microbial quality of street foods.

In the same study, examinations were made of 511 menu items, classified as breakfast/snack foods, main dishes, soups and sauces, and cold dishes. Mesophilic bacteria were detected in 356 foods (69.7%): 28 contained Bacillus cereus (5.5%), 163 contained Staphylococcus aureus (31.9%) and 172 contained Enterobacteriaceae (33.7%). The microbial quality of most of the foods was within the acceptable limits but samples of salads, macaroni, fufu, rice balls and red pepper had unacceptable levels of contamination. Shigella sonnei and entero aggregative Escherichia coli were isolated from macaroni, rice, and tomato stew, and Salmonella arizonae from light soup.
In conclusion street foods can be sources of enteropathogens and vendors should therefore receive education in food hygiene. Special attention should be given to the causes of diarrheal, the transmission of diarrheal pathogens, the handling of equipment and cooked food, hand-washing practices and environmental hygiene. The microbiological quality of macaroni and vegetable salads served with waakye, was investigated. Aerobic mesophiles counts (AMC), coliforms counts (CC) and moulds and yeasts counts (MYC) were estimated, and the coliform profiles for different samples of macaroni (raw, local/ imported, laboratory-cooked) served with waakye, and vegetable salads served with waakye were determined. Raw macaroni (local and imported) had AMC of 3.6 and 3.0 log10 CFU/g, MYC of 1.9 and 1.0 log10 CFU/g and no CC, respectively. Laboratory cooked local samples had AMC of 2.4 log10 CFU/g and 3.3 log10 CFU/g (after 4 h storage) and no MYC. Macaroni obtained from vendors had AMC mean of 3.1-8.4, CC mean of 2.5-7.3 and MYC mean of 0-4.1 log10 CFU/g depending on time of sampling. Vegetable salads sampled at early and late morning had AMC of 6.9 and 7.6, CC of 5.7 and 6.4, MYC of 4.9 and 5.4 log10 CFU/g, respectively. Six coliforms were detected on macaroni and three were detected in addition to Salmonella spp. on vegetable salads. No significant difference was recorded in the microbial load of raw local and imported macaroni.

Cooking improved the microbial quality of raw macaroni (AMC of 2.4 log10 CFU/g). Generally, there were increases of 3-5 log cycles in the AMC, CC and MYC in macaroni sampled from waakye vendors in the morning (early and late) compared to those at dawn. Although the nature of raw macaroni and its cooking are adequate, cross-contamination from vegetable salads during the holding and bulk display periods cause deterioration in microbial quality of macaroni in waakye.
A study conducted by Feglo, P. and Sakyi, K. (2008) in Kumasi, Ghana suggest that 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 was 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 particular 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. The mean bacterial counts in these foods expressed to log10 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 log10 CFU/ml. The isolates obtained were Coagulate negative *staphylococci* (23.7%), *Bacillus spp* (21.5%), *Klebsiella pneumoniae* (18%), *Aeromonas pneumophila* (17.7%), *Enterobacter cloaceae* (6.7%), *Staphylococcus aureus* (3.7%), *Escherichia coli* (2.2%) and *Pseudomonas aeruginosa* (2.2%). The conclusion from this was that most ready-to-eat foods selected from Kumasi bus terminals 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.

Street foods are readily available, inexpensive and nutritionally-balanced and also provide a source of income for the vendors (Dawson and Canet, 1991, Ekanem, 1998, Swanepoel et al., 1995). Despite these benefits, concerns have been raised about their
safety and quality because most of the vendors lack training in basic food hygiene practices concerning raw material acquisition, food preparation, storage, handling, and final delivery to the consumer (Moy, Hazzard and Kaferstein, 1997; Bryan et al., 1988).

This study would want to find out whether street food in Dunkwa – On–Offin are also contaminated by these microorganisms since there are similar prevailing characteristics at bus terminal in Kumasi and Dunkwa.

2.3 Food hygiene knowledge and practices

Knowledge of the consequences of unsafe food hygiene practice can enhance adherence to food safety guidelines. Studies on food hygiene have been done across the globe. In Philippines, a survey on food safety knowledge and practice of street food vendors in a university campus in Quezon City was carried out by Azanza, Gatchalian, and Ortega (2000). Topics such as health and personal hygiene of vendors, food manufacturing procedures, food contamination and waste management as well as food legislations were assessed. The study found that among the 54 street food vendors surveyed, knowledge on food safety concepts was established particularly on topics that dealt with health and personal hygiene, food contamination and good manufacturing procedures; however, vendors were shown not to be knowledgeable in food legislation and waste management. A significant gap existed between knowledge and practice on these topics and this primarily attributed to the tendencies of street food vendors to compromise food safety for financial issue. The provision of continuous food hygiene education, some financial assistance through social service affiliation and basic water out waste management utilities were recommended to reduce the gap between knowledge and practices of safe vending on school campuses.
Burt, Volel and Finkel (2003), conducted study to assess the food handling practice of 10 processing mobile food vendors operating in Manhattan, New York City and found out that over half of all vendors (67%) contacted served food with bare hands. Also some vendors were observed vending with visibly dirty hands or gloves and no vendors once washed his or her hands or changed gloves in the 20 minutes observation period, more so, four (4) vendors were observed to contaminate served food with uncooked meat and poultry.

Chukuezi (2010) conducted a study on food safety and hygienic practices at street food vendors in Owerri, Ngira. Data collection was done with help of structured interviews, semi structured questionnaires as well as through observations. A descriptive survey design was used. Results shows that 23.81% of the vendors prepared food in on hygienic conditions, 42.86% did not use aprons, 47.62% handled food with bare hands and 52.38% wore no hair coverings while 61-90% handled money while serving food. In all, 19.05% wore jewelry while serving foods and 28.57% blew air into polythene bag before use. Some (9.52%) of the vendors, stored food for serving openly in the stalls while 23.81% stored then in the wheel barrows. A good number (42.86%) of food vendors had left over’s for serving the next day with poor storage facilities. In all, 47.62% of the vendors washed their utensils with dirty water which is recycled and used severally in 28.57% despite the fact that only 9.52% of them complained of water shortages. The researcher recommends that there is need for health education of those vendors in order to ensure food safety for the consumers.

Muinde (2005) had a study on Hygiene and sanitary practices of vendors of street foods in Nairobi, Kenya. The accessible population was all street food vendors from Dandora and Kayole estates. Data collection was done by using in depth interview schedule and observational checklist. Data was analyzed using both descriptive and inferential
statistics. Results show that 35% of vendors belong to 20-25 years, 60% were males while 40% were females. Slightly over half of vendors (57.5%) were married. In all, 62% of vendors had primary education and below, 36.3% had secondary education while only 1.3% had college education. Most vendors 61% vendors acquired cooking principles by observation, 33.3% were taught by parents while 6.3% gained by trial and error. Based on observation about 85% of vendors prepared their foods in unhygienic conditions given that garbage and dirty waste were consciously close to the stalls, about 92.5% did not have garbage receptacles, hence they dispose their waste just near the stalls. In all, 92% of vendors threw waste water just beside the stalls making the environment surrounding the eaters quite filthy. Hence there is a significant P value > 0.5 indicating that there was no relation between education and state of environment.

Benny –Oliviera (2007) conducted a study on “Hygienic practices by vendors of the street food “doubles” and public perception of vending practices in Trinidad”. A structured questionnaire was administered to 120 street vendors and 115 public members in Trinidad, West Indies. Most vendors are male (61.7%), had been vending for 5 years (81.7%) and received primary level of education (72.5%). Preparation of doubles was mainly by family (84.2%) in the morning of vending (81.7%). Vendors were appropriately dressed (99.2%), used forks/spoons (100%) and tongs (81.7%) for serving. At vending sites, containers with faucets supplied water (85.7%) and toilets were not close (97.5%). Most respondents (86.1%) consumed doubles. Some (30.6%) felt ill from eating doubles, but only 2.7% reported to a medical doctor/health authority. Significant associations were found for vending practices and sanitation of vending environment.
Furthermore, a study conducted in Latin America by Arambulo, Almeida, Gueller and Belotto (1994) on street food vending showed that there was a rapid rise of food vending. It was also found out that the generally unregulated and quasi-clandestine street food industry tended to observe poor hygiene practices which pose significant public health problems. Latin America rice cholera epidemics in this context have drawn increasing attention to street food potential for disease transmission and have created growing support for attempts to resolve these problems. To them this could be achieved through legal reorganization directed at structurally developing the street for food vending and permitting application of measures especially provision and use of safe food. Programmes that would provide appropriate training for inspectors as well as health education for both vendors and consumers of street food, the promotion and adaptation of improved methods for preparing and selling such food were advocated for. This they said may not provide immediate panacea for the street food vending problem in Latin America but can immensely improve the situation that existed at the time. Some studies have been done globally on contamination of street food, to assess microbiological contamination of street food.

Begue, Gonzales, Correa-Gracian and Tang (1997) studied the dietary risk factors, associated with the transmission of *Helicobacter Pylori* in Lima, Peru, in trying to establish the facts influencing the risk of acquisition of *Helicobacter pylori* infection. They sampled one hundred and four children within the age range of 0-17 years requiring an endoscopy for the evaluation of gastrointestinal systems. These children had their demographic and dietary data collected and biopsy specimens of the gastric antrum stained for the identification of *Helicobacter pylori*. They discovered that 52 representing 50% infected subjects were significantly older than the uninfected ones with no difference in gender, crowding, source of drinking water, or exposure to
domestic animals, increased consumption of fish, chicken, beef, beans, vegetables, rice cheese, milk and unboiled water. They concluded that their findings supported the role of food prepared under unhygienic conditions as a probable mechanism of transmission of *Helicobacter pylori* in developing countries.

Also a study carried out by Volland, Ali, Van Asten, Ismid, Widjaja, Visser et al (2004) to assess the risk factors for transmission of food borne illness in restaurants and street vendors in Jakarta, Indonesia sought to explain a previous study in Jakarta which showed that eating from restaurant was not associated with disease. To explain this 128 street food vendors with the food handlers from restaurant were engaged in a cross sectional study. Poor hand washing hygiene and direct hand contact with food, male sex and educational level were independent characteristics of street vendors in logistic regression analysis.

Faecal contamination of drinking water in 65% of samples, dish water in 91% and ice cubes in (100%) was frequent. Transmittable pathogens including *S. Typhi* and *non-typhoid salmonella* were isolated in faecal sample in 13 (7%) vendors. It was established that there is poor food hygiene among food vendors as compared to restaurant vendors. The study recommended that, health intervention to reduce the transmission of food borne illness should include hand washing with soap, adequate food-hygiene and frequent and renewal of dish water in street food truck.

Musa & Akande (2003) carried out a research on food hygiene practices of food vendors in Ilorin Secondary School in Nigeria. The study reveals that among 185 respondents, premedical practice was high 141 (76%) but periodic medical examination was low 30 (16%). More than 61 (33%) and 72 (39%) respondents prepared food in advance and reheated food before sale respectively. The major unhygienic practices
observed among the food vendors were poor care of utensils, 100 (57%) use of previously used water for washing and cleaning, lack of covering apron among food vendors 128 (69%) and lack of hand washing basin for immediate cleaning, lack of soap and water to clean their utensils, while the rest 100 (57%) used unhygienic methods to clean their utensils. Some of the food contaminating risk factors including unclamp finger nails, skin lesions and poor protection from flies. According to the study, the need exist for food vendors and other handlers to be trained in basic principle of safe food handling.

In Kenya, Muinde and Kuria (2005) conducted a study to determine the hygienic and sanitary practices of vendors in Nairobi using a descriptive survey design. A sample size of 80 street food vendors selling commonly consumed food was selected. Most of the food vendors neither underwent any form of formal training in food preparation nor did they attempt to seek it. Moreover, water for washing utensils and hygiene was compromised. Also stalls were poorly constructed. They would not give proper protection of the street food from the dust and smoke from vehicles. Furthermore, vendors observed minimal personal hygiene. It was found out that 81.3% of the vendors did not use apron, 60% handled food with their hair uncovered. All the vendors handled money while serving food and only 10% of them wore jewelry of their hand. Also, utensils were washed using water in buckets which were rinsed only once and the water used repeatedly before it was replaced. The water for washing and rinsing the utensils was observed to be dirty. More so, proper methods of storing leftover food were not used, hence this could have promoted the sale of stale food. Out of the food vendors interviewed, 32.1% reported consuming them and rest saved for the following day’s sale. Vendors stored leftover food in open places (21%) refrigerator (21%) and plastic containers (21%) while 16% kept them either in polythene bags or in cupboards
for sale the next day. Findings also showed that vendors prepared the food either at home or at the stalls, which were located by the road side. These places were highly unhygienic as food vendors deposited their food and waste water beside stalls which rendered the environment dirty and attracted houseflies. Their presence compromised sanitation.

Similarly, Okojie, Wagbatsoma and Ighoroge (2005), also carried out a study to assess the knowledge and practice of food hygiene by food handlers in a Nigerian University. A descriptive, cross sectional study was carried out on randomly selected for handlers operating on the campus. A total of 102 respondents were interviewed and inspected using a structured questionnaire administered by researchers. The study showed that 90 (88.21%) of the respondents were females and these had a predominantly poor level of food hygiene knowledge. The practice of steering and reheating left over was a very low and was practiced by 15 (30.41%) of the respondents, which was a very low frequency of hand washing. Inspection of food handlers showed a low level of personal hygiene. Only 31 (30.41%) had pre-employment medical examination and 49 (48%) had received any form of health education.

Moreover, Barro, Ouattara, Nikiema, and Traore (2002), conducted a study on microbial quality assessment of some street food widely consumed in Ouagadougou, Burkina Faso. The first part of their research showed that 75% of food vendors were women. The vendors sat close to water drainage system and solid waste. Sometimes food was not as in areas infested by flies and other insect it was also found that water used to wash food materials was of poor quality. The second part of the study showed some foods which were not preheated such as milk product; fruit juice vegetable and fruit failed the microbial quality assessment.
In Ghana, Mensah, Yeboah- Manu, Owusu-Darko and Ablordey (2002), carried out a study entitled, Street food in Accra, Ghana how safe are they? The study investigated the microbial quality of food sold on street of Accra and factors predisposing food to contamination. They found out the 177 street vendors 79 (66.7%) were educated and these vendors exhibited good hygiene behavior. The surroundings of the vending sites were clean but some sites (3.4%) were classified as very dirty. The cooking of food well in advance of consumption, exposure of food to flies and preparing food on the ground were likely risk factors for contamination.

Examinations made from 511 menu items classified as breakfast/snack food, main dishes, soups and cold dishes showed the presence of *Mesopholic bacteria* in 356 foods (69.7%), 28 contained *Enterobacteriaceae* (33.7%). The microbial quality of most of the food was within the acceptable limits but samples of salads, macaroni, fufu, rice balls and red pepper had unacceptable level of contaminating. To them, street foods can be a source of pathogens.

Tjoa *et al* (1997) were quoted to have confirmed the role played by unwholesome meat in the causation of disease. They recommended that food vendors should receive education on food hygiene and moreover special attention be given to the causes of diarrhea, transmission of diarrhea pathogens, the handling equipment’s and cooked food, hand washing practices and environmental hygiene. Similarly, this study also assesses the presence of micro organisms that can cause diarrhea in the selected food sample on Dunkwa- On-Offin .Environmental and personal hygiene, handling of equipment which has been identified by Tjoa to contaminate meat will also be assessed to find out similarities and difference between these two settings.
Also, Paa Nii (2005), in collaboration with some institutions in Ghana had the concerns that livelihood of vendors and health of consumers may be at risk if concerns over food safety are not addressed. A survey of 180 vendors in five different markets in Accra was conducted and the result showed that most vendors worked under poor sanitary conditions. They also found out from a micro biological survey (45 samples) that some streets foods were intrinsically safer than others. It was found out that kenkey and waakye were safe products while fufu was contaminated. The study also showed that most food vendors (197) sampled had no concern regarding heavy metal (lead metal).

Finally, in a study by Okai and Dordi (2002), a non-experimental design was used to determine the knowledge, attitude and practices on food hygiene by food vendors of University of Ghana campus. The study highlighted on two types of vendors. Those who brought already prepared food from home and those who cooked on site. It was showed that food vendors’ educational background and the relation of the selling had further established that the food vendors had high knowledge with regard to purchasing, transporting, storing, preparing and handling food as well as personal cleanliness. The study also showed that food vendors practiced poor food hygiene as evidenced by the poor state of cooking and selling environment as well as improper handling and washing of drinking cups, napkins and lack of proper water storage facilities.

Food safety experts have identified the most common food handling mistakes made by consumers as well as food vendors. The mistakes include serving contaminated raw food, cooking or heating food inadequately, obtaining food from unsafe sources and cooling food inadequately. Consumers need to appreciate the seriousness of food borne-disease. They must learn to recognize unsafe food-handling practices, the latency
period for some microbes and the symptoms of food-borne diseases. They also need to understand how to protect themselves through kitchen and personal hygiene, including thoroughness and frequency of hand washing, temperature control and safe food choices.

Besides water, other raw materials are also important to the safety of the street vended foods because of the biological, chemical and physical hazards that they might introduce. In order to keep prices down, some vendors purchase cheap or adulterated ingredients containing unpermitted chemical additives from unauthorized suppliers which may further increase the risks associated with the food so prepared.

Raw meat, poultry and vegetables are commonly contaminated with large numbers of bacteria, including potential foodborne pathogens such as B. cereus, C. perfringens, C. jejuni, E. coli, L. monocytogenes, Salmonella and S. aureus. Spices are known to harbor a large number of microorganisms which include members of the genus Bacillus, anaerobic sporeformers, enterococci, members of Enterobacteriaceae, a variety of yeast and mould and pathogens like coagulase positive staphylococci (International Commission on Microbiological Specifications for Foods (ICMSF, 1996). Contamination of foods by spices which act as spore carriers has been reported to lead to food spoilage and can even lead to food poisoning. Sporeformers in spices may lead to food spoilage, when they survive the cooking process and multiply under favorable conditions. (Powers, Latt and Brown, 1976). This study tries to look at whether food vendors in Dunkwa-on-offin are using food additives or spices and their reasons for this practice.
In a study done in Calcutta, samples that were suspected of adulteration were analysed and in 30 of the 50 samples, unauthorized food additives were detected. Similarly, pathogens like *B. cereus*, *S. aureus*, *C. perfringens*, *V. metschnikovii* and *E. coli* were reported in raw chicken, salad and gravy raw materials (Mosupye and Von Holy 1999). These organisms were probably present in these foods either prior to purchase by vendors or may have been introduced by cross contamination during food handling or during preparation.

The above literature reviewed internationally and locally shows the peril a person’s health is exposed to through the consumption of unhygienic street foods. It indicates that poor personal and environmental hygiene, lack of food hygiene knowledge on the part of food vendors can go a long way to affect the health of the patrons of street foods.

Reasons for contamination could be the location of the stall (surroundings), poor personal hygiene, and poor food hygiene practices during cooking, storing and serving, poor source of drinking water, poor storage system, uncovered food container, improper practices of taking out water from the pitcher, long hours of storage of food among others.

This study sought to find out whether the factors reviewed above also affected microbial quality of street foods in Dunkwa-On-Offin. Secondly, this study wants to establish whether there are other factors that contribute to microbial load apart from what has been described from literature.
CHAPTER THREE

Methodology

3.1 Introduction

This chapter describes the type of study, the population, the sample and sampling technique used in the study. The methodology also focuses on the instrument that was used for data collection, pre-testing of the instrument, the validity and reliability of the instrument and the procedure for data collection. In other words, this chapter highlights what was done in the research, how it was done in order to avoid bias and the population for the study.

3.2 Background of the Study Area

Dunkwa-On-Offin is in the Upper Denkyira East Municipality, in the Central Region of Ghana, with an estimated population of about 79,793 (Upper Denkyira East Health Directorate, 2013). The municipality lies within latitude 5° – 30° and 6° – 02° North of the equator and longitude 1° West and 2° West of the Greenwich meridian. It shares common boundaries with the Adansi South in the North, the Assin district in the East and the Twifo Hemang Lower Denkyira in the West. The Upper Denkyira East Municipality covers a total land area of 1700 square kilometers, which is about 17% of the total land of the Central Region of Ghana. Apart from farming and public service work; the people in this municipality are mainly miners. It is a very busy town with a lot of commercial activities. The main water supply in the town is by Ghana Water Company. The company covers close to 85% of the entire population. Some selected communities have at least a bore hole under the Rural Water Project. Most houses at the new sites have mechanized bore holes which also serve surrounding houses. Supply of water from the Ghana Water Company is provided to communities; the tap flows
continuously within certain hours in a day. Sometimes flow of water from taps becomes erratic due to technical challenges.

Dunkwa-On-Offin in the Upper Denkyira East Municipality was the setting for this research. The total number of registered food vendors within the town is about four hundred and five (405). Out of this number, three hundred and ninety five (395) vendors were medically fit and 10 were not fit as per the last medical screening in the municipal capital. There are many eating places in the town. These eating places include bus stations, mini-restaurants, canteens, and night markets. The various chop bars, mini-restaurants and open market eating places have been selected for this study due to the high patronage of food being sold by the vendors who operate within them. Cooked food ranging from kenkey, fufu, waakye, fried rice, and banku dominate the food vending market.

*Kenkey and banku:* This is prepared from fermented whole meal maize dough. To prepare kenkey, the fermented maize dough is divided into two halves. One half is partially cooked into a thick paste called “aflata” and the remaining half of fresh dough added and mixed thoroughly. There is no significant difference between the composition of banku and kenkey except for how it is presented.

*Fufu:* This is a sticky paste prepared by pounding cooked cassava only, cassava and either plantain or cocoyam, or yam only in a wooden mortar.

*Waakye:* This is a mixture of cooked rice and beans (cowpea) colored with the stock of dry millet leaves. The millet leave is soaked and boiled to release the brown color.
3.3 Research Design:

A descriptive cross-sectional study was used to assess the microbial content and how food vendors are able to meet the food hygiene standards in Dunkwa – On-Offin. The study involved finding out food hygiene practices of the food vending industry as a social unit. A census was conducted to obtain the list of food vending establishments in Dunkwa – On-Offin town. The town was divided into five (5) zones namely Dunkwasoro, Barrier, Kumasi/Obuasi station, Abankesieso /Atechem and Mfuom based on the population density of food vendors. A proportional sample size was determined for each zone and the food service establishments were randomly selected from each zone using random table. Four hundred and twenty-three (423) food handlers working in chop bars, food joints, restaurants, day and night markets were randomly selected for the study.

3.4 Data Collection Techniques

A self-designed structured questionnaire as well as an observational checklist was used to collect data from 423 food vendors. Apart from these two data collection tools, 216 food samples of, kenkey and hot pepper, waakye, fried rice and fufu were collected and transported to laboratory in sterile plastic bags within a period of one (1) month to assess its microbial quality. Data collectors and supervisor were oriented about the purpose of the study, the components of the questionnaire and data quality management. A pre-tested, structured questionnaire was used for data collection. The questionnaire was initially prepared in English and translated into Twi and Fante for data collection. The knowledge questionnaire contained items on the source and methods of transmission of food borne pathogens and knowledge of food handling.
Data collectors interviewed the food handlers and observed the food handlers while they were performing their chores to see their food handling practices and collected information on food preparation and handling in the facilities and the sanitary condition of the facilities. They also collected information on the socio-economic and demographic characteristics of the handlers. An observational guide / checklist were used by data collectors to assess the food handlers' food handling practices and environmental conditions under which food were prepared and sold. The street food vendors were engaged into the study after the owners of these vending sites had given their approval and the vendors were assured of total confidentiality.

3.5 Study population, sample size and sampling technique

This study had as its population the total number of street food vendors in Dunkwa- On – Offin.

3.5.1 Sampling of food vendors

Self- designed structured questionnaires as well as an observational check list was used to collect data from 423 street vendors on their demographic characteristics, personal hygiene, knowledge on food hygiene and practices as well as foodborne illness.

Sample size determination was as follows;

\[ n = \frac{z^2 (pq)}{d^2} \]

\( n \) = the required sample size

\( z \) = confident interval at 95% with standard value of 1.96

\( p \) = estimated prevalence (0.5)

\( q = 1.0 - p \)

\( d \) = margin of error at 5% with standard value of 0.05
\[ n = (1.96)^2 \frac{(0.5)(0.5)}{(0.05)^2} = 384.16 \]

Adding 10% of non response rate

\[ \frac{10}{100} \times 384.16 = 38.416 \]

\[ 384 + 38 = 423. \]

A proportional sample was obtained from each of the five zones (cluster). These respondents were selected using a simple random sampling method based on the population density and type of food sold by the food vendors. In all a total of 423 food vendors were selected from the five these zones.

It must be stated that records from the municipal environmental office indicates that 405 food vendors are registered to operate within the municipality. The reality on the ground is that food vendors operating in the municipality are more than those registered. This study identified 423 food vendors, whether registered or not.

### 3.5.2 Food sampling

A stratified sampling method was used to collect 216 food samples after categorizing vending sites into five (5) zones for the study. Specific food samples which include ice kenkey, waakye, kenkey and hot pepper, fufu and fried rice were collected within a period of one (1) month from five (5) selected categorized sites and sent to the laboratory for microbial assessment. The food samples were bought into sterile polythene bags, kept into a cold box containing ice packs and transported within two and half hours to the KNUST biological science laboratory. These food samples were subjected to microbial analysis for estimation of *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aurerus* and faecal coliform levels.
3.6 Laboratory materials and methods

(Total and faecal coliforms, Escherichia coli, Salmonella typhi, Staphylococcus aureus)

The Most Probable Number (MPN) method was used to determine total and faecal coliforms in the samples. Serial dilutions 10⁻¹ to 10⁻⁴ were prepared by picking 1 ml of the sample into 9 ml sterile distilled water. One millilitre aliquots from each of the dilutions were inoculated into 5ml of MacConkey Broth with and incubated at 35°C for total coliforms and 44°C faecal coliforms for 18-24 hours. Tubes showing colour change from purple to yellow after 24 hours were identified as positive for both total and faecal coliforms. Counts per 100 ml were calculated from Most Probable Number (MPN) tables.

From each of the positive tubes identified a drop was transferred into a 5 ml test tube of trypton water and incubated at 44°C for 24 hours. A drop of Kovacs’ reagent was then added to the tube of trypton water. All tubes showing a red ring colour development after gentle agitation denoted the presence of indole and recorded as presumptive for thermotolerant coliforms (E.coli). Counts per 100 ml were calculated from Most Probable Number (MPN) tables.

Prepared 10ml of manufactured formula of Buffered peptone water (BPW) was in a universal bottle and serial dilution of samples added to it. It is incubated at 37°C for 24 hours. Then 0.1 ml or the sample from the BPW is placed in a 10 ml of selenite broth in universal bottle and incubated at 44°C for 48 hours. Swaps from the bottle onto SS agar and incubated at 48 hours at 37°C. Black colonies on the SS agar indicate the presence of salmonella.
Staphylococcus were isolated and enumerated by pour plate method. Growth on salt Manitol Agar (SMA) serial dilution of $10^{-1}$ to the $10^{-4}$ were prepared, 1gm of sample was diluted into 10mls of sterilized distilled H$_2$O. One mililre aliquots from each of the dilution were inoculated into petri dishes with already prepared (SMA). The plates were then incubated at 35°C for 24 hours. After incubation staphylococcus yellow arrows spot or spread were counted and recorded as staphylococcus counts using the colony counter.

3.6.1 Quality checks / controls

Quality control measures put in place to ensure quality laboratory results included making sure food samples were placed into a sterile polythene bag immediately it was purchased, using water, media and plates which were sterilized and doing inoculation in an air conditioned room.

Alcohol was used to swab field before dilution, sterilized Petri dish was kept in sterile oven 160 degree Celsius for two hours, petri dish was placed in a lamina hood solidified agar was then sent to an incubator for 24 hours and colony counter was used to count colonies and averages were found.
3.7 Study variables

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>OPERATIONAL DEFINITIONS</th>
<th>INDICATOR</th>
<th>TYPE OF VARIABLE</th>
<th>INDICATOR MEASUREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge on food hygiene practices</td>
<td>General awareness, ideas and facts about food preparation, handling and serving</td>
<td>Awareness of hygiene practice.</td>
<td>Nominal</td>
<td>Questionnaire/Observational checklist</td>
</tr>
<tr>
<td>Microbial quality</td>
<td>Acceptable range of microbial load using the PHL standard to measure the presence of <em>salmonella, vibro cholera</em> and <em>E. coli</em>. Microbial load will be classified as satisfactory, unsatisfactory and unacceptable</td>
<td>Presence of unacceptable levels of specific microbes in selected foods.</td>
<td>Ordinal</td>
<td>Laboratory results</td>
</tr>
<tr>
<td>Source of food contamination</td>
<td>Any possible means of getting food infected with microbes.</td>
<td>Presence of specific microbes on hands, aprons etc.</td>
<td>Nominal</td>
<td>Questionnaire/Observational checklist</td>
</tr>
<tr>
<td>Educational level of food handlers</td>
<td>Highest level of education attained.</td>
<td>basic, primary, secondary and tertiary level of formal learning</td>
<td>Ordinal</td>
<td>Questionnaire</td>
</tr>
<tr>
<td>Source of food ingredients or food stuffs</td>
<td>This refers to where food stuffs and ingredients are purchased for food preparation</td>
<td>Where food ingredients are purchased.</td>
<td>Nominal</td>
<td>Questionnaire</td>
</tr>
</tbody>
</table>
3.8 Pre-testing of instruments

Validity and repeatability of the study were ensured through pre-testing of the questionnaire and observational guides in Upper Denkyira West district specifically, Diaso. This town is the district capital of Upper Denkyira West and it was selected because it has similar characteristics as the East Municipality. In all 50 questionnaires were pre-tested three weeks before the actual administration in Dunkwa.

Findings from the pre-test included most respondents’ inability to fill the questionnaire by themselves, complaints that some questions were not understood and unwillingness by some food vendors to take part in the study. There was the need to reshape some questions to make it understandable for respondents and to train research assistants to be able to translate questions.
3.9 Data analysis method

Data collected on 423 respondents were entered into SPSS version 16.0 software, edited and subsequently used for univariate analysis. The Student t-test was used to compare continuous variables and the Pearson Chi-square test for discrete variables. P-values of less than 0.05 were taken as statistically significant. Also point estimates were compared and presented as means and percentages. Nominal 2 sided p-values were reported with statistical significance defined at p-value < 0.05 at 95% confidence interval. Percentage or proportion was calculated for discrete variables while the mean with its standard deviation (SD) were computed for the continuous variable.

3.10 Ethical consideration

Ethical clearance was sought from the ethics committee of Kwame Nkrumah University of Science and Technology, the review board of the municipal administration. Clearance was also sought from the Upper Denkyira East Municipal health directorate. Questionnaires and observational guide had no space for names of respondents, chop bars, restaurants or markets. Also, informed verbal consent was obtained from the food handlers before the interview. Above all, participation in this study was voluntary.

3.11 Limitation of the study

Translation of research questions on the questionnaire into the language that the research participants understand could change the actual meaning of the question. There is a possibility that what the research team may have observed and the meanings they had given to it using the observational guide may be different from the meanings food handlers may give to the observed situation. That notwithstanding, data collectors
made sure that questionnaires have been duly explained repeatedly to food vendors before options were ticked or answers supplied appropriately.

Transporting food samples over two and sometimes three hours may affect the microbial load of food samples since temperature variations can cause a difference in microbial load though data collectors ensured that ice packs were well packaged and their containers well sealed to avoid heat exposure.

**3.12 Justification and description of selected foods**

The street foods in the survey were selected on the basis of prior knowledge from an earlier Centre for Public Health Practice project (R7493) and perceived risk. Fufu and waakye were chosen because these were studied in an earlier project and preliminary investigations suggested both microbiological and heavy metal health hazards to consumers.

Ice *kenkey and kenkey and hot pepper* were added because it is widely sold by street vendors. These street foods are sold to the consumer for immediate consumption or are taken home to be eaten later. The consumers of these foods come from all segments of society without respect to age, gender, social and income status.

The street foods are described below:

*Kenkey:* This is prepared from fermented whole meal maize dough. To prepare kenkey, the fermented maize dough is divided into two halves. One half is partially cooked into a thick paste called “aflata” and the remaining half of fresh dough added and mixed thoroughly.
**Fufu:** This is a sticky paste prepared by pounding cooked cassava only, cassava and either plantain or cocoyam, or yam only in a wooden mortar.

**Waakye:** This is a cooked mixture of rice and beans (cowpea) colored with the stock of dry millet leaves. The millet leave is soaked and boiled to release the brown color.

3.13 Assumptions

It was assumed that the respondents provided accurate and concise information when answering the questionnaire and observations were made without any predetermined ideas. It was assumed that the district authorities (political, traditional and health) considered the research findings and accepted the recommendations that were made.

3.14 Operational Definitions

**Acceptable:** test results indicating good microbiological quality

**Certified:** Informal traders who are regulated, i.e. they comply with Food Safety Regulations relating to food premises and have been issued a Certificate of operation.

**Environmental Health Officers (EHOs):** Trained professionals, competent to enforce, amongst others, Food Safety legislation in Ghana. For law enforcement, they are authorized as Inspectors.

**Food hygiene:** all practices conducive to maintaining food in healthy conditions safe for consumption / all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

**Food Safety:** The assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.

**Food:** anything which when taken into the body, serves to nourish or build up tissues or supply energy.
**Formal food vendor:** Person involved in food preparation, distribution or selling thereof in the mainstream sector e.g. restaurants, hospitals, catering establishments, food factories etc.

**HACCP approach:** Food Safety Management plan that utilizes an assessment of Hazards, analysis thereof and identification and implementation of Critical Control Points.

**Informal food vendor:** Person involved in food preparation, distribution or selling thereof in the “non-mainstream” sector such as street food vendors or hawkers.

**Knowledge:** general awareness, ideas and facts about food preparation, handling and serving by cooked food sellers.

**Microbial quality:** The terms used to express the microbiological quality of the ready-to-eat foods are:

**Potable water:** Water that is considered suitable for human consumption (drinkable) as per the WHO Drinking water Guidelines, 2006.

**Practices:** the accustomed ways and habits employed by food vendors during cooking, handling and serving.

**Registered:** Informal traders who are legally operating by complying to business/trade regulations.

**Street Food Vendors:** Entrepreneurs selling ready-to-eat foods and beverages

**Street foods:** are ready-to-eat foods and beverages prepared and/or sold by vendors and hawkers especially in streets and other similar public places / ready-to-eat foods prepared and/or sold by vendors and hawkers in streets and other similar public places.

**Unacceptable/potentially hazardous:** test results indicating that urgent attention is needed to locate the source of the problem; a detailed risk assessment is recommended.
CHAPTER FOUR

Results

Data collected on 423 respondents was entered into SPSS version 16.0 software, edited and subsequently used for multivariate analysis. The Student t-test was used to compare continuous variables and the Pearson Chi-square test for discrete variables. P-values of less than 0.05 were taken as statistically significant.

Also point estimates were compared and presented as means and percentages. Nominal 2 sided p-values were reported with statistical significance defined at p-value< 0.05 at 95% confidence interval. Percentage or proportion was calculated for discrete variables while the mean with its standard deviation (SD) were computed for the continuous variable.

Table-1: Proportion of food vendors who have been trained in food safety

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Freq (n)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health education on food hygiene received</td>
<td>No</td>
<td>161</td>
<td>38.42</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>258</td>
<td>61.58</td>
</tr>
<tr>
<td>Frequency of health education on food hygiene received</td>
<td>Once a year</td>
<td>172</td>
<td>68.25</td>
</tr>
<tr>
<td></td>
<td>Twice a year</td>
<td>23</td>
<td>9.13</td>
</tr>
<tr>
<td></td>
<td>3 times a year</td>
<td>11</td>
<td>4.37</td>
</tr>
<tr>
<td></td>
<td>4 or more times in a year</td>
<td>46</td>
<td>18.25</td>
</tr>
<tr>
<td>Contamination of food can lead to food poisoning</td>
<td>No</td>
<td>50</td>
<td>12.08</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>364</td>
<td>87.92</td>
</tr>
</tbody>
</table>

Table-1 shows the proportion of food vendors who have been trained in food safety. 258 (61.58%) of the respondents had been trained in food safety. With regards to how often respondents goes through health education on food hygiene, the majority 172 (68.25%) had
it once in every year and a minority 46 (18.25%) had it 4 or more times in a year. Also 364 (87.92%) had the knowledge in how contamination of food can lead to food poisoning.

Table-2: Demographic characteristics on sampled street food vendors at Dunkwa-On-Offin

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Freq (n)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 – 25</td>
<td>120</td>
<td>28.37</td>
<td></td>
</tr>
<tr>
<td>26 – 36</td>
<td>133</td>
<td>31.44</td>
<td></td>
</tr>
<tr>
<td>37 – 47</td>
<td>120</td>
<td>28.37</td>
<td></td>
</tr>
<tr>
<td>48 and above</td>
<td>50</td>
<td>11.82</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>423</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>35</td>
<td>8.27</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>388</td>
<td>91.72</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>423</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Educational Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>97</td>
<td>22.93</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>58</td>
<td>13.71</td>
<td></td>
</tr>
<tr>
<td>Middle school</td>
<td>84</td>
<td>19.86</td>
<td></td>
</tr>
<tr>
<td>JHS</td>
<td>139</td>
<td>32.86</td>
<td></td>
</tr>
<tr>
<td>SHS</td>
<td>45</td>
<td>10.64</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>423</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Religion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Islam</td>
<td>85</td>
<td>20.10</td>
<td></td>
</tr>
<tr>
<td>Christian</td>
<td>333</td>
<td>78.70</td>
<td></td>
</tr>
<tr>
<td>Traditional</td>
<td>5</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>423</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>256</td>
<td>60.52</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>133</td>
<td>31.44</td>
<td></td>
</tr>
<tr>
<td>Separated</td>
<td>19</td>
<td>4.49</td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>15</td>
<td>3.55</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>423</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Source of start-up capital

<table>
<thead>
<tr>
<th>Source of start-up capital</th>
<th>Own</th>
<th>101</th>
<th>23.93</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spouse</td>
<td>118</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parents</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relatives</td>
<td>33</td>
<td></td>
<td>7.82</td>
</tr>
<tr>
<td>Friends</td>
<td>40</td>
<td></td>
<td>9.48</td>
</tr>
<tr>
<td>Credit from banks</td>
<td>41</td>
<td></td>
<td>9.72</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>422</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

### Years of selling or preparing food for sale

<table>
<thead>
<tr>
<th>Years of selling or preparing</th>
<th>0 - 2 years</th>
<th>189</th>
<th>44.68</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 5 years</td>
<td>108</td>
<td></td>
<td>25.53</td>
</tr>
<tr>
<td>6 - 8 years</td>
<td>36</td>
<td></td>
<td>8.51</td>
</tr>
<tr>
<td>9 and above</td>
<td>90</td>
<td></td>
<td>21.28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>423</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

### Source of knowledge on food Preparation (n=422)

<table>
<thead>
<tr>
<th>Source of knowledge on food Preparation (n=422)</th>
<th>Catering school</th>
<th>21</th>
<th>4.98</th>
</tr>
</thead>
<tbody>
<tr>
<td>From relatives</td>
<td>160</td>
<td></td>
<td>37.91</td>
</tr>
<tr>
<td>Learnt on their own</td>
<td>241</td>
<td></td>
<td>57.11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>422</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

### Type of food sold

<table>
<thead>
<tr>
<th>Type of food sold</th>
<th>Ice kenkey</th>
<th>60</th>
<th>14.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waakye</td>
<td>160</td>
<td></td>
<td>38.00</td>
</tr>
<tr>
<td>Kenkey &amp; hot pepper</td>
<td>94</td>
<td></td>
<td>22.00</td>
</tr>
<tr>
<td>Fufu</td>
<td>45</td>
<td></td>
<td>11.00</td>
</tr>
<tr>
<td>Fried rice</td>
<td>64</td>
<td></td>
<td>15.01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>423</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

### Mandate to prepare and sell Food (n=416)

<table>
<thead>
<tr>
<th>Mandate to prepare and sell Food (n=416)</th>
<th>Contacting a health inspector</th>
<th>85</th>
<th>20.43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through application to environmental officer</td>
<td>125</td>
<td>30.05</td>
<td></td>
</tr>
<tr>
<td>Started on your own</td>
<td>175</td>
<td>42.07</td>
<td></td>
</tr>
<tr>
<td>Continued from a friend or Relative</td>
<td>31</td>
<td>7.45</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>416</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Demographic information on street food vendors of Dunkwa-On-Offin are summarized in Tabl-2.

The ages ranged from 15-54; with a mean of 44±3.19 years; there were 388 (91.70%) females and 35 (8.30%) males. In all, 97 (22.93%) had no education with 139 (32.86%) been JHS graduates. Concerning the source of knowledge on food preparation; the majority 241 (57.11%) acquired their knowledge learning by themselves, followed by 160 (37.91%) who acquired theirs from relatives with a minority 21 (4.98%) from a catering school.

The majority 175 (42.07%) had no mandate to prepare and sell food while 125 (30.05%) had their mandate through application to environmental officer and only 31 (7.45%) continued from a friend or relative who once had the mandate to sell and had left the food vending industry for some reasons.

**Table-3: Univariate analysis of test of association**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Food Contamination</th>
<th></th>
<th></th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source of food and veg.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dunkwa town</td>
<td>25(6.23)</td>
<td>268(66.83)</td>
<td></td>
<td>0.000*</td>
</tr>
<tr>
<td>Surrounding villages</td>
<td>22(5.49)</td>
<td>56 (13.97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obuasi</td>
<td>1 (0.25)</td>
<td>22 (5.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kumasi</td>
<td></td>
<td>7 (1.75)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Considerations for choosing foodstuff</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>6 (1.46)</td>
<td>100(24.39)</td>
<td></td>
<td>0.002*</td>
</tr>
<tr>
<td>Cost</td>
<td>24(5.85)</td>
<td>167(40.73)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>20(4.88)</td>
<td>73 (17.80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>20 (4.88)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Source of meat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From open market</td>
<td>25(6.63)</td>
<td>79 (20.95)</td>
<td></td>
<td>0.000*</td>
</tr>
<tr>
<td>Meat shop</td>
<td>5 (1.33)</td>
<td>76 (20.16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abattoir</td>
<td>2 (0.53)</td>
<td>28 (7.43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold store</td>
<td>13(3.45)</td>
<td>149(39.52)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Knowledge on indicators of safe meat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>25(6.61)</td>
<td>76(20.11)</td>
<td><strong>0.000</strong>*</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>21(5.56)</td>
<td>256(67.72)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Indicators for choice of food</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshness</td>
<td>6 (2.23)</td>
<td>62 (23.05)</td>
<td>0.263</td>
<td></td>
</tr>
<tr>
<td>Texture</td>
<td>1 (0.37)</td>
<td>34 (12.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>2 (0.74)</td>
<td>59 (21.93)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scent</td>
<td>10(3.72)</td>
<td>72 (26.77)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Softness</td>
<td>2 (0.74)</td>
<td>21 (7.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Place where food is prepared</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At the selling place</td>
<td>21(5.11)</td>
<td>105(25.55)</td>
<td>0.048</td>
<td></td>
</tr>
<tr>
<td>At home</td>
<td>28(6.81)</td>
<td>257(62.53)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Who prepares the food</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seller</td>
<td>10(2.52)</td>
<td>55 (13.85)</td>
<td>0.260</td>
<td></td>
</tr>
<tr>
<td>Other people apart from seller (cook)</td>
<td>35(8.82)</td>
<td>297(74.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Whether medically examined</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>21(5.16)</td>
<td>77 (18.92)</td>
<td><strong>0.001</strong>*</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28(6.88)</td>
<td>281(69.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Who gets examined</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seller</td>
<td>38(9.20)</td>
<td>256(61.99)</td>
<td>0.423</td>
<td></td>
</tr>
<tr>
<td>Cook</td>
<td>12(2.91)</td>
<td>107(25.91)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constant supply of water at the cooking site</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>23(5.72)</td>
<td>71 (17.66)</td>
<td><strong>0.000</strong>*</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>26(6.47)</td>
<td>282(70.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Source of water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other source</td>
<td>-</td>
<td>30 (8.98)</td>
<td>0.121</td>
<td></td>
</tr>
<tr>
<td>Piped water</td>
<td>15(4.49)</td>
<td>94 (28.14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well/ borehole</td>
<td>10(2.99)</td>
<td>115(34.43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covered tank</td>
<td>8 (2.40)</td>
<td>62 (18.56)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the 0.05 level.
**Con't Table-3: Univariate analysis of test of association**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Food Contamination</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NO (%)</td>
<td>YES (%)</td>
<td>P-Value</td>
</tr>
<tr>
<td><strong>Use of food additives and condiments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>8 (2.02)</td>
<td>111(27.96)</td>
<td>0.026</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td>41(10.33)</td>
<td>237(59.70)</td>
<td></td>
</tr>
<tr>
<td><strong>Means of transporting food stuffs to cooking site</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At the spot</td>
<td></td>
<td>22 (6.01)</td>
<td>68 (18.58)</td>
<td><strong>0.001</strong>*</td>
</tr>
<tr>
<td>By carrying</td>
<td></td>
<td>17 (4.64)</td>
<td>163(44.54)</td>
<td></td>
</tr>
<tr>
<td>By car</td>
<td></td>
<td>6 (1.64)</td>
<td>86 (23.50)</td>
<td></td>
</tr>
<tr>
<td>By carriage truck</td>
<td></td>
<td>4 (1.09)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Place of storing cooked food</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In an open plastic bowl</td>
<td></td>
<td>4 (0.97)</td>
<td>75 (18.12)</td>
<td>0.089</td>
</tr>
<tr>
<td>In an ice chest</td>
<td></td>
<td>13 (3.14)</td>
<td>106(25.60)</td>
<td></td>
</tr>
<tr>
<td>In a saucepan</td>
<td></td>
<td>18 (4.35)</td>
<td>110(26.57)</td>
<td></td>
</tr>
<tr>
<td>In a plain rubber suck</td>
<td></td>
<td>13 (3.14)</td>
<td>53 (12.80)</td>
<td></td>
</tr>
<tr>
<td>In a sieve</td>
<td></td>
<td>2 (0.48)</td>
<td>20 (4.83)</td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of washing eating plates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After each use</td>
<td></td>
<td>21 (5.57)</td>
<td>254(67.37)</td>
<td><strong>0.000</strong>*</td>
</tr>
<tr>
<td>At the end of the day</td>
<td></td>
<td>25 (6.63)</td>
<td>50 (13.26)</td>
<td></td>
</tr>
<tr>
<td>At the beginning of sale</td>
<td></td>
<td>-</td>
<td>27 (7.16)</td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of changing water for washing plates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once</td>
<td></td>
<td>13 (3.48)</td>
<td>90 (24.06)</td>
<td><strong>0.001</strong>*</td>
</tr>
<tr>
<td>Twice</td>
<td></td>
<td>22 (5.88)</td>
<td>75 (20.05)</td>
<td></td>
</tr>
<tr>
<td>3 times</td>
<td></td>
<td>5 (1.34)</td>
<td>73 (19.52)</td>
<td></td>
</tr>
<tr>
<td>4 or more</td>
<td></td>
<td>6 (1.60)</td>
<td>90 (24.06)</td>
<td></td>
</tr>
</tbody>
</table>
### Treatment of leftover foods

<table>
<thead>
<tr>
<th>Action</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discard</td>
<td>22 (5.71)</td>
<td>121 (31.43)</td>
<td>0.118</td>
</tr>
<tr>
<td>Consume</td>
<td>12 (3.12)</td>
<td>139 (36.10)</td>
<td></td>
</tr>
<tr>
<td>Reheat for sale</td>
<td>13 (3.38)</td>
<td>78 (20.26)</td>
<td></td>
</tr>
</tbody>
</table>

### Health education on food hygiene received

<table>
<thead>
<tr>
<th>Education Received</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>22 (5.34)</td>
<td>138 (33.50)</td>
<td>0.424</td>
</tr>
<tr>
<td>Yes</td>
<td>28 (6.80)</td>
<td>224 (54.37)</td>
<td></td>
</tr>
</tbody>
</table>

### Certified to sell food

<table>
<thead>
<tr>
<th>Certification</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>34 (8.48)</td>
<td>89 (22.19)</td>
<td><strong>0.000</strong>*</td>
</tr>
<tr>
<td>Yes</td>
<td>12 (2.99)</td>
<td>266 (66.33)</td>
<td></td>
</tr>
</tbody>
</table>

### Food hygiene practices ensured

<table>
<thead>
<tr>
<th>Practice</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covering foods regularly</td>
<td>17 (4.25)</td>
<td>147 (36.75)</td>
<td>0.280</td>
</tr>
<tr>
<td>Keeping foods warm always</td>
<td>3 (0.75)</td>
<td>34 (8.50)</td>
<td></td>
</tr>
<tr>
<td>Keeping clean environment &amp; personal hygiene</td>
<td>20 (5.00)</td>
<td>122 (30.50)</td>
<td></td>
</tr>
<tr>
<td>Providing clean water &amp; soap for washing</td>
<td>6 (1.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keeping cups, bowls, spoons &amp; napkins clean</td>
<td>6 (1.50)</td>
<td>28 (7.00)</td>
<td></td>
</tr>
<tr>
<td>Washing hands before preparing &amp; serving meals</td>
<td>11 (2.75)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparing well cooked foods</td>
<td>2 (0.50)</td>
<td>4 (1.00)</td>
<td></td>
</tr>
</tbody>
</table>

P-Value based on chi-square test, stated significantly at 5% level

Source: Survey data, 2013

A summary of ways by which food got contaminated are shown in Table-3. There was a significant association between the variables such as the source of food, vegetables and meat, considerations for choosing food stuffs and microbial quality (p≤0.001).
Table-4(a): Means by which food got contaminated - Logistic regression model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Food Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td>Considerations for choosing foodstuff</td>
<td>3.19</td>
</tr>
<tr>
<td>Source of meat</td>
<td>2.84</td>
</tr>
<tr>
<td>What do you look out for on safe meat</td>
<td>2.53</td>
</tr>
<tr>
<td>Place where food is prepared</td>
<td>9.18</td>
</tr>
<tr>
<td>Who prepares the food</td>
<td>8.48</td>
</tr>
<tr>
<td>Have you gone through medical examination</td>
<td>10.04</td>
</tr>
<tr>
<td>Who gets examined</td>
<td>0.54</td>
</tr>
<tr>
<td>Constant supply of water at the cooking site</td>
<td>8.49</td>
</tr>
<tr>
<td>Source of water</td>
<td>10.85</td>
</tr>
<tr>
<td>Use of food additives and condiments</td>
<td>5.78</td>
</tr>
<tr>
<td>Place of storing cooked food</td>
<td>2.28</td>
</tr>
<tr>
<td>How often do you wash eating plates</td>
<td>2.89</td>
</tr>
<tr>
<td>How often does water for washing plates changed</td>
<td>3.01</td>
</tr>
<tr>
<td>How do you treat leftover foods</td>
<td>4.28</td>
</tr>
<tr>
<td>Medical examination</td>
<td>10.04</td>
</tr>
<tr>
<td>Frequency of medical examination</td>
<td>1.71</td>
</tr>
<tr>
<td>Food hygiene practices ensured</td>
<td>2.03</td>
</tr>
</tbody>
</table>

* Significantly associated with Food contamination (p<0.05).

OR= odds ratio, CI= confidence interval.

From the logistic regression model tables-4 above, significant associations (p<0.05) were found between all the variables and food contamination.
Table 4(b)  Observational Checklist

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical appearance neat</td>
<td>No</td>
<td>52</td>
<td>12.3</td>
</tr>
<tr>
<td>Location</td>
<td>Roadside</td>
<td>380</td>
<td>90.0</td>
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<tr>
<td></td>
<td>Nearness to Gutter</td>
<td>22</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Closeness to Bush</td>
<td>15</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>6</td>
<td>1.00</td>
</tr>
<tr>
<td>Sanitation of place of selling clean &amp; neat:</td>
<td>Yes</td>
<td>253</td>
<td>59.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>170</td>
<td>40.3</td>
</tr>
<tr>
<td>Garbage and dirty waste close to selling place</td>
<td>Yes</td>
<td>127</td>
<td>30.0</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>296</td>
<td>70.0</td>
</tr>
<tr>
<td>Availability of dustbins to keep waste</td>
<td>Yes</td>
<td>121</td>
<td>28.5</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>302</td>
<td>71.5</td>
</tr>
<tr>
<td>Availability of covered dustbins</td>
<td>Yes</td>
<td>45</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>378</td>
<td>89.3</td>
</tr>
<tr>
<td>Regular wiping of eating table</td>
<td>Yes</td>
<td>264</td>
<td>62.4</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>159</td>
<td>37.6</td>
</tr>
<tr>
<td>Availability of portable water</td>
<td>Yes</td>
<td>272</td>
<td>64.4</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>151</td>
<td>35.6</td>
</tr>
<tr>
<td>Use of clean water for washing hands and plates</td>
<td>Yes</td>
<td>237</td>
<td>56.1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>187</td>
<td>43.9</td>
</tr>
<tr>
<td>Water container covered</td>
<td>Yes</td>
<td>283</td>
<td>66.8</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>140</td>
<td>33.2</td>
</tr>
<tr>
<td>Prepared foods are stored in:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flytrap sieve</td>
<td>Yes</td>
<td>177</td>
<td>41.9</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>246</td>
<td>58.1</td>
</tr>
<tr>
<td>Glass sieve</td>
<td>Yes</td>
<td>179</td>
<td>42.3</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>244</td>
<td>57.7</td>
</tr>
<tr>
<td>Open bowl</td>
<td>Yes</td>
<td>172</td>
<td>41.0</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>117</td>
<td>28.0</td>
</tr>
<tr>
<td>Plain rubber suck</td>
<td>Yes</td>
<td>260</td>
<td>61.5</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>163</td>
<td>38.5</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----</td>
<td>-----</td>
<td>------------</td>
</tr>
<tr>
<td>Ice chest</td>
<td>222</td>
<td>201</td>
<td>52.4</td>
</tr>
<tr>
<td>Hair covered</td>
<td>162</td>
<td>261</td>
<td>38.3</td>
</tr>
<tr>
<td>Apron worn</td>
<td>157</td>
<td>266</td>
<td>38.3</td>
</tr>
<tr>
<td>Use of the same hand to serve and collect money</td>
<td>355</td>
<td>68</td>
<td>84.0</td>
</tr>
<tr>
<td>Regularly washing bowls</td>
<td>231</td>
<td>192</td>
<td>54.6</td>
</tr>
<tr>
<td>Availability of hand washing soap</td>
<td>266</td>
<td>157</td>
<td>62.8</td>
</tr>
<tr>
<td>Talking while serving</td>
<td>249</td>
<td>174</td>
<td>58.9</td>
</tr>
<tr>
<td>Serving method: Hand covered with polythene</td>
<td>68</td>
<td>355</td>
<td>16.1</td>
</tr>
<tr>
<td>Bare hands</td>
<td>379</td>
<td>44</td>
<td>89.7</td>
</tr>
<tr>
<td>Ladle</td>
<td>382</td>
<td>41</td>
<td>90.4</td>
</tr>
<tr>
<td>Wearing jewellery during serving</td>
<td>96</td>
<td>327</td>
<td>22.6</td>
</tr>
<tr>
<td>Finger nails Kept short</td>
<td>396</td>
<td>27</td>
<td>93.7</td>
</tr>
<tr>
<td>Finger nails Polished</td>
<td>64</td>
<td>359</td>
<td>15.1</td>
</tr>
<tr>
<td>Availability of napkins</td>
<td>118</td>
<td>305</td>
<td>27.9</td>
</tr>
<tr>
<td>Availability of place of convenience</td>
<td>53</td>
<td>370</td>
<td>12.6</td>
</tr>
<tr>
<td>Customers make contact with food before choosing</td>
<td>39</td>
<td>384</td>
<td>9.3</td>
</tr>
</tbody>
</table>
From the above table, in relation to location, 380 food vendors representing 90.0% were at the roadside, 22 representing 5.00 % were found near gutters, 15 representing 4.00 % were also close to a bush. Majority of food vendors, 302 (71.5%) were seen to have no dustbins to keep their waste.

Majority, 378 representing 89.3 % had no covering for their dustbins. In all, 157 (35.6%) were seen not to have any portable water available.

A total of 306 (72.0%) were seen to sell in open bowl. For covering of hair, majority of food vendors, 261 (61.7%), were not seen with hair cover on while 266 (62.9%) food vendors were not seen wearing aprons. Most food vendors 355 (84.0%) were observed to use the same hand to serve and collect money. In all 157 (37.2%) were not to have hand washing soap available for hand washing. Also, 249 (58.9%) of food vendors were seen to be talking while serving. Also, majority of 379 (89.7%) were observed to use their bare hands to serve.

It was observed that majority of food vendors, 359 (84.9%) had polished nails. In relation to availability of place of convenience, majority 370 (87.4%) were seen not to have any place of convenience.
## SUMMARY OF MICROBIAL QUALITY DATA

Table 5(a): Summary of Specific Microbial Presence in Selected Food samples.

<table>
<thead>
<tr>
<th>FOOD SAMPLES</th>
<th>Faecal coliforms /100ml</th>
<th>Escherichia coli /100ml cfu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of food samples</td>
<td>% of food samples isolated for faecal coliforms</td>
</tr>
<tr>
<td>Banku</td>
<td>12</td>
<td>12 (100%)</td>
</tr>
<tr>
<td>Fufu</td>
<td>6</td>
<td>2 (33.3%)</td>
</tr>
<tr>
<td>Kenkey</td>
<td>62</td>
<td>18 (29%)</td>
</tr>
<tr>
<td>Pepper/Tomato Sauce</td>
<td>50</td>
<td>44 (88%)</td>
</tr>
<tr>
<td>Rice (Jollof, Fried, Waakye, Plain)</td>
<td>86</td>
<td>52 (86%)</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>216</strong></td>
<td><strong>128</strong></td>
</tr>
</tbody>
</table>

From the table above, 12 (100%) banku, 2 (33.3%) fufu, 18 (29%) kenkey, 44 (88%) pepper/sauce, 52 (86%) rice samples were isolated for *Faecal coliforms*. Additionally, 12 (100%) banku, 2 (3.2%) kenkey, 32 (64%) pepper / tomato sauce, 44 (51.2%) rice samples were isolated for *E. coli*. Fufu samples were not isolated for *E. coli*. 
Table 5 (b): Summary of Microbial Presence in Specific Food Samples

<table>
<thead>
<tr>
<th>FOOD SAMPLES</th>
<th><em>Salmonella typhi</em>/100 ml cfu</th>
<th>% of food samples isolated for <em>Salmonella typhi</em></th>
<th><em>Staphylococcus aureus</em>/1ml</th>
<th>% of food samples isolated for <em>Staphylococcus aureus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of food samples</td>
<td>% of food samples isolated for <em>Salmonella typhi</em></td>
<td>Number of food samples</td>
<td>% of food samples isolated for <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>Banku</td>
<td>12</td>
<td>0 (0%)</td>
<td>12</td>
<td>12(100%)</td>
</tr>
<tr>
<td>Fufu</td>
<td>6</td>
<td>0 (0%)</td>
<td>6</td>
<td>2(33.3%)</td>
</tr>
<tr>
<td>Kenkey</td>
<td>62</td>
<td>2 (3.2%)</td>
<td>62</td>
<td>32(51.6%)</td>
</tr>
<tr>
<td>Pepper/Tomato sauce</td>
<td>50</td>
<td>16 (32%)</td>
<td>50</td>
<td>30(60%)</td>
</tr>
<tr>
<td>Rice (Jollof, Fried, Waakye, Plain)</td>
<td>86</td>
<td>8 (9.3%)</td>
<td>86</td>
<td>58(67.4%)</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>216</strong></td>
<td><strong>26</strong></td>
<td><strong>216</strong></td>
<td><strong>134</strong></td>
</tr>
</tbody>
</table>

From the above table, banku and fufu samples were free from *Salmonella typhi*. In all, 2(3.2%) samples of kenkey, 16(32%) samples of pepper/sauce and 8(9.3%) samples of rice were isolated for *Salmonella typhi*.

Additionally, *Staphylococcus aureus* were isolated in all 12 (100%) banku samples, 2(33.3%) fufu samples, 32(51.6%) kenkey samples, 30(60%) pepper and sauce samples and 58(67%) rice samples.
Figure 1: Summary of Acceptable Rate for All Food Items
Figure 2: Summary of Unacceptable Rate For All Food Items

<table>
<thead>
<tr>
<th>Food Samples</th>
<th>FEACAL COLIFORMS/100ml</th>
<th>E. coli/100ml cfu</th>
<th>Salmonella/100ml cfu</th>
<th>Staphylococcus/1ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>BANKU</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>FUFU</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>KENKEY/ICE KENKEY</td>
<td>33.3</td>
<td>33.3</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td>PEPPER/TOMATO</td>
<td>29.0</td>
<td>51.6</td>
<td>64.0</td>
<td>32.0</td>
</tr>
<tr>
<td>RICE (JOLLOF, FRIED, WAAKYE, PLAIN)</td>
<td>60.5</td>
<td>60.0</td>
<td>60.5</td>
<td>51.2</td>
</tr>
</tbody>
</table>

% Unacceptable Rate
Table 6: Summary of Microbes Found In All the Food items

<table>
<thead>
<tr>
<th>MICROBIAL QUALITY</th>
<th>Faecal coliforms/100 ml</th>
<th>Escherichia coli/100 ml cfu</th>
<th>Salmonella typhi/100ml cfu</th>
<th>Staphylococcus aureus /1ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of food samples</td>
<td>128</td>
<td>90</td>
<td>26</td>
<td>134</td>
</tr>
<tr>
<td>% of food samples isolated with microorganism</td>
<td>59.3</td>
<td>41.7</td>
<td>12</td>
<td>62</td>
</tr>
</tbody>
</table>

In all 216 food samples which were collected, *faecal coliforms* were isolated in 128 (59.3%), *p* = 0.001, *Escherichia coli* were found in 90 (41.7%, *p*=0.001), *Salmonella typhi* were isolated in 26 (12.0%, *p* = 0.001) and *Staphylococcus aureus* were isolated in 134 (62.0%, *p* = 0.001) with their *p*-values indicating statistical significance. Some food samples had more than one microorganism isolated.

**MQ = MICROBIAL QUALITY**

<table>
<thead>
<tr>
<th>Acceptable levels</th>
<th>Unacceptable levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em>, <em>Salmonella typhi</em> and <em>Faecal coliform</em> must be absent or = 0 while <em>Staphylococcus aureus</em> must be less than 1 x $10^3$</td>
<td>Isolated levels of <em>Escherichia coli</em>, <em>Salmonella typhi</em> and <em>faecal coliform</em> above 0 and <em>Staphylococcus aureus</em> greater than 1 x $10^3$.</td>
</tr>
<tr>
<td>Source, GSA, 2013</td>
<td>Source, GSA, 2013</td>
</tr>
</tbody>
</table>
CHAPTER FIVE

Discussion of findings

5.1 Relevant background of food vendors

In Sub-Saharan Africa, the problem of food safety and hygiene stems not only from inadequate knowledge but also as a result of the interplay of many antecedent factors that are social, cultural, economic and behavioral coupled with very high illiteracy. Even in situations where there are modern facilities such as portable water, many routine traditional or normative practices affect the quality of food sold by food vendors. According to FAO (2008), food handlers should have the necessary knowledge and skills to enable them to handle food hygienically. Systems should be put in place to ensure that food handlers remain aware of all procedures necessary to maintain the safety and suitability of food. FAO (1997) recommends that every vendor/helper of food should undergo a basic training in food hygiene before licensing.

A total of 160 (37.91%) of the respondents in this study acquired their food preparation knowledge from relatives at Table 2. Similar to the findings of Muinde and Kuria (2005) in Kenya, only a few had formal training in food preparation. This implies that, food vendors learned both good and bad practices from their parents. They may see these practices as normal since parents practice them. This may affect their objectivity in identifying and changing unhygienic practices learned from parents thereby putting the health of consumers at risk. This reflects the general practices in Africa where most parents impart knowledge on various aspects of life to their young ones.

Educational level is an important determinant of knowledge or practice. Majority 139 (32.86%) of food vendors were observed to have had only up to Junior High School, 45
(10.64%) Senior High Education, 58 (13.71%) has had Primary education, 84 (19.86%) had Middle education, 97 (22.93%) had no formal education. In all 326 (77.07%) have had a form of formal education which is expected to positively impact on their hygiene practices. On the hand 97 (23.93%) have not had any form of formal education. This can negatively affects their hygiene practices. Since educational level is an important determinant of knowledge or practice ranging, food vendors who have no formal knowledge may engage in unhygienic practices from food selection, preparation through to sales.

The finding of this study where 97(23.93) have not had any formal education is in consonance with a study conducted in Ghana by Mensah, Yeboah- Manu, Owusu-Darko and Ablordey (2002), entitled, Street food in Accra, Ghana how safe are they? The study investigated the microbial quality of food sold on street of Accra and factors predisposing food to contamination. They found out that out of the 177 street vendors, 79 (66.7%) were educated and these people exhibited good hygiene behavior (Mensah et al, 2002). Similarly, a study conducted by Isara and Isah in Benin in 2009 to assess knowledge and practice of food hygiene and safety among food handlers in fast food restaurants showed that majority (98%) of the respondents had formal education. There was good knowledge and practice of food hygiene and safety among the respondents. Knowledge was significantly influenced by previous training in food hygiene and safety (p = 0.002).
5.1.1 Medical examination and food vendors

“All persons engaged in handling of food or drink shall undergo medical examination and must be declared medically fit, by a certified medical officer and must obtain a certificate to that effect. The medical certificate must be renewable yearly” (UDEMA, 2002).

Even though someone can be medically fit today and can be unfit tomorrow, it is advisable for food vendors to undergo it for early detection of diseases and to avoid possible spread of food and water-borne infection. The study showed that 358 (84.6%) have once undergone medical examination as against 49 (15.4%) who have not done it in the last five (5) years.

This finding is similar to a study conducted by Annan-Prah (2011) on street foods: handling, hygiene and client in Cape Coast. That study showed that 15 (55.5%) out of 50 food vendors investigated had undergone medical examination (8 only once and 7 annually).

Musa and Akande (2003) showed similar results in a study carried out on food hygiene practices among food vendors in Ilorin Secondary School in Nigeria. The study showed that out 185 respondents, 141 (76%) went through medical examination as a requirement and 30 (16%) underwent periodic medical examination. Similarly, Okojie, Wagbatsoma and Ighoroge in (2005) found out that only 31 (30.41%) out of 102 respondents had pre-employment medical examination. The finding of this study is in consonance with other aforementioned studies where the number of food vendors who have had medical examination were woefully less than the sample size. This implies that in a situation where food vendors are infected with any transmittable disease, consumers may not be safe for consuming food from such food vendors. Secondly,
early detection which is a good principle in treatment of disease may be skipped and consumer safety may be compromised.

5.1.2 Mandate to Sell
The food industry survives on sales and to get more sales, chefs, farmers and other vendors often take their wares to the streets, selling their food out of mobile kiosks and stands. Doing so requires a food vendor's license. It is also a requirement for all people who want to prepare and sell food on commercial bases to acquire a permit according to the municipal assembly’s bye-laws (UDEMA, 2002). This permit is subject to renewal every six months. Originally, the municipal has registered 405 food vendors. Out of this number three hundred and five (305) food vendors have been medically screened and ten (10) have not gone through it as at the time of this study. This study found out that 210 (49.6%) as against 175 (42.07%) have been given certificate to sell. It is interesting to know that the study sample was even more than the registered food vendors on the municipal assembly’s records.

The study also sought to find out when these food vendors had their certificates of operation. The study indicated that 110 (37.30%) had theirs within the last six months, 109 (36.90%) a year ago, 46 (15.6%) 2 years ago and 30 (10.20%) had their certificate 3 years ago. License to prepare and sell food on commercial bases expires after six (6) months of issue. This situation is probably occurring because of poor supervision and enforcement by the appropriate officers mandated to do so. It can also imply that the food vendors themselves do not know or understand the need or implication of selling without permit. It can also mean that because almost half of the food vendors are operating in the night, they have not been captured.
5.2 Proportion of food vendors trained

Health education on food hygiene plays an important role in ensuring that quality foods are produced. Food vendors require such education on regular basis to ensure that their food meets standards required of them. This study showed that 161(38.42%) had not received health education on hygiene practices. Among food vendors who have had health education, 172 (68.25%) receives it once a year. This finding is similar to the findings of Rane, 2011 who acknowledged that food vendors lacked factual knowledge in basic food safety measures which hampered the deployment of precise scientific approach to this very serious issue of public health importance. Also, epidemiological in Shangdong Province, China showed 49 deaths in 1983 -1992 relating these deaths to food poisoning. That study recognized deficiencies in knowledge about important parameters in the food chain and host pathogen interaction. In the event where food vendors do not attend workshops to update their knowledge on current trend of food preparation, they may stick to an existing style of food preparation which may be posing danger to the health of their patrons.

5.3 Means of contaminating food

5.3.1 Means of contaminating

The type of food stuffs a food vendor chooses to buy play an important role in either contaminating the food or compromising on its wholesomeness. From this study, 167 (40.73%) considered cost, 73 (17.80%) quantity, 100 (24.39%) quality and 20 (4.88%) also considered other factors including cultural background. Majority of the respondents looked at the cost of the product. In Ghana, there is a general perception that expensive products are of high quality. In a situation where food vendors would want to make super normal profit they may go for food items that are cheap without
considering quality. A good number of respondents also considered the quality of food stuffs irrespective of its cost. This implies that even though most people would want to make profit, some food vendors place a high premium on the quality of food they sell thereby selecting quality foodstuffs.

Some food vendors on the other hand, look at the quantity of the food stuffs which in most cases goes with its cost. In effect the cheaper the items, the higher the quantity that can be bought, all things been equal. Religious background is also one of the factors that influence one’s food choices. For example, Muslims would want to find out how an animal was slaughtered before buying meat. To them cost, quality and quantity does not matter, what is important is whether the slaughtering of the animal meets their religious standards.

5.3.2 Preparation of food

From the study 55 (13.85%) indicated that they (sellers) prepare and sell the food while 297 (74.81%) stated that other people apart from the sellers prepare the food. Some sellers indicated that medical examinations and any form of meeting for food vendors are attended by their owners. These owners in most cases are not directly involved in the preparation and sale of food. Assuming people who are directly involved in preparation and sale of food are not screened; they can be a source of food contamination.

5.3.3 Source of meat

This study showed that 149 (39.52%) bought their meat from cold store, 79 (20.95%) from market stall, 28 (7.43%) from abattoir and 76 (20.16%) from meat shop. Most
food vendors 256 (67.0%) express having knowledge on meat safety, 25 (6.61%) had no knowledge on what to look out for when buying meat, 59 (21.93%) looked out for color of meat, 62 (23.05%) looked for its brightness and freshness, 131 (31.0%) color and smell, 34 (12.64%) texture. Color, texture and quantity cannot be equated to meat quality. In situations where food vendors looked out for color, texture and quantity instead of meat safety tags then the possibility of compromising on meat quality becomes high.

5.3.4 Water supply

The importance of water cannot be sidelined when talking about the food vending industry. It is therefore a critical raw material in many street-vended operations. Water, when contaminated can create a public health risk when it is used for drinking, washing of foods, incorporated in the food as an ingredient and used in the processing of food or used for washing equipment, utensils and hands. It is a known medium for enteropathogens such as E. coli, Salmonella spp. and Campylobacter spp. amongst others (Rane, 2010). Studies carried out in different regions of Asia, Africa and South America has frequently pointed the unavailability of potable water for various activities at the vending site as a major concern. Due to the shortage of clean potable water, many vendors tend to reuse the water, especially for cleaning utensils and used dishes (Chekuezi, 2010). This report is similar to the findings of this study where 100 (23.64%) of food vendors were not having constant supply of potable water. This situation of not having potable water to wash hands in food preparation may pose a serious health risk to both food vendors and their patrons.
Studies done to find out the bacteriological quality of the water used by some street vendors have showed frequent contamination with coliforms and fecal coliforms. When the street foods in Trinidad and Tobago were analyzed, it was that 35% of foods were contaminated by E. coli while 57.5% of water used by vendors were contaminated by coliforms (Barro, 2006). Absence of potable water may create a situation where unwholesome water may be used to prepare food and even wash hands and this unwholesome water may contaminate food.

5.3.5 Means of transporting foodstuff to cooking site

The way food is packaged and transported from place of preparation to vending site can be a source of getting it contaminated. If food is carried on the head, by truck or car, the way it is packaged may pre-dispose it to contamination. A total of 86 (23.50%) by car, 4 (1.09%) by carriage truck and 68 (18.58%) prepares and sells at the vending site. Cooked food and utensils were not covered, which could result in food contamination due to the presence of dust and microbes at vending site. The utensils in which the food is displayed for sale must be kept clean, covered and protected as they easily become contaminated if left dirty or unprotected. Kinton and Ceserani (1992) recommends that foodstuffs of all kinds should be kept covered as much as possible to prevent contamination from dust and flies.

5.3.6 Storage of cooked food

Cooked food and utensils when not covered could result in food contamination due to dust and microbes. The utensils in which the food is displayed for sale must be kept clean, covered and protected as they easily become contaminated if left dirty or unprotected. Kinton and Ceserani (1992), recommend that foodstuffs of all kinds
should be kept covered as much as possible to prevent contamination from dust and flies. This study showed 75 (41.0%) food vendors stored food in open plastic which is similar to the findings of Donkor *et al* (2009) in an intervention study conducted in Ghana, the knowledge of the street food vendors where only 27% of the total respondents reportedly practiced good storage of food (*Donkor et al.*, 2009). In contrast, Campbell (2011) in his found eighty nine (89%) knowing how cooked foods are stored separately from raw foods and how foods are displayed to prevent contamination. No matter how safely foods are prepared, if it is not stored well and under right temperature, it can be predisposed to contamination. In Ghana, most patrons of the food vending industry would want to food displayed before making a selection of their choice. In view of this, food vendors prefer to display food items for easy access to speed customers’ decision making process on what to choose and also attract them to buy.

### 5.3.7 Frequency of changing water used in washing plates

Unlike Muinde and Kuria (2005) who found out that their respondents were washing in utensils in buckets and rinsing only once and the water used repeatedly before it was replaced. The findings from this study quiet contrasted the above study. It was observed that majority of respondents, 254 (67.37%) were observed to be washing bowls regularly as against 50 (13.26%) who observed to be doing otherwise, 27 (7.16%) did theirs at the beginning of sales.

Similarly, Chukuezi (2010) found out 47.62% of the vendors washed their utensils with dirty water which was recycled and used severally, thus, 28.57% of the vendors gave no reason for the recycling the water while only 9.52% of them complained of water shortages. Regular washing of bowls and plates use for serving food as well as
constant wiping of eating tables are very important in preventing food contamination. When bowls, plates and eating tables are not washed and cleaned regularly, it will attract insects such as flies to get the chance to contaminate food. Unfortunately, a significant number of food vendors in this study washed bowls and plates once before daily sales end. This habit creates a serious health risk as diseases causing microbes find such environment attractive to live in.

5.3.8 Treatment of left-over foods

It was showed from this study that 78 (20.26%) of food vendors reheated left-over foods for their next sales. Reheating food at the right temperature is not the problem but how these foods are stored before getting it reheated. From this study, 139 (36.10%) of food vendors said they consume their left-over, 121 (31.43%) discards it.

This finding is in contrast to a study by conducted by Muinde and Kuria (2005), where food vendors stored left-over foods in open places (21%), refrigerator (21%) and plastic containers (21%) while (16%) kept them in polythene bags or in cupboards, thus, proper methods of storing left-over foods were not used; hence promoting selling of stale food. In other words when food is not stored at the proper place and temperature, it may go bad or get contaminated.

At an international conference on nutrition, it was resolved that if food cannot be served immediately, it should be kept hot or cooled down rapidly and reheated completely to a temperature of at least 700 C before eating. This is to make sure that microbes will not thrive on the food because these microbes flourish well between 100 C and 600 C. It is recommended that the street food vendors prepare enough food for
the day, so that they can sell all the food since most of them do not have good storage facilities.

5.3.9 Availability of potable water

Latham (1997) emphasizes that personal hygiene can only be achieved if adequate water is available. Therefore, vendors should have sufficient portable water for drinking, preparation of all kinds of foods and sufficient running water for all washing operations.

In all, 151 (35.6%) food vendors lacked potable water and there cannot be proper hygiene practice without water for washing hands and cooking. The absence of potable water for some food vendors can lead to transmission of water and food borne diseases. The study also sought to find out whether water containers were covered or not and it was found that, 140 (33.2%) had no cover for containers. The availability of potable water is one thing and it being covered is another hence potable water can be rendered unwholesome for consumption when not covered and this can be a major cause of diseases to consumers of street foods.

5.3.10 Use of same hand to serve and collect money

Chukuezi (2010), conducted a study on food safety and hygienic practices on street food vendors in Owerri, Ngira. Results show that 61-90% handled money with same hand while serving. This findings is similar to this study as it was observed that a total of 355 (84.0%) were observed to be using the same hands to serve and collect money.

In most cases in Ghana, food vendors operate individually. Typically, a food vendor will be seen as dishing out food to customers and using that same hand collecting and giving change. On the other hand, some sole proprietors would want to receive the
money in order to monitor the progress of daily sales while they dish out food. Meanwhile, certain chemicals are used in minting money and these chemicals we are told can be harmful to human health. The tendency to contaminate food as they use the same hand to dish out food and collect money is high. Secondly, the chemical components of money can also be harmful to the health of its patrons. Some food vendors may engage themselves in this practice because of convenience as it is easier when one hand dishes and collects the money than to dish food, collect money and wash hands before serving the next client. Certain security checks on the authenticity of currency use to buy food requires that the hand must be use to feel money before its genuiness can be ascertained. The person handling money should not handle food without washing his/her hands because money is dirty and can contaminate safe food.

**5.3.11 Availability of hand washing soap**

Musa and Akande (2003) found that some food vendors lacked hand washing basin for immediate cleaning, soap and water to clean their utensils, while the rest 100 (54%) used unhygienic methods to clean their utensils. Their finding is similar to what was showed in this study where 157 (37%) were not having hand washing soap at their eating places. This situation is common as there is lack or no law enforces to check on the activities of food vendors and probably food vendors do not see the need for providing soap. Proper hand and bowl washing should be done with soap under running water. In situations where dishing bowls are not washed regularly, it creates an environment for insects such as flies to hover around to contaminate foods when it gets the chance.
5.3.12 Hand washing

Hand washing with soap and clean water is one of the most important ways of preventing diseases. Hand washing with soap has proven to be an effective way of removing microbial organisms from the hands. This study showed that, 187 (43.9%) out of 423 respondents did not use clean water for hand washing. Also, on availability of hand washing soap it showed that 157 (37.2%) of food vendors out of the total of 432 respondents did not have any soap at their stalls to be used for hand washing either by themselves or for their patrons. Washing hands with clean water alone cannot prevent the transmission of microorganisms unless soap is added yet the study showed a significant number (187) not using clean water to wash hands and this may be a contributory factor to finding microorganisms in food sample.

5.3.13 Talking while serving

It is an undisputable fact that communication plays a role in the vending industry, but communication in excess can be a source of contaminating food. Food vendors who suffer from droplets infections can contaminate food by talking excessively while dishing out food. It was observed from this study that, 249 (58.9%) talked excessively while serving as against 174 (41.1%) who talked less while serving. Those food vendors who talk excessively while serving may have some type of communicable disease which can contaminate the food they serving to customers.

5.3.14 Method of serving food

Burt, Volel and Finkel (2003), conducted a study to assess the food handling practice of 10 processing mobile food vendors operating in Manhattan, New York City and found out that over half of all vendors (67%) contacted served food with bare hands. Also
some vendors were observed vending with visibly dirty hands or gloves and no vendors once washed his or her hands or changed gloves in the 20 minutes observation period. Their finding is similar to the results of this study where 203 (48.0%) used ladle, 197 (47.0) of food vendors used their bare hands and 23 (5.0%) used hands covered with polythene to serve food. The vendor observed minimal personal hygiene meanwhile, personal hygiene is important because according to Marriot (1985), human beings are the largest contamination sources of food.

5.3.15 Use of Additives

The study showed that some food vendors 237 (59.70%) used food additives during food preparation, thus, food vendors preparing food like rice and stew, soups and waakye used additives. Some of these additives were ginger, magi cube, ‘onga’ seasonings and curry powder.

This finding is similar to a study done in Calcutta, where samples that were suspected of adulteration were analyzed and in 30 of the 50 samples, unauthorized food additives were detected. Pathogens like B. cereus, S. aureus, C. perfringens, V. metschnikovii and E. coli were reported in raw chicken, salad and gravy raw materials (Mosupye and Von Holy 1999).

The reason been that some vendors purchase cheap or adulterated ingredients containing unpermitted chemical additives from unauthorized suppliers which may further increase the risks associated with the food prepared. Other reasons include improving upon the taste, aroma and the color of food. Such additives could cause health related problems such as gastric cancer, heart burns, hypertension and stroke.
However, spices are known to harbor a large number of microorganisms which include members of the genus Bacillus, anaerobic spore formers, enterococci, members of Enterobacteriaceae, a variety of yeast and mould and pathogens like coagulase positive staphylococci (International Commission on Microbiological Specifications for Foods (ICMSF, 1996).

5.3.16 Customers making contact with food before choosing

According to revised guidelines for the design of control measures for street-vended foods in Africa, clean tongs, forks, spoons or disposable gloves should be used when handling, serving or selling food. In all, 39 (9.30%) customers were observed to be having contacts with food sold before making a choice. Personal hygiene is important because according to Marriot (1985), human beings are the largest contamination sources of food. Some vendors in his study did not wear aprons or caps, and they handled food with bare hands. Cooked street food should not be handled with bare hands as it may result in cross contamination.

5.3.17 Ensuring food hygiene

In ensuring food hygiene, 122 (30.50%) of the food vendors said keeping the environment clean will help keep their food clean, 147 (36.75%) said covering of food bowls, 28 (7.00%) also said cleaning food bowl always and preparing well cooked food 4 (1%). These findings is similar to the findings of Mensah, et al (2002) in a study in Accra where the study showed that among other factors that food vendors were aware that using spoons and forks instead of the bare hands can reduce food contamination, defective personal hygiene can also be a medium of transmitting pathogens from food vendors to customers. This implies that, food vendors are aware of some food hygiene
practices but due factors such as lack of enforcement of hygiene laws, resources, and commitment on the part of some food vendors makes it difficult and unwilling to apply them to the latter.

5.4 Environmental conditions under which foods were prepared and served

5.4.1 Personal and Environmental Hygiene

Observing personal hygiene is vital for any food establishment. Any food handler, who observes other forms of hygiene but not personal hygiene, will definitely contaminate food. Training should, therefore, be conducted for the street food vendors on various aspects of personal hygiene. According to UDEMA bye-laws section 5 and Local Government Act 462 (1993) any person who sells, prepares, packages, conveys, stores or displays for sale any food or drink under insanitary condition and without adequate protection from dust, bad handling etc commits an offence. Without enough water, hygiene and sanitary practices cannot be met. World Bank asserts that safe water is an essential pillar for health. Latham (1997) emphasizes that personal hygiene can only be achieved if adequate water is available. Therefore, vendors should have sufficient potable water for drinking, preparation of all kinds of foods and sufficient running water for all washing operations. It was observed from this study that, 371 (87.7%) appeared to be generally neat as against 52 (12.3%) who were otherwise. A total of 396 (93.7%) were observed to have had short finger nails while 27(6.3%) had long fingernails, 64 (15.1%) out of the total respondents had their fingernails polished.162 (38.3%) were observed to have covered their hair with a hair gear as against 261(61.7%) who had exposed their hair in different hairdo’s. A total of 157 (37.1%) were seen to be using protective apron while 266 (62.9%) did use apron. A total of 96 (22.6%) were seen to be wearing jewelry during serving while 327 (77.4%) were not
wearing it. Similarly, Burt, et al, (2003) in a study to assess the food handling practice of 10 processing mobile food vendors operating in Manhattan, New York City, observed 67% of respondents vending with visibly dirty hands or gloves and no vendor once washed his or her hands or changed gloves in the twenty (20) minutes observation period. This is very similar to a study carried by Musa and Akande (2003) in Nigeria where it was observed that 100 (57%) of respondents use previously used water for washing and cleaning, lack covering apron. In all, 128 (69%) lacked hand washing basin for immediate cleaning, soap and water to clean their utensils, while the 100 (57%) used unhygienic methods to clean their utensils.

A research finding in Kenya by Muinde and Kuria (2005), a study to determine the hygienic and sanitary practices of food vendors in Nairobi showed that food vendors observed minimal personal hygiene; 81.3% of the food vendors did not use apron, 60% handled food with their hair uncovered, all the vendors handled money while serving food and only 10 % of them wore jewelry on their hand. Chukuezi (2010) studies in Owerri, Ngira confirms this finding as it was showed that, 19.05% wore jewelry while serving foods. Jewelry can harbor microorganism and dirt under it. Water vapor from food due to its hotness can settle on the hands miss with sweat and may drip down into food to contaminate it. This makes wearing of jewelry while serving food unacceptable a practice for food vendors to engage in. Similarly, Okai and Dordi (2002) in a non-experimental design determined the knowledge, attitude and practice on food hygiene by food vendors of University of Ghana campus. The study showed that food vendors practiced poor food hygiene as evidenced by the poor state of cooking and selling environment as well as improper handling and washing of drinking cups, napkins and lack of proper water storage facilities. Contrary, Benny – Oliviera (2007), who conducted a study on “Hygienic practices by vendors of the street food “doubles” and
public perception of vending practices in Trinidad” in West Indies found out that food vendors were appropriately dressed (99.2%), used forks/spoons (100%) and tongs (81.7%) for serving.

Hairs can harbor microbes and so are clothing we wear to serve clients. This is the reason why hair must be covered as well as our clothing to prevent microorganism and dirt from having access to food. Even though some food vendors were aware of the importance of putting on an apron and a hair cover, they choose not to do it. In this sense, the wearing of these coverings may be seen as a choice other than obligation. Secondly, it may also be as a result of lack of enforcement by the authorities entrusted to do it. Equally, some vendors may also not be aware of the essence of these covering and may even regard them as mere decorations to attract customers. Personal and environmental hygiene plays an integral role in preventing food from being contaminated. Food safety can be compromised in a situation where food vendors do not cut fingernails, cover their hair and put on protective apron. Uncovered hair and unkempt nails can harbor microorganisms which can get food contaminated. The fact that a study in the West Indies shows positive results is an indication that, it is possible for food vendors to live up to personal and environmental hygiene standards provided they are given the needed support, education and respective laws enforced.

5.4.2 Location / Environmental hygiene

FAO (2008) notes that foods should be prepared in a place set aside exclusively for that purpose, while the place of preparation should be kept clean at all times and should be far from any source of contamination (rubbish, waste water, dust and animals). Vending stalls should therefore be designed and constructed so that they are easily
cleaned and maintained as such the Ministry of Local Government should design appropriate food vending stalls. Also, according to FAO (2008) adequate drainage and waste disposal systems and facilities should be provided in the street food industry and designed properly so that the risk of contamination of food and potable water is low. Where food is prepared and sold is crucial to avoiding it been contaminated or otherwise and this study shows that, 380 (90%) food vendors sold along roadside, 22 (5%) near gutters, 15 (4.0%) close to a bush and 6 (1%) none of the options probably hawking. This study reveals that, 130 (30.74%) food vendors prepare the food they sell at their vending place while 293 (69.26%) prepare the food at home and sold at a different place. A total of 353 (83.5%) do have constant water supply as against 49 (11.6%) indicating otherwise. It was observed that, 253 (59.7%) food vendors operated in a fairly clean environment as against 170 (40.3%) with varying sanitation challenges. Again, 127 (30.0%) respondents had garbage and dirty waste close to selling place, 302 (71.5%) food vendors had no dustbins to keep waste, 378 (89.3%) had dustbins which were not covered. These findings are similar to that of Annan-Prah in Cape Coast, Mensah et al., (2002) in Accra, Muinde and Kuria (2005) in Kenya, Barro et al., (2002) in Ouagadougou and Paa Nii (2005) in Accra.

Poor sanitation continues to be a major environmental challenge and a contributing factor to food contamination in Africa as food vendors operate under varying degrees of environmental challenges. In most cases, the authorities mandated to oversee their activities are not able to do so due to various reasons ranging from lack of manpower to equipment’s to work with.

Unhygienic environment are breeding place for houseflies and other disease causing microbes hence the need for food vendors to operate within a clean environment.
5.4.3 Availability of place convenience

In all, 53 (12.6%) had place of convenience available within some few meters away from where they sold while the majority of respondents, 370 (87.4%) had no place of convenience at their vending sites. This is similar to findings from Benny–Oliviera (2007) who conducted a study on “Hygienic practices by vendors of the street food “doubles” and public perception of vending practices in Trinidad” in West Indies.

At vending sites, containers with faucets supplied water (85.7%) and place of convenience were not close (97.5%).

Meanwhile, closeness of place of convenience to food vending site can pose a health risk to the final consumers of such foods as flies can settle on food and cause contamination. On the other hand, in situations where there are no places of convenience available to food vendors and their patrons, people may indiscriminately defecate around thereby increasing the risk of food contamination.

5.5 Microbial quality of some selected foods

5.5.1 Microbial quality of some selected foods

A prospective study conducted by Feglo and Sakyi (2008) among street food vendors in four bus terminals in Kumasi showed that bacterial counts on selected food like fufu, red pepper, ice-kenkey, macaroni, and salad. The isolates obtained among other bacteria were negative staphylococcus aureus, faecal coliforms and staphylococcus aureus were isolated in unacceptable levels; Staphylococcus aureus (3.7%) and Escherichia coli (2.2%). The results of this study also show similar trend as microorganisms were isolated in this study. The similarity between these two studies are as a result of that fact that, food vendors operated within similar settings, their knowledge levels were similar, prevailing defective environmental and personal hygiene
conditions according to the studies. This is may be the reason why this study isolated aforementioned microorganisms in foods sold on the streets of Dunkwa-On-Offin.

Again, this study is similar to Mensah et al, (2002), a study in Accra in the sense that factors such as poor environmental and personal hygiene, non enforcement food hygiene bye-laws, selling along gutters and poor hand washing practices were all identified in both studies. Some of these factors create a congenial atmosphere for microbes to exist or multiply. It was therefore not surprising to have isolated Staphylococcus aureus, Escherichia coli and Salmonella typhi in selected food such rice, banku, kenkey and fufu samples.

Similarly, in Santa Fe de Bogota, Colombia a study conducted on a group of food vendors by Buchanan et al in 1998 and their study showed that 30 % of food vendors were carriers of pathogenic microorganisms including Salmonella typhi, Staphylococcus aureus, Salmonella enterididis and shigella. This reflected in the high levels of Escherichia coli, Staphylococcus aureus in foods they sold. Presence of Escherichia coli of faecal origin was detected in all investigated food samples. Khebab, fried fish and beans with gari had acceptable bacterial contamination levels of <5 log10 cfu/g. Yeasts were found in all investigated food items. These findings were similar to the findings of this study where Escherichia coli, Staphylococcus aureus, and salmonella typhi were isolated in pepper and tomato source, kenkey and banku.

The street foods were, therefore, found to have threatening unacceptable microbial contamination levels. Unfortunately, food vendors in Dunkwa- On –Offin do not undergo all test as it happened in Bogota. However, these findings may be as a result of environmental conditions under which foods were prepared, stored and dished to customers.
Stakeholder education, legislation, verifiable microbiological standards, inspections and environmental sanitation improvement are necessary to ensure quality standards.

Begue et al. 1997 sample one hundred and four food vendors to ascertain risk factors with regards to the transmission of *H. pylori* in Lima, Peru. They concluded that their findings supported the role of prepared foods under unhygienic conditions as a probable mechanism of transmission of *H. pylori* in developing countries. This finding is similar to the findings of this study as poor environmental condition continues to be a constant factor contributing to food contamination.

### 5.5.2 Pepper and tomato sauce

Sauces appeared to be even more contaminated with bacteria *Escherichia coli* which were isolated from tomato and pepper stew. These are usually prepared the day before consumption and if reheating in inadequate, bacteria can multiply which could be the reason why in all food samples collected, 64% were isolated for *Escherichia coli*. This finding is similar to a study by Mensah et al. (2002) in a study ascertaining the safety of street foods in Accra where pepper and tomato sauce were also isolated for *Escherichia coli*.

Sauces, such as red pepper sauce, are made from fresh vegetables and eaten without been heated. All bacteria introduced from harvesting, during food preparation and packaging may multiply if held for prolonged periods at ambient temperature. Also, pepper and tomato sauce for accompanying kenkey is usually not properly washed therefore if it is not washed as it should be, it can be a source of contamination.
5.5.3 Scooping of food

The scooping of rice and waakye into bowls or polythene bags was a major influence in the contamination of these foods in a study by Mensah *et al.* 2002. Similarly, this study showed that food vendors dished out food into polythene bags, plates and bowls for customers. These bowls, plates and polythene bags could be a source of contaminating food if it is not appropriately and hygienically taken care of.

5.5.4 Excessive handling of fufu

Defective personal hygiene can facilitate the transmission of these pathogens via food to human, since the serving stage is a critical point in the street food industry. Entero pathogens can survive on the hands for three hours or longer. Diarrheal pathogens on the hands of mothers can be transmitted to infants (Mensah, 1997). In similar studies *E. coli* was detected in hand washings of high-income and low-income mothers in India at levels of 7.0 + 4.2 log10 cfu/ml and 9.0 + 5.7 log10 cfu/ml, respectively (19). In Peru, *E. coli* was detected in 11 of 78 mothers’ hand washings (15). In Thailand, entero toxigenic *E. coli* (ETEC) was detected in 6 of 42 mothers’ hands and in 50 of 37 children’s hands. In most instances the type isolated from diarrheal cases corresponded to that isolated from hands (20).

The preparation of fufu involved pounding the staple after cooking by means of a mortar and pestle and turning the stiff dough with bare hands, which were occasionally washed in a container. During the preparation of fufu, there is a direct contact of hands to the food and if this hand is defective hygienically, it can directly contaminate the fufu. This could be the reason why *staphylococcus aureus* and *faecal coliforms* were isolated in fufu.
5.5.5 Flies activity

Pathogens can be passed mechanically by flies because *Salmonella typhimurium* and *shigella* can multiply in the gut of the housefly and can be excreted for weeks or longer. There is consequently a risk of contamination associated with the exposure of food to flies. Flies like habiting in gutters, places of convenience and dirty environments. This study showed that some food vendors sold along gutter and some with uncovered dustbins. This situation created congenial atmosphere for flies to exist, moreover, the presence of these flies serves as carriers of these disease causing microbes.

FAO (2008) notes that foods should be prepared in a place set aside exclusively for that purpose, while the place of preparation should be kept clean at all times and should be far from any source of contamination (rubbish, waste water, dust and animals). Vending stalls should be designed and constructed so that they are easily cleaned and maintained.

5.5.6 Availability of Soap

The use of soap to wash utensils and crocked reduced the levels of bacteria. Gram-negative bacilli such as *Salmonella typhi* are fairly susceptible to soap made from saturated fatty acids while most microorganism die after coming into contact with soap but their susceptibilities vary. This study showed 32% unacceptable rate of *Salmonella typhi* in all food samples collected and *salmonella typhi* isolated could be as a result of lack of hand washing soap which this study showed a percentage rate of 37.2 representing 157 stalls visited.
CHAPTER SIX

Conclusion and Recommendation

6.1 Conclusion

This study intended to find out some relevant background information on street food vendors in the selected population. The study findings indicated that 97 (22.93%) had no formal education, 241 (57.11%) taught themselves food preparation and 175 (42.07%) started food vending without going through the appropriate procedures.

The proportion of food vendors who have not been trained in food safety from the study population was 161 (38.42%) and 172 (68.25%) had been trained once ever since they joined the food vending business.

This study identified factors such as places where food is stored, sources of water for food preparation, source of meat, treatment of left-over food, exact kitchen or site for food preparation, poor hand washing practice among other factors are ways by which street foods could get contaminated.

Poor environment of food vending site is a major determinant of food safety in the food vending industry. This study intended to establish the environmental conditions under which food vendors prepared and sold food in selected population. The findings indicated 127 (30%) prepared and sold food close to garbage and dirty waste, 380 (90%) sold along side road and 22 (5%) conducted sales near a gutter.

This study intended to ascertain the microbial quality of some selected foods that were sold along the streets of selected population. The study finding indicated the presence
of microbial agents of more are those that potentially could cause serious gastrointestinal infection. These isolated micro organism included *salmonella typhi, Escherichia coli, Staphylococcus aureus and fecal coliforms.*

Any intervention should therefore target organizing periodic training on food safety, food preparation, means of contaminating food, strictly regulating and monitoring activities of food vendors and organizing routine screening for food vendors on some selected medical conditions.

**6.2 Recommendations**

Based on the findings of this study, a recommendation is made to the Upper Denkyira East Municipality (UDEMA) with a view to initiate suitable intervention. The planned intervention shall be aimed at improving the personal hygiene of food vendors and improving upon the sanitation conditions under which foods are prepared within the municipality.

A copy of the major findings of this study shall be given to the Health Department (Municipal Health Directorate) of the UDEMA. Discussions should be held with the relevant staff of the UDEMA in order to facilitate the implementation of findings of this study.

Based on the findings of this particular study, the following recommendations are made to the UDEMA in order to improve overall efficiency and effectiveness of the food vending industry;

**Municipal Assembly**

1. Health education which focuses on personal and environmental hygiene must be organized by the Municipal Assembly in collaboration with the Health Directorate of UDE for food vendors at every quarter. This recommendation,
when implemented will help address the challenge the study found with poor personal and environmental.

2. Licensed street food vendors must be provided facilities by the municipal assembly for conducting their trade since some of the street vendors do not sell under decent environmental conditions.

3. The municipal assembly must increase awareness about the benefits of observing proper food hygiene practices by food vendors.

4. The municipal assembly should provide incentives for food vendors who are doing a good job in terms of personal and environmental hygiene.

**The Environmental Health Department - UDEMA**

5. The environmental health department should promote improved methods of preparing and selling food through the available media houses in order to reach most of the food vendors to improve upon food vendors’ knowledge on food preparation.

6. Medical examination should be done at least four (4) times a year and the law ensuring it must be enforced. This recommendation when implemented will improve upon the number of food vendors who have been screened to work in the food vending industry.

7. Food vendors who have successfully undergone medical examination must be given tag / certificate to be displayed at their vending stalls. This recommendation will help to easily identify food vendors who are not complying with the by-law which states that food vendors must be medically screened before they are certified to sell food.

8. Monitoring of food vendors at night to by the UDEM environmental officers ascertain the right population of people in the food vending industry.
The Government of Ghana

9. The government should invest in the street food industry as it provides employment, cheap food, and wide variety of foods for the urban dwellers. Through the ministries of Health and Local government, legislation should be developed to recognize the street food industry by developing code of practice for street food vending.

10. There should be an establishment of sub-units of committees like National Food and Drugs Board that would be involved in the regular check up of sanitary conditions of fast food centers just like the Food Safety and Inspection Service (FSIS) UK.

11. For further studies, it is recommended to screen street foods for parasites such as Ascaris and Planaria. The hands of food vendor should also be screened or analyzed for pathogenic microorganisms.
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APPENDIX

Appendix I

UPPER DENKYIRA EAST
HEALTH FACILITIES AND COMMUNITIES

Legend
- Dunkwa Sub
- Kyekyewere Sub
- Oponso Sub
- Pokukrom Sub
- Facilities_UDE
- Communities

Prepared by: John Hammond (HDO-UDE)
Check list for evaluating food vendors the microbial content and hygiene practices among food vendors in relation to the food they sell.

**SERIAL NUMBER_________________**

<table>
<thead>
<tr>
<th>SERIAL NUMBER</th>
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<th>NO</th>
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<tbody>
<tr>
<td>1. Physical appearance: neat</td>
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<tr>
<td>2. Location of stall or shade where food is sold</td>
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<tr>
<td>Roadside</td>
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<tr>
<td>Near gutters</td>
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<td>Close to bush</td>
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<td>None</td>
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<tr>
<td>3. Sanitation of place of selling :clean and neat :</td>
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<tr>
<td>4. Garbage and dirty waste close to the place of selling</td>
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<tr>
<td>5. Availability of dust bins to keep waste</td>
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<tr>
<td>6. Availability of covered dustbins</td>
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<tr>
<td>7. Presence of houseflies in the stalls or shade where food is sold</td>
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<tr>
<td>8. Regular wiping of eating table</td>
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<tr>
<td>9. Availability of portable water</td>
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<tr>
<td>10. Use of clean water for washing hands and plates</td>
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<tr>
<td>11. Water container covered</td>
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<tr>
<td>12. Prepared foods are stored in ;</td>
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<td></td>
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<tr>
<td>Flytrap sieve</td>
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<td>Glass sieve</td>
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<td>Open bowl</td>
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<tr>
<td>Plain rubber suck</td>
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<td>Ice chest</td>
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<tr>
<td>13. Hair covered</td>
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<tr>
<td>14. Vendor having apron on</td>
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<tr>
<td>15. Use of the same hand to serve and collect money</td>
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<tr>
<td>16. Regularly washing bowls</td>
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<tr>
<td>17. Availability of hand washing soaps</td>
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<td></td>
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<tr>
<td>18. Talking while serving food</td>
<td></td>
<td></td>
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<tr>
<td>19. Method of serving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hands covered with polythene</td>
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<tr>
<td>Bare hands</td>
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<tr>
<td>Ladle</td>
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<td>20. Wearing of jewellery during serving</td>
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<tr>
<td>21. Fingernails are;</td>
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<tr>
<td>Kept short</td>
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<td>Polished</td>
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<tr>
<td>22. Availability of napkins</td>
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<tr>
<td>23. Use of cloth /dress /apron as napkins</td>
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<tr>
<td>24. Availability of place of convenience</td>
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<tr>
<td>25. Customers allowed making contact with food sold before making a choice</td>
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</table>
Appendix III

QUESTIONNAIRE

This questionnaire is designed to assess hygiene practices among food vendors in relation to the food they sell in Dunkwa–On–Offin, Upper Denkyira East municipality. All information given on this questionnaire will be held confidential. Names are not required on this questionnaire.

Please tick ( ), fill in the blank or write as appropriate to each question.

SERIAL NUMBER___________________

SECTION A

DEMOGRAPHIC INFORMATION

1. Age
   15-25 years [ ]
   26-36 years [ ]
   37-47 years [ ]
   48-58 years [ ]
   Specify, if otherwise_______

2. Sex
   Male [ ]
   Female [ ]

3. Place of residence _______________________

4. Level of education of respondents
   None [ ]
   Primary school [ ]
   Middle school [ ]
5. **Religion**

- Christian [ ]
- Islam [ ]
- Traditional [ ]
- Others ____________________

6. **Marital status**

- Single [ ]
- Married [ ]
- Separated [ ]
- Divorced [ ]

7. **Where did you get your start-up capital from?**

- Spouse [ ]
- Parents [ ]
- Relatives [ ]
- Friends [ ]
- Credit from banks [ ]
- Specify if others________________________
SECTION B

FOOD HYGIENE PRACTICES

8. For how long have you been selling or preparing food for sale?

   0-2 years    [    ]
   3-5 years    [    ]
   6-8 years    [    ]
   9 and above  [    ]

9. How did you acquire your knowledge on food preparation?

   From relatives  [    ]
   Self taught     [    ]
   Catering school [    ]

10. What food do you sell?

    Ice kenkey      [    ]
    Waakye          [    ]
    Kenkey and hot pepper [    ]
    Fufu            [    ]
    Fried rice      [    ]

11. How did you get mandate to prepare and sell food?

    Through application to environmental officer [    ]
    Contacting a health inspector               [    ]
    Started on your own                          [    ]
    Continued from a friend or relative          [    ]
12. Where do you buy food stuffs and vegetables from?

Dunkwa town [ ]
Surrounding villages [ ]
Obuasi [ ]
Kumasi [ ]
Others________________

13. What do you consider before you select food stuffs?

Cost [ ]
Quantity [ ]
Quality []
Cultural background [ ]
Specify if others________________

14. Where do you buy your meat from?

Meat shop [ ]
Abattoir [ ]
Cold store [ ]
From open market []

15. Do you have any knowledge on indicators of safe meat?

Yes [ ] No [ ]

16. If yes, what do you look out for?

______________________________________________________________
17. Where do you prepare your food before selling?
   At the selling place [ ]
   At home [ ]

18. If at home, is it in an; open space [ ] or kitchen [ ]

19. Who prepares the food?
   Seller [ ]
   Other people apart from seller [ ]
   Others, specify ____________________________

19. Is there constant supply of water at the place of cooking? [ ]

20. Where do you get water from when the tap is not flowing?

21. Do you know that contamination of food can lead to food poisoning?
   Yes [ ]
   No [ ]

22. What are some of the diseases that can be contracted from contaminated food?
   __________________________________________

23. Do you use food additives and condiments during and after food preparation?
   Yes [ ]
   No [ ]
24. How do you transport foodstuff to cooking site?

By carrying [    ]

By car [    ]

By carriage truck [    ]

25. Where do you store cooked foods?

In an open plastic bowl [    ]

In an ice chest [    ]

In a saucepan [    ]

In a plain rubber suck [    ]

Specify if others ______________________

26. How often do you wash your plates?

At the end of the day [    ]

After each use [    ]

At the beginning of sales [    ]

27. How often do you change the water for washing plates within the period of sales?

Once [    ]

Twice [    ]

3 times [    ]

4 or more [    ]

28. How do you treat leftover foods?

Consume [    ]

Discard [    ]

Reheat for sale [    ]
29. Have you ever undergone medical examination?
    Yes [ ] No [ ]

30. If yes, when was the last time you underwent medical examination?
    A year ago [ ]
    2 years [ ]
    3 years [ ]
    4 years [ ]

31. How often do you go through medical examination?
    Once every year [ ]
    Once every two years [ ]
    Once every five years [ ]
    Specify, if others_____________________

32. Have you received any health education on food hygiene?
    Yes [ ] No [ ]

33. If yes, how often do you go through it?
    Specify______________________________

34. Do you have a certificate to sell food?
    Yes [ ] No [ ]

35. If yes, when was it issued?
    ________________________________

36. What do you do to ensure food hygiene?
    ________________________________
7th January, 2014

The Chairman
The Committee on Human Research,
Publications and Ethics
KNUST – SMS/KATH
Kumasi

Dear Sir

LETTER OF INTRODUCTION

This is to introduce to you Emmanuel Boateng Acheampong an MPH Health Education and Promotion student from the Department of Community Health, School of Medical Sciences, Kwame Nkrumah University of Science and Technology.

He needs ethical clearance to be able to complete her research in fulfillment of the requirements of the award and I would be very grateful if you would kindly assist her in this endeavor.

Thank you.

Sincerely,

Dr. Ellis Owusu - Dabo
SUPERVISOR
In case of the reply the number
and the date of this
letter should be quoted.

MUNICIPAL HEALTH DIRECTORATE
UPPER DENKYIRA EAST

My Ref. No. UDE/MHD/PR/217
Your Ref. No. .......................................................... 29 November 2012

THE ETHICS COMMITTEE CHAIRMAN
KNUST
KUMASI

Dear Sir,

LETTER OF NOTIFICATION

I write to confirm that the Municipal Health Directorate of the Upper Denkyira East has been contacted by Mr. Boateng Acheampong Emmanuel, an MPA student from KNUST to conduct a study on "Food Hygiene practices by food vendors and assess microbial quality of some selected food sold".

Thank you.

.....................................................
DR. GODFRED KWABENA SARPONG
(MUNICIPAL DIRECTOR OF HEALTH SERVICES, PH)
Picture A: a woman selling very close to the gutter

B: A Cluster of food stalks along a main drain

C: A poorly constructed eating/kitchen along a road side

D: A food vendor serving with no hair gear but an apron

E: a partially exposed fried fish on display and a serving ladle exposed on a table

F: A popular eating joint