UNIVERSITY OF CAPE COAST

FOOD SAFETY IN SELECTED SENIOR HIGH SCHOOLS IN THE HO MUNICIPALITY, VOLTA REGION

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis 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.

Candidate's Signature…… Date……

Name: Melody Enyonam Appietu

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of the thesis laid down by the University of Cape Coast.

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ABSTRACT

In the school catering setting, food handlers particularly those in boarding senior high schools are considered the most sensitive group responsible for all forms of contamination resulting in various forms of food-borne illnesses. The purpose of the study was to assess food safety in selected Senior High Schools in the Ho Municipality. Questionnaire and observation checklist were used to gather data on the food safety knowledge and practices of 97 food handlers recruited from boarding secondary schools registered with the Ghana Education Service in the Ho Municipality. Sixty food samples collected from the schools were also analyzed to determine their microbial quality. Chi-square statistic was used to establish the relationship between food safety knowledge and the socio-demographic characteristics of food handlers. The results showed that majority of food handlers had high knowledge in food safety issues but their practices did not reflect this level of knowledge. Among the major barriers that accounted for the gap between knowledge and practice were inadequate provision of equipment and resources, irregular water supply as well as inadequate space and the unenclosed nature of the kitchen. These subsequently influenced the microbial quality of prepared foods served to students. It is recommended that closer and more stringent supervision during food preparation processes in boarding secondary schools should be carried out by the Ho Municipal Assembly to prevent possible outbreak of food-borne illness in the future. Also, health education should be carried out by the Ho Municipal Assembly together with the school authorities to improve the food safety knowledge and hygiene practices of food handlers.

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DEDICATION

To my children

Prince-Henry and Francisca Hadzah

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LIST OF ACRONYMS

ACC	Aerobic Colony Count
ADWG	Australian Drinking Water Guidelines
AWUSCO	Awudome Secondary School
CDC	Centers for Disease Control and prevention
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drugs Authority
FoF	Flow of Food
FSMS	Food Safety Management Systems
GES	Ghana Educational Service
GHP	Good Hygiene Practices
HACCP	Hazard Analysis and Critical Control Point
HMA	Ho Municipal Assembly
ICMSF	Institutional Commission for Microbiological Specification for Foods
MMDAs	Metropolitan Municipal District Assemblies
NRAEF	National Restaurant Association Educational Foundation
PHC	Population and Housing Census
TC	Total Coliforms
TPC	Total Plate Count
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

Background to the Study

Food in the human development process is an important basic necessity as its procurement, preparation, and consumption is vital for the sustenance of life (Daniyan & Nwokwu, 2011). Food is said to be any substance in a liquid or solid form that can be taken through ingestion to supply essential nutrients which provides energy for growth and development of the human body. It is also required by microorganisms for growth due to the rich nutrients they contain. Undoubtedly, food has direct impact on health (Daniyan & Nwokwu, 2011) and is therefore appropriate to avoid contamination from possible sources such as water, atmosphere, dust, sewage, surfaces, equipment, insects, rodents, and humans otherwise known as food handlers.

As described by Scallan, Angulo, Tauxe, Widdowson, Roy and Jones (2011), a food handler is anyone who works in food or drink establishments and handles food or has contact with any equipment or utensils such as cutlery, plates, bowls or chopping boards that are likely to be in contact with food. In other words, they are directly involved in the food handling processes from the preparation through to the service stage (Ishak, Mustaffa, Hamid, Shaari, Hamzah & Talib, 2013). Food handlers may include hawkers, restaurant staff, cooks in kitchens of various institutions, food factory workers and so on.

According to WHO (1989), food handlers play a major role in both the promotion and prevention of food contamination or poisoning throughout the chain of production, processing, storage, preparation, and service in the food sectors. Food handlers can promote food contamination by improperly

handling, storing, and inadequately cooking raw and processed foods (Abdalla et al. 2009). On the other hand, they can prevent food contamination by doing otherwise.

Food handlers carry food-borne pathogens such as Hepatitis A, *Noroviruses, Typhoidal Salmonella, Staphylococcus aureus* and *Shigella sp* in their hands, cuts or sores, mouth, skin, and hair (Adams & Moss, 2008) and gradually transfer them onto foods during preparation. This occurs because they neglect and take for granted certain basic rules of safe hygiene practices which eventually lead to outbreaks of food-borne illnesses (WHO, 1999). Their level of food safety knowledge and practices is therefore critical for the prevention of microbiological contamination and spoilage of food which leads to food-borne illnesses (FAO, 1995, cited in Abdalla, Suliman & Bakhit, 2009) of various forms.

As indicated by Walker, Pritchard and Forsytre (2003), food handlers are also asymptomatic carriers of food poisoning organisms thus, they do not show obvious symptoms of them but a clinical examination confirms they are carriers. In a retrospective cohort study conducted to investigate an outbreak of acute Norovirus gastroenteritis in a boarding school in Shanghai, this assertion was confirmed as asymptomatic food handlers were found to have contaminated the cooked food during its preparation (Xue, Fu, Zhu, Fei, Zhu, Zhang, Pan, Xu, Wang, Wang & Sun, 2014). Clearly, food handlers who are asymptomatically ill may present a real hazard and therefore should be thoroughly examined and declared medically fit before permitted to handle any food in the kitchen.

Food-borne illness is a disease transmitted to human beings through food (NRAEF, 2008) and is usually caused by ingesting food or drinking water

contaminated by dangerous microorganisms and their *toxins, parasites, viruses,* or toxic chemicals (World Health Organization [WHO, 2006]; Khan, Cao, Zheng, Huang &Zhu, 2008; Suther, Chimpa &Singh, 2009; Gamara, Manuel, Piper, Nachimuthu & Balasundaram, 2013). This constitutes a major public health problem in almost all parts of the world (Martins, Hogg & Otero, 2012).

As an example from the Unites States of America (USA), the Center for Disease Control and Prevention indicated that an estimated figure of 48 million food-borne illnesses is recorded annually, out of which 128,000 result in hospitalizations and 3,000 results in the death of victims (CDC, 2011). Similarly, statistics compiled in Ghana indicate the occurrence of food-borne illnesses being common with 420,000 cases per year and an annual death rate estimated at 65,000, costing some US$ 69 million to the Ghanaian economy (Mahami & Odonkor, 2012).

As an ongoing phenomenon, incidents of food-borne illness are still being reported, with the food service industry consistently implicated in a number of the outbreaks (Lues & Van Tonder, 2007; Velusamy, Arshak, Korostynska, Oliwa & Adley, 2010). With reference to data published by the European Food Safety Authority (EFSA, 2010), 48.7 % of verified food-borne outbreaks were associated with catering services. Comparable data from Ireland indicated that approximately fifty percent of all food-borne illnesses were traced to food eaten in catering establishments (Anonymous, 2000a, 2000b).

Failure to observe satisfactory standards in the preparation, processing, cooking, storing or retailing of food (Tomohide, 2010), obtaining food from

unsafe sources, inadequate cooking, improper holding temperatures, and the use of contaminated equipment were the factors cited to be responsible for the frequent outbreaks of food-borne illnesses (Bean & Griffin, 1990). Quite apart from these factors, specific mention has been made of the poor food safety knowledge and practices of food handlers (Howes, McEwen, Griffiths& Harris, 1996; WHO, 2000) particularly in both the commercial and welfare or institutional sectors of the hospitality and tourism industry (WHO, 2002; Adams & Moss, 2008; EFSA, 2009).

The hospitality industry is made up of two major sectors which are commercial and institutional. Marzano (2010) explains that institutional catering basically provides meals to their consumers either as part of a service to the community or as a complementary service to the main product or service on offer. Examples include police and military catering, schools and hospitals catering, nursing homes, prisons and daycare centers. One major characteristic of this sector is the fact that it is a non-profit oriented operation (Tan, Rifan, Khalid, Musa & Anuar, 2015) usually operating within an allocated budget (Foskett, Ceserani & Kinton, 2003). Depending on the policy of the institutional operation, the budget allocated may usually span over a quarterly, termly or an academic year period as in the case of boarding senior high schools.

Senior high schools in Ghana are either owned privately or publicly by individuals, corporate organizations, or the government. Public senior high schools apart from students fees, mostly receive government's subventions (feeding grant) as a subsidy to the cost of providing some basic needs especially school meals. However, in the private senior high schools, meals

provided to students are run on commercial basis similar to the case in the United Kingdom (UK) (Abrams, 2007).

School catering is the focus for this study and it is described as the preparation and provision of meals to students in schools either on commercial or non-commercial basis. According to Tikkanen and Urho, (2009), school catering has constituted a part of the curriculum in comprehensive school education as well as an integral part of student welfare since 2004. It has over the years formed the pivot of interest and a cause for concern for parents, school officials, researchers as well as governments. The reason being that, providing school meals to students constitute an important educational function and implies a number of factors namely: a physiological aspect of learning to eat properly and the cultural phenomenon of learning different varieties of foods (Pagliarini, Gabbiadini & Ratti, 2005). Further, it can help enhance students' cognitive development and eventually impact on their educational performance.

The boarding school setting represents a second home to students. It stands out among all the institutional catering services due to communal feeding of a large number of students who equally require great care in terms of food safety (Ababio & Lovatt, 2015). School meals accordingly play a significant role in the school setting because they are one of the most perceptible instruments for policy intervention in the development of healthy eating patterns for students (Moy, Gan & Siti Zaleha, 2006; Yabanci & Sanlier, 2007). It is therefore important that schools realize their shared responsibility in providing nutritious and safe meals to their students (Aziz & Dahan, 2013) during this period of nurturing.

In Ghana, the institutional catering sector particularly schools have been identified as a platform for facilitating the occurrence of food-borne illnesses thus, accounting for 77 percent of all traceable food-borne diseases in the country (Alale, 2013). This is evident in the number of food-borne illness outbreaks reported in the media. For example, about forty (40) students of the Adonten Senior High School in the Eastern Region were hospitalized following what medical professionals described as a case of food poisoning after eating a meal from their dining hall (City FM online, 2013).

Another report based on anecdotal evidence indicated that, almost 20 students of Awudome Senior Secondary School (AWUSCO) at Awudome-Tsito in the Ho-West District were rushed to the Ho Regional Hospital on suspected cases of food poisoning after eating food from their dining hall. Yet another report of 15 students from the North Ridge Senior High School in Adeiso in the Eastern Region were rushed to the Adeiso Health Center on suspected cases of food poisoning after eating food from their dining hall (City FM online, 2013). Apart from the immediate gastrointestinal symptoms, affected students may exhibit signs such as nausea, vomiting, stomach pains, abdominal cramps, diarrhea as well as long-term health effect such as kidney failure, disorders of the brain and nervous system (Mossel & Struijk, 1995).

According to Oranusi, Galadima, Umoh and Nwanze (2007) these incidents occur as a result of the poor food preparation and storage practices together with poor personal hygiene and the lack of knowledge in food safety practices that are inherent with food handlers' notably in boarding schools. In addition, the incorrect food safety practices of food handlers at various stages of the food storage, preparation, or service process such as improperly washed

utensils and equipment, poor hygiene, dirty environment, and the presence of animals in the cooking environment are attributable to the outbreaks.

Similarly, findings from observational studies conducted by various researchers revealed poor hand washing (Henroid & Sneed, 2004; Hertzman & Barrash, 2007), lack of hair restraints (Giampaoli, Cluskey & Sneed, 2002; Gilmore, Brown & Dana, 1998), lack of calibration of thermometers (Henroid & Sneed, 2004), improper reheating (Kim & Shanklin, 1999), inappropriate sanitizing of equipment, improper heating and cooling (Henroid & Sneed, 2004) as well as consumption of food in food preparation areas (Giampaoli, Sneed, Cluskey & Koenig, 2002) as factors contributing to food contamination in schools.

The frequent occurrence of food-borne disease outbreaks has led to the global concern for ensuring food safety in all operations and institutions that handle food (Sanlier & Konaklioglu, 2012; Lues & Van Tonder, 2007). According to Keener (2005), food safety refers to the biological, chemical or physical status of a food that will permit its consumption without incurring excessive risk of injury, morbidity or mortality. Alternatively, the WHO (1984) defines food safety as the conditions and measures that are necessary during the production, processing, storage, distribution, and preparation of food to ensure it is safe, sound, wholesome, and fit for human consumption.

Food safety is a public health challenge and its concern for all has necessitated the need for governments who bear the brunt of these outbreaks including other international organizations and local authorities worldwide to intensify efforts to improve food safety in the food processing chain (Sanlier, 2010; Sanlier & Turkmen, 2010). Among such efforts is the enforcement of

laws on food safety, adequate health education for food handlers and consumers and more importantly ensuring the implementation of food safety management systems (FSMS) in all food service operations by ensuring the strict adherence to the hazard analysis and critical control point (HACCP) principles and Good Hygiene Practices (GHP) (Moreaux, 2014).

On the global front, the WHO (2010) provides hygienic practices related to food safety that is expected to be adapted and practiced by all food handlers in all food service institutions. These include; separating raw meat, poultry and seafood from other foods, using separate equipment and utensils such as knives and cutting board for handling raw and cooked foods, storing food in containers to avoid contact between raw and prepared foods, washing fruits and vegetables, especially if eaten raw, removing outer leaves of leafy vegetables, cooking food thoroughly, reheating cooked food thoroughly, avoiding leaving cooked food at room temperatures and finally refrigerating promptly all cooked and perishable food (preferably below 5°C). These will help ensure that all foods handled within the food processing chain are safe and fit for human consumption.

With specific emphasis to the Ghanaian context, government agencies such as the Food and Drugs Authority (FDA) together with the Public Health Units or Environmental Health Department, Metropolitan Municipal and District Assemblies (MMDAs) as well as the Ho Municipal Assembly (HMA) have instituted rules and regulation to control the activities of food handlers in all food operations so as to ensure the provision of safe food to consumers. These regulations include obtaining medical report annually, using protective clothing such as hair restraints, hand gloves etc., exhibiting general cleanliness

and ensuring adequate vermin control in food preparation areas in order to protect food contamination among others (HMA, 2012; FDA, 2013).

Statement of the Problem

Food contributes significantly to the total development of the human being whiles feeding in school largely contributes to the total mental and physical development of students. Poor nutritional status therefore renders them particularly infants and children susceptible to food-borne diseases. Within the boarding school setting, providing meals to students is usually a complement to the formal education offered. This is aimed at monitoring the eating habit of students whiles they are away from home and also ensuring that meals provided are nutritionally balanced and prepared under strict hygienic conditions devoid of possible contamination.

Unfortunately, this aim is being defeated as majority of food-borne outbreaks are traced to schools. This notwithstanding, it appears food researchers in Ghana have devoted less attention to the sporadic cases of food-borne disease outbreaks in schools and focused more on the commercial sector of the food industry with specific highlights on street foods and vendors. Thus, epidemiological data on the safety and quality of school meals particularly those in the boarding secondary schools have not been adequately investigated creating a dearth of knowledge in literature.

Additionally, since poor food preparation and storage practices together with poor personal hygiene and the lack of knowledge in food safety practices are inherent with food handlers in boarding schools, it is very important to determine the practices followed during the storage, preparation,

and service of food so as to know the hygienic status of food provided to students in the boarding schools. This study therefore sought to partially fill the gap in literature by investigating the food safety practices of the food handlers in Senior High Schools in the Ho Municipality of the Volta Region, Ghana.

Research Questions

Specifically, the study attempted to answer the following questions;

- What was the knowledge level of food handlers in food safety issues?
- How well did food handlers practice food safety?
- What were the sources of contamination of foods served to students?
- What were the barriers to the implementation of food safety practices among food handlers?
- What was the microbiological quality of foods prepared in the boarding schools?

Objectives of the Study

The main objective of the study was to assess food safety in Senior High Schools in the Ho Municipality. The specific objectives were to;

- evaluate the food safety knowledge of food handlers;
- evaluate the food safety practices of food handlers;
- identify the sources of contamination of food served to students;
- identify the barriers to the implementation of food safety practices of food handlers;
- assess the microbiological quality of prepared foods;

Hypotheses

Ho 1: there is no significant relationship between the food safety knowledge of kitchen staff and their gender

Ho 2: there is no significant relationship between food safety knowledge of kitchen staff and their educational level

Ho 3: there is no significant relationship between food safety knowledge of kitchen staff and their age

Significance of the Study

This study aside contributing to the body of literature on food safety will also reveal the current issues relating to the food safety practices employed by food handlers during the storage, preparation, and service of food to students in the selected boarding senior high schools within the Ho Municipality.

It will more so provide valuable information to health and sanitation officers regarding food safety practices of food handlers in boarding secondary schools so as to appropriately design and modify strategic plans or policies towards effective regulation and monitoring of their activities.

Results from the study will also prompt policy makers and planners to introduce suitable food safety interventions to address the barriers to food safety practices identified in the study. In addition, the results will inform school authorities and management of the level of food safety knowledge and hygiene practices of their food handlers in the kitchen. This will subsequently inform the need to plan and implement health education programmes to improve their food safety knowledge and hygiene practices so as to reduce health risks along feeding in schools.

Finally, the study of food safety in boarding senior high schools is in place and indeed timely considering the food safety gaps identified by Ababio and Lovatt (2015) in a review of food safety and hygiene studies in Ghana. This study will therefore add to the available literature on the food safety practices in the institutional sector of the hospitality and tourism industry.

Organization of the Study

The study is made up of five major chapters. Chapter one was the introductory chapter which looked at the background to the study, the statement of the problem, research questions, objectives of the study as well as the significance of the study.

The second chapter includes the review of related literature regarding food safety in food service organizations. The various issues discussed includes the concept of food safety, food safety in schools, the microbiological quality of food, sources of contamination, the concepts of the flow of food, food safety knowledge, HACCP practices and barriers to food safety practices. The chapter further focused on the model guiding the study. This set the basis for developing a conceptual framework for the study.

Chapter three provided detailed information on the methods adopted for the study. This included a profile of the study area, study design, data sources, target population, field work issues, data analysis and presentation. Chapter four presented the analysis of data collected from the field and further discussed the findings of the study guided by the literature review and the conceptual framework. The final chapter summarized the major findings. It also presented the conclusion of the study and subsequently provided relevant recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

This chapter constitutes a review of related literature pertaining to food safety. The concepts of food safety, food safety in schools as well as the microbiological quality of foods are discussed. Further, issues related to the sources of food contamination, food safety knowledge, HACCP practices and the barriers to food safety practices are also reviewed. This provides the foundation for the development of a conceptual framework for the study.

The Concept of Food Safety

The importance of safe food is gradually going beyond it being the main source of energy and nutrition to playing the enviable role of being the strategic tool for sustaining our health, providing our livelihood security and maintaining the very essence of the human race. Worldwide, there is the growing interest in the quality of food supplied to consumers rather than how much food is produced. This interest has subsequently determined the level of food safety practiced by concerned institutions where the use of the food safety management systems (FSMS) such as HACCP and GHP are adapted.

According to Moreaux (2014), food safety is all about the safe handling of food throughout the food chain to avoid contamination which will eventually lead to food-borne illness. This mode of safe handling requires a conscious effort on the part of the food handler bearing in mind the health of the consumer. As pointed out by WHO (2000), providing safe food is important and a basic human right. Despite this fact, many foods are frequently contaminated with naturally occurring pathogenic microorganisms

which cannot be detected organoleptically (seen, smelled or tested) but can cause diseases of varying severity including death especially if they are exposed to conditions favourable for those microorganisms to grow and reach considerable levels of contamination (WHO, 2000).

Safe food is described as any food or food product that is out of the way of biological, chemical or physical hazards and will not cause harm to the consumer (FAO, 2005 cited in MacArthur, 2007). In other words, safe food refers to foods that are free from hazards. Unsafe food however, results from contact with food hazards or contaminants (Kitagwa, 2005) which sometimes alter the physical composition of the food. According to Getachew (2010), food safety is directly related to the harmful substances present in food. In that, their presence beyond acceptable levels tends to contaminate food by impacting on its wholesomeness and subsequently causing harm, injury or illness to humans after consumption (Getachew, 2010; McSwane, Rue & Linton, 2000).

Food safety hazard is described as any physical, biological or chemical substance that is reasonably likely to promote the growth of disease causing microorganisms and its toxins in food, causing spoilage thereby leading to unacceptable health risk (Omemu & Adeosun, 2010; McSwane, Rue, Linton & Williams, 2003) to humans. Alternatively, food safety hazard is a biological, chemical or physical agent in food with the potential to cause an adverse health effect. Hazardous substances in food can be classified into three groups which consist of physical, chemical, and biological hazards (Jay, 2000; NRAEF, 2006; Tan et al., 2015).

Nyamari (2013) and Moreaux (2014) explain that physical or objectionable hazards include rust, dirt, hair, machine parts, nails, bolts, toothpicks, false or acrylic fingernails, flakes of nail polish, pebbles, and jewelries. In addition, needles, pins, particles of stones, pieces of sticks, plastic or metal fragments from kitchen or table wares, paper, and cigarette butts are also physical contaminants that can be found in food.

Indeed, physical food safety hazards originally do not constitute the composition of food and therefore are foreign or alien to food. They find their way into food at any stage of the food storage, production, and service process due to improper handling. Physical food safety hazards are usually least likely to affect large numbers of people since they are easily recognized unlike the chemical hazards which cannot be easily seen. However, they can be injurious to health when ingested. For example, they can cause cuts in the mouth or throat, damage to the teeth or gums and the intestines (Olsen, 1998 cited in Getachew, 2010; Grintzali & Babatsikou, 2010).

Biological hazards consist of tiny living creatures known as microorganisms and their waste products or toxins which can cause illness when transmitted to humans through ingestion of the implicated food (NRAEF, 2006). Examples include; bacteria, viruses, protozoan, moulds, parasites, and fungi. Biological hazards also include foods that are in themselves poisonous to humans. These naturally occur in certain species of fish and mushrooms. Generally, illnesses caused by biological hazards are either classified as infections or intoxication (NRAEF, 2006). A victim will suffer an infection when food that contains harmful microorganisms is

ingested whiles intoxication arises when toxins or poisons produced by the microorganisms are ingested.

Chemical hazards that can contaminate food include cleaning agents, pesticides, and the excessive or intentional use of food additives, preservatives, veterinary drugs, agrochemicals, and adulterants (FDA, 2005). The description of a chemical hazard is given as natural toxicants such as mycotoxins and marine toxins (WHO, 2002) which may be present in food for example, some fish species and crops.

Chemical contamination of food can also occur through environmental pollution of water, the atmosphere, and soil. For instance, the use of untreated sewage or polluted water in irrigation results in excessive accumulation of heavy metals in soils, which leads to elevated levels of heavy metal uptake by food crops (Karanja, Njenga, Prain, Kangethe, Kironchi, Githuku, Kinyari & Mutua, 2010). Also, the use of uncured animal manure is an additional source of pathogen contamination and heavy metal uptake by food crops (Lagerkvist, Hess, Okello, Hansson & Karanja, 2013).

Food products have several opportunities along the food chain of being contaminated (Paez & Ortiz, 2011; Hennessy & Cheng, 2004) by food safety hazards. Considering the 'farm to fork' approach, food can first be contaminated by the grower, processor, canner or packer through mishandling or poor control methods. Secondly, through its transportation, distribution or storage stage, middlemen coupled with unfavourable environmental conditions can pose a threat to the safety of the food. Finally, when the food arrives at the food service premises, the food handlers can equally contaminate the food due

to the poor food safety knowledge and hygiene practices inherent in them (Oranusi et al. 2007).

In reality, by the time any food item arrives at the food service premises, it might be carrying its own load of contaminants. It is therefore incumbent on the food handler to practice measures that can minimize them. Among such measures include adequately cooking foods to the required minimum internal temperature as a way of reducing the presence of microorganism to safe levels (Guilford County Department of Public Health, 2011). Also, the FAO/WHO (2008) highly recognizes the importance of environmental hygiene and its contribution to food safety. It recommends that foods should be prepared in a place set aside exclusively for that purpose and this place of preparation should be far from any source of contamination (rubbish, waste water, dust and animals) and kept clean always. This will ensure the safety of all foods prepared within the food service institution.

Food Safety in Schools

The most susceptible population group for food-borne diseases are children because they are more likely to become ill when exposed to food-borne pathogens (Rodríguez-Caturla, Valero, Carrasco, Posada, Gracia-Gimeno & Zurera, 2011) particularly those that pose greater risk to them (General Accounting Office, 2003). There is an ongoing argument that the youth of today get a large portion of their daily energy needs while at school (French, Story, Fulkerson & Hannan, 2004). Research has further established that healthy nutrition is positively related to desirable behaviour as well as school performance (Kristjansson, Sigfusdottir & Allegrante, 2010; Florence, Asbridge & Veugelers, 2008; MacLellan, Taylor & Wood, 2008;

Wang & Veugelers, 2008). As a result, school meals served to students should be nutritionally balanced and avoid placing students at risk of food-borne illnesses (Santos, Nogueirab, Patarata & Mayan, 2008).

Food safety is fundamental to school catering due to the higher number of meals served to larger number of students on a daily basis and the fact that any outbreak can affect higher number of students (Osaili, Abu Jamous, Obeidat, Bawadi, Tayyem & Subih, 2013). According to the Center for Disease Control and prevention (CDC, 2005),"schools are the only institutions that can reach nearly all youth and are in a unique position to improve both the education and health status of young people throughout the nation". Due to this sensitive role schools play, they amongst other major institutions occupy a sizable portion of governments' budget particularly in the developed world (Winson, 2008). But as one of many other types of food service operations, school catering is most frequently cited location for outbreaks of food-borne disease (Seaman, 2010; Sanlier & Konaklioglu, 2012).

An annual report by the Ministry of Health in Malaysia (2012) indicated that 62 percent of the episodes of food-borne outbreaks were traced to schools while a similar situation in Portugal reported by the WHO showed that 31 percent of the outbreaks reported between 1993 and 2000 were related to schools and kindergartens (WHO, 2003; 2004). This makes the issue of food safety in schools a concern for all most especially when outbreaks of food-borne illnesses have significant impact in a school environment i.e., student absenteeism, insurance costs, attorney fees, and loss of revenues due to decreased participation of students in school meals (Marx, 2008).

School catering operations usually prepare large quantities of different types of food within the same food preparation area. Due to the large numbers of students catered for at a time, the food preparation process employs many hands which possibly create a risk environment for microbial contamination thereby increasing the chances of food contamination due to improper handling (Annor & Baiden, 2011) among other factors. It is important that hygienic food preparation and the education of those involved in storage, preparation, processing, and service of meals are employed since they form crucial lines of defense in the prevention of most types of food-borne illness (Gibson, Rose, Haas, Gerba & Rusin, 2002) in schools.

Microbiological Quality of Food

Every food has an acceptable level of microbial load which will not cause illness when consumed. However, the presence of microorganisms beyond the acceptable levels can pose a serious threat to public health. The International Commission for Microbiological Specification for Foods (ICMSF, 1996) provides that, ready-to-eat foods with plate count between 0-10^3 is acceptable, between 10^4-≤ 10^5 is tolerable and above $10^6$is unacceptable. Therefore, the microbiological quality of food is defined as the amount of microbial contaminants it contains (Oranusi, Oguoma & Agusi, 2013).

As pointed out by Oranusi et al. (2013), a high level of contamination indicates the low quality of food storage and its handling and this is more likely to transmit diseases. Handling as a process which includes moving and touching of food substances is an important component in the food storage, preparation, and service process and as such has the ability to influence the

microbial quality of prepared foods. On several occasions, mishandling of food during the multitude stages of processing, preparation, storage, and even service contributed to the majority of contaminated foods which led to food-borne disease outbreaks (ÇakÂroflu & Uçar, 2008; Alale, 2013).

The hand of a food handler is an indispensable tool in the food storage, preparation, and service process and this, according to Ehiri and Morris (1996) cited in Bas, Ersun and Kıvanc (2006) plays a major role in the transfer of microbial contaminants from faeces, nose, skin or other sites to food because of poor personal hygiene and cross-contamination. Personal hygiene especially with regards to those handling food is very critical because of the fact that the human body carries varieties of pathogenic and non-pathogenic microorganisms.

Studies conducted by Shojaei, Shooshtaripoor and Amiri (2006) and ÇakÂroflu and Uçar (2008) showed that the most common potentially pathogenic bacteria isolated from the hands of food handlers were *Bacillus spp., E. coli, Enterobacter spp., Klebsiella spp., Diptheroid bacilli,* and *Staphyloccocci aureus*.

On the contrary, another study conducted to determine the microbiological quality of food handlers' hands revealed that even though the general indication of the microbiological quality was out of the standard, the fecal contamination and personal hygiene of food handlers were well maintained during the three intervals of hand swabbing thus, no microorganisms were isolated (Tan, Lee, Abu Bakar, Abdul Karim, Rukayadi& Mahyudin, 2013). This suggests the need for effective hand washing so as to

significantly reduce the transmission of pathogens from hands to food and other surfaces (US, FDA, 2005).

Food safety and hygiene practices have a direct link with the microbiological quality of food in that, the type of food safety and hygiene practice violated determines the indicator organism to be present. The indicator organism contributes to the determination of the microbiological quality of food. According to Nik Rosmawati, Wan Manan, Noor Izani and Nik Nurain (2014), common indicator organisms associated with food safety and hygiene practices include total plate counts (TPC), total coliforms (TC), *Escherichia coli*, *Bacillus cereus (B. cereus)*, *Staphylococcus aureus* and *Salmonella spp*. amongst others.

The Total Plate Count (TPC) analysis is a useful tool in monitoring food process and the results may reflect the hygienic level employed during food handling and storage (Collins, Lynes & Grange, 1989) processes. The detection of coliforms in food is widely used as a means of measuring the effectiveness of sanitation programmes and their presence could indicate a substantially increased risk of the presence of pathogens (Lues & Van Tonder, 2007). Improper handling and storage may increase the number of coliforms in food or water. *E. coli* on the other hand, is commonly used as surrogate indicator in which its presence is thought to give a better indication of faecal contamination (De Wit & Rombouts, 1992) and poor personal hygiene practice of food handlers (Eley, 1992a). Further, a significant number of *E coli* in food may also suggest a general lack of cleanliness in food handling and improper storage of food. (Food and Environmental Hygiene Department of Hong Kong, 2001).

Much of the work done across the globe focused on the microbiological quality of foods as health risk is related to the potential of food to support microbiological growth. In Ghana, a study was conducted to investigate the microbial quality of street foods sold in Accra. Out of 511 menu items selected, 69.7 percent were contaminated with mesophilic bacteria. Salads, Macaroni, *Fufu, Omo tuo* and Red pepper had unacceptable levels of microbial contamination. Human pathogens including *Salmonella arizonae, Shigella sonnei, Enteroaggregative, Escherichia coli* were isolated from some food samples (Mensah, Yeboah-Manu, Owusu-Darko & Ablordey, 2002). The authors reported that street foods could be sources of enteropathogen and therefore vendors required education in hygiene training. Another study by Saba and Gonzalez-Zorn (2012) to evaluate the Microbial food safety in Ghana concluded that Microbiological food contamination in Ghana was alarming. The authors suggested the need for a concerted effort to help curb the incidence of preventable food-borne diseases.

Furthermore, a study was conducted with the aim of isolating pathogenic bacteria from some foods sold at selected private schools in Akoka area of Yaba, Lagos, Nigeria (Okolie, Omonigbehin, Badru & Akande, 2012). The cooked foods selected included rice, beans, boiled beef, and spaghetti which were purchased from four randomly selected private primary schools within the study area. The samples were collected into a sterile plastic container and transported to the laboratory for analysis within an hour of collection. The results of the plate count indicated that the foods had high microbial counts considering the recommended limit of bacterial count of less than 10^5 CFU/ml (Owhe-Ureghe, Ekundayo & Ohue, 1993; Rose &

Osunnaiye, 2003). Further examination of the isolates revealed the presence of rod and cocci shaped bacteria some of which were identified as *Escherichia coli, Staphylococcus aureus, Pseudomonas spp.,* and *Bacillus cereus*.

Monday, Francis and Mohammad (2014) carried out a study to assess the microbiological quality of ready-to-eat foods (Rice and Moimoi) sold by food vendors in Federal Polytechnic Bali, Taraba State, Nigeria. A total of six ready-to-eat food samples were collected from the vending site. The result obtained revealed total bacterial count ranging from 1.0 x 10^2 to 8.7 x 10^4CFU/g. Microorganisms isolated include *Staphylococcus aureus*, *Escherichia coli, Klebsiella spp., Salmonella spp., Mucor spp.,* and *Aspergillus spp*. The study showed that ready-to-eat foods sold by vendors in Federal Polytechnic, Bali campus were contaminated with various microorganisms indicating inadequate processing and poor handling practices which can pose danger to the health of the consumers.

Undeniably, the major health hazard associated with school meals is microbial contamination even though few might be caused by physical or chemical contamination (Esena & Owusu, 2013). The risk of microbial contamination is dependent on the type of food and the mode of its preparation. Foods that are cooked immediately before consumption are safer than those which have been cooked and stored at ambient temperature (WHO, 1984). Also, the use of unclean, insufficiently or inadequately cleaned cooking equipment can serve as a source of microbial contamination in processed food. It is therefore desirable that processing equipment coming into contact with food be constructed in such a way as to ensure adequate cleaning, disinfection, and proper maintenance to avoid microbial contamination.

The Flow of Food (FoF)

Sources of food contamination are linked to the multitude stages food goes through to arrive at the table of the consumer. The flow of food is described as path through which raw food product follows in a catering establishment, i.e., from the purchasing and receiving through storing, preparation, cooking, holding, cooling, reheating, and finally serving to the consumer (NRAEF, 2006). Any stage in this path is a possible source of food contamination. Cross-contamination and time/temperature control are an important concept of the FoF and contribute significantly to the causes of food-borne illnesses. Therefore, the success of ensuring the safe travel of food through these stages largely depends on how food handlers understand and utilize the concepts of the FoF as discussed.

Concepts of the Flow of Food (FoF)

- Cross-Contamination

Cross-contamination is the process whereby microorganisms are transferred from one food or surface to another. It is a major hazard in the flow of food and the most singular source responsible for almost all food contamination. Cross-contamination accounts for the majority of all digestive infections. For example, in an outbreak of Salmonellosis and Staphylococcal food poisoning, cross-contamination was cited as the main cause of the outbreak (Varghese, George & Nayak, 2013; Chandran, 2012).

The common causes of cross contamination in the kitchen are linked to contaminated hands of food handlers, contaminated equipments used to prepare raw and cooked food at the same time and the storage of uncovered raw foods directly adjacent to or above ready-to-eat foods in a refrigerator or

other holding equipments (AbdPatah, Issa & Nor, 2009). Microorganisms in the kitchen environment either directly or indirectly cross-contaminate food. Direct cross-contamination occurs when food handlers do not wash hands in the process of handling raw and cooked food whereas indirect contact occurs when equipment, utensils, cutting boards, and improper storage practices contaminate food. Since cross-contamination can occur at any stage in the kitchen, it is fairly simple to prevent it through the creation of physical or procedural barriers (NRAEF, 2006).

The physical barriers refer to assigning specific equipment to each type of food product, thus colour coding of equipments for specific purposes may be helpful during food preparation as it minimizes the risk of cross-contamination but does not in itself eliminate the need to practice other methods for preventing it. Also, efficient cleaning and sanitizing of all work surfaces, equipment and utensils after each task and the use of deli tissue, tongs, and disposable gloves by food handlers can help minimize the risk of cross-contamination.

Procedural barriers are usually practicable in kitchens where limited food preparation space exists. Procedural barriers require the preparation of high risk foods (i.e., salads) first after which the working surface is thoroughly cleaned and sanitized for the preparation of raw meat, fish or poultry.

- Time-Temperature Abuse

Another major factor responsible for food-borne illness outbreaks is time-temperature abuse. Time-temperature abuse occurs when food has been allowed to stand for an extended period of time at temperatures favourable for bacterial growth (NRAEF, 1999). On the other hand, abuse of temperature

may also be caused by insufficient amount of cooking or reheating time at desired temperatures that should eliminate the existence of harmful microorganisms (McSwane, Rue, Linton & Williams, 2004).

Microbial pathogens grow at temperatures between 41°F and 135°F (5°C and 57°C) and multiply faster at temperature between 70°F and 125°F (21°C and 52°C) necessitating the control of temperature during cooking and holding so as to ensure that food safety regulations are complied with (McSwane et al. 2004). Foods of varying composition require different cooking temperatures enough to give the culinary quality desired and the safety needed. Various combinations of time and temperatures are needed to inactivate pathogenic vegetative bacteria (Schmidt & Rodrick, 2003).

Improving temperature control practices in institutional foodservice is important to improve public health. Temperature measuring devices such as thermometers, thermocouples, and infrared reading is essential in determining whether the food is in the danger zone or otherwise (McSwane et al., 2004). It is noted that improper holding temperature of food can also contribute to the growth of certain bacteria through its spores because not all of these spores will be destroyed by the heating processes (McSwane et al., 2004). Therefore, it is essential that food handlers familiarize themselves with the temperature measuring devices and ensure that at each stage of food storage, preparation or service, food temperature is measured and recorded accordingly.

Sources of Food Contamination

The major sources of microbiological contamination in food may occur through the atmosphere, water, food product itself, humans, and equipments.

- Atmosphere

Basically, microorganisms are present in dust and moisture droplets in the air. Although they do not grow in dust, they are transient and variable depending on the particular environment within which they are found. It is generally noted that dry air with low dust content and higher temperature has a low microbial level (Krieg, 1984; Sneath, 1986). However, if the surroundings contain a source of pathogens (e.g., domestic animals, open drainage systems etc.), different kinds of bacteria such as pathogens and viruses can be transmitted through the atmosphere.

According to the WHO (2010), food preparation and service should take place in a hygienic and well organized setting with food contact surfaces cleaned, free from visible dirt and sanitized other than in unhygienic environment where contaminated water, flies, dust and domestic animals abound. It is therefore important that microbial contamination of food from the atmosphere be significantly reduced through the elimination of all potential sources, controlling dust particles, and reducing humidity levels in the air.

- Water

Water in its purest form is odorless, colorless, and tasteless. Human and animal activities, however, continue to challenge the wholesomeness of potable water. Water is used in production, processing, and under certain conditions, storage of foods. It is also used as an ingredient in many processed foods. Thus, the quality of water can greatly influence the microbial quality of

foods. Although potable water does not contain coliforms and pathogens, improperly treated water can contain pathogenic and spoilage microorganisms which can cause adverse reaction when consumed.

Water-related diseases continue to be one of the major health problems globally with an estimated 3.4 million water-related deaths per year (which represents 4 percent of all deaths) and 5 percent of health loss to disability (WHO, 2002). The health effects of exposure to disease-causing bacteria, viruses, and protozoa in water are varied (Health Canada. Guidelines for water quality, 2006) but the most common and widespread health risk associated with drinking water is contamination either directly or indirectly, by human or animal excreta and the microorganisms contained in faeces (ADWG6, 2004). To overcome this challenge, food service institutions should use water with higher microbial quality than potable water in their food preparation processes.

- Food product

Product-induced source of food contamination arises from the natural composition of the food where enzymes present can cause its decomposition and deterioration (Getachew, 2010). For instance, if a food consists primarily of carbohydrates, spoilage does not result in major odour. Unlike foods which contain large amount of proteins and fats, spoilage can produce variety of offensive odour. In addition, a variety of intrinsic and extrinsic factors determine whether microbial growth will preserve or spoil food. The intrinsic factors include pH, moisture content, water activity or availability, oxidation-reduction potential, physical structure of the food, available nutrients, and the possible presence of natural antimicrobial agents while extrinsic factors

include temperature, relative humidity, gases (carbon dioxide and oxygen) present, and the types of microorganism present in food (Prescot, Harley& Klein, 1999; Rath & Patra, 2012). These create suitable conditions to support the growth of microorganisms in food.

- Humans

Human induced sources of contamination are the most common ones that occur along the stages of the flow of food (FoF) and therefore correct handling of food during all stages of its storage, preparation, and service is essential in reducing the incidence of food-borne illness. Between the processes of production through to consumption, food product goes through various hands and these have been the source of pathogenic microorganisms in food which later caused food-borne illnesses particularly with ready-to-eat foods.

It is noted that food handlers who engage in poor food handling practices such as practicing poor personal hygiene (Fawiz, Gomaa & Bakr, 2009), improper hand washing, chewing or talking during food preparation or service, tasting of cooked food using the fingers or same spoons several times without proper washing after each use, and thawing or defrosting of food at room temperature can contribute significantly to microbial food contamination. Evidently, epidemiological studies of Salmonella typhi, non-typhi Salmonellae, Campylobacter, and Escherichia coli have demonstrated that these organisms can survive on finger tips and other surfaces for varying periods of time and in some cases after hand washing (WHO, 1989). It is therefore desirable that clean food tongs, forks, spoons or disposable gloves be used when preparing and serving food (Omemu & Aderoju, 2008).

- Food processing equipment

A wide variety of equipment are used in food production processes and these could easily be infected with microbial contaminants from the air, raw foods, water, and humans subsequently contaminating processed foods. According to Aarnisalo, Tallavaara, Wirtanen, Maijala and Raaska (2006), food-processing equipment is a major source of food contamination partly due to their poor hygienic design. This compromises food safety as some small parts or inaccessible sections may not be thoroughly cleaned and sanitized thus, providing favourable conditions for the growth and multiplication of pathogenic and spoilage organisms.

Small equipment and utensils such as cutting boards, knives, spoons, and similar articles can also be a major source of cross contamination due to improper cleaning. Therefore when handling food with such equipment and utensils, it is important that they are colour coded for specific use (WHO, 2010). For example, the use of separate cutting boards, knives or bowls for raw and cooked foods is the best practice to avoid food poisoning (Jevsnik, Hlebec & Raspor, 2008) or cross contamination. Also, proper cleaning and sanitization of equipment and utensils at prescribed intervals are important to reduce microbial levels in food.

Food Safety Knowledge

Knowledge accumulates through learning processes and the process may be through formal or informal instruction, personal experience and experiential sharing (Glanz & Lewis, 2002). Training and education are essential to ensure that food handlers acquire the knowledge necessary to comply with food safety requirements within the food service establishment.

As well documented, training helps to improve overall employee food safety knowledge (Pirshaeb, Almasi & Rezaee, 2010; Afolaranmi, Hassas, Bello, Tagurum, Miner, Zoakah & Ogbonna, 2014) within the food service establishment. Hence, training and education are recognized by major international organizations such as WHO (2000) and forms an essential part of HACCP concept.

Traditionally, it is assumed that knowledge is automatically translated into behaviour (Glanz & Lewis, 2002) and subsequently to practice due to the vital role it plays in the cognitive processing of information with regards to the attitude-behaviour relationship (Simelane, 2005). In a study conducted by Chapman, Eversley, Fillion, MacLaurin and Powell (2010), the influence of a food safety information sheet on practices within the foodservice environment was observed and results showed that the information had a positive impact on food handlers' behaviours.

Although training may increase food safety knowledge, knowledge does not always result in positive changes in food handling practices. More often, food handlers seem to think that they know how to handle food safely but their self-reported food handling behaviors do not support this confidence (Fawzi & Shama, 2009). Angelillo, Viggiani, Rizzo and Bianco (2000) in a study determined that whilst food handlers had a positive attitude towards food safety, this was not supported by observed practices. Nevertheless it is not only the ignorance of food hygiene that causes food poisoning but also, failure to apply the acquired knowledge (Bryan, 1988; Ehiri & Morris, 1996). Adequate knowledge together with the correct application of sound food

safety practices by food handlers goes a long way to minimize the occurrence of food-borne illnesses in food service institutions.

Food safety knowledge has been found to be closely associated with the socio-demographic characteristics of food handlers (Osaili et al. 2013). Major variable categories like gender, age, educational level and source of food preparation knowledge have yielded inconclusive results.

Considering respondents' gender, females were found to have higher food safety knowledge scores than males (Byrd-Bredhenner, Maurer, Wheatly, Schaffner, Sanlier, 2009; Sanlier & Konaklioglu, 2012). Perhaps, females are traditionally more involved in cooking than their male counterparts thus accounting for their better food safety knowledge and practice. But results from a study conducted by Akonor and Akonor (2013) revealed gender was statistically independent of food safety knowledge. Thus, both male and female respondents were equally knowledgeable on the food safety themes examined ($p > 0.05$). This result may be attributed to a higher increase in the level of literacy among males recorded by the GSS Population Report (2003). Similarly, reports from numerous studies (Norazmir, Hasyimah, Shafurah, Sabariah, Ajau & Noraziansah, 2012; Nee & Sani, 2011) agreed with their out-come.

Age on the other hand has showed rippling relationship with food safety knowledge. While some researchers (Annor & Baiden, 2011; Martins, Hogg & Otero, 2012) found that age did not influence food safety knowledge, Sanlier & Konaklioglu (2012) reported that food safety knowledge tend to increase with age thus, younger respondents showed the greatest need for additional knowledge on food safety. Contrary to these findings, Sun, Wang &

Huang, (2012) reported younger respondents having higher food safety knowledge than their older counterparts.

Successful knowledge of food safety was found to be appreciably influenced by the level of education of respondents. Generally, the higher the educational level attained the more knowledgeable the individual is in food safety issues. A cross sectional study conducted by Farahat, Mona, El-Shafie, Mostafa and Waly **(**2015**)** among 811 Saudi women to evaluate their food safety knowledge, practices and further explore factors affecting them revealed that Saudi women with higher educational levels showed higher mean knowledge score in the overall food safety parameters measured than those in other educational levels with significant variations ($P < 0.05$) among different educational levels. Similarly, findings from Martins et al. (2012) also indicated the significant impact of the educational level of respondents on their food safety knowledge ($p = 0.025$). This suggests that education of food handlers is an important prerequisite to the success of food safety practices.

The source of knowledge on food preparation is an essential element in determining the success of its implementation. Family business, formal training, and observation have been reported in literature as some sources of knowledge on food preparation. According to Omemu and Aderoju (2008), while only 12 percent of the respondents had acquired their knowledge of food preparation by formal training, the majority (72%) of them acquired the knowledge through observation. Comparably, Sun, Wang and Huang (2012) reported that few vendors acquired their knowledge of food preparation through formal training while the larger part of the vendors acquired their knowledge from family business.

Hazard Analysis and Critical Control Point Practices

Hazard Analysis and Critical Control Point (HACCP) is a management system which focuses on food safety through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement, and handling to manufacturing, distribution, and consumption of the finished product (Sohrab, 1999; Sauer, 1998). HACCP is a hazard preventive concept and method that is used to control food processing procedures by identifying the hazards of food production and their critical control points etc. and furthermore, to ensure food safety by controlling the hazards and reducing the risks (Sun & Ockerman, 2005). According to Bas, Yuksel and Cavusoglu (2007), it is one of the most important tools used to ensure food safety against hazard infections.

The HACCP system is based on seven standard principles recommended by the FDA Food Code (cited in McSwane et al., 2003). They include;

- Conduct a Hazard Analysis
- Identify the critical control points (CCPs) in food preparation
- Establish critical control limits (thresholds) which must be met at each identified critical control point
- Establish procedures to monitor CCPs
- Establish the corrective action to be taken when monitoring indicates that a critical limit has been exceeded
- Establish procedures to verify that the HACCP system is working
- Establish effective record keeping that will document the HACCP system.

The application of HACCP in the school catering service is equally important as in other food service institutions. For successful implementation of a HACCP plan, school authorities and management must be strongly committed to the application of the HACCP concept at each stage of the Flow of Food (FoF) and this will provide food handlers with a sense of the importance of producing safe food for students. The HACCP approach is to control problems during processing or serving before they happen (McSwane et al.2003). By following the procedures of safe food production with the HACCP system, food-borne illnesses will be reduced and safer foods will be prepared and served (Sun & Ockerman, 2005) to students.

In conducting HACCP plan in school catering, the first task (HA) is to list all the foods served in the menu and identify the locations of harmful contaminants (biological, chemical, and physical) that may pose a threat to the quality of the food being prepared. The hazard locations identified are then listed on the food flow chart to be used for the food preparation after which CCPs will be determined for the types of foods that pose hazards.

The critical control points (CCP) include the procedures in a food process where control can be applied to prohibit, eliminate or reduce food safety hazards to acceptable levels (Grintzali & Babastikou, 2010). The CCPs can be measured on features such as time, temperature, moisture level, and organoleptic parameters. By listing the various foods served, finding the possible CCPs and the control limits, monitoring the CCPs, taking corrective actions if problems occur, validating the HACCP plan, and finally keeping records accurately (Sun & Ockerman, 2005), the HACCP programme will be

established and this will assist in producing safer foods for students' consumption.

Barriers to Food Safety Practices

Barriers to food safety practices play significant roles in obstructing safe food practices among food handlers in food service operations. Several studies have been conducted across the globe to identify the major factors that inhibit the safe practices of food safety in food service institutions.

Green and Selman (2005) conducted a qualitative study employing eleven focus groups which consisted of food service workers and managers in which they discussed their current implementation of seven food preparation practices and the factors they believed impacted the safe implementation of those practices. Results from this study revealed inadequate provision of equipment and resources as well as the lack of enforcement from management in ensuring that the food workers wore protective clothing or carried out food safety practices as barriers to safe practices. The participants also identified lack of food safety education and training as other barriers to food safety practices.

Another study conducted by Hertzman and Barrash (2007) to assess the food safety knowledge and practices of catering employees in the United States of America revealed that employees observed were unable to perform proper food safety practices either in the kitchen or the dining room. To this, the researchers explained that perhaps, employees were so busy trying to complete basic preparation and as a result, either consciously or unconsciously were unable to follow proper food safety and sanitation procedures such as the

improper covering of foods in warming or refrigeration units, not washing hands as well as not wearing gloves when it was required. In all, busy work schedule was reported as a major barrier to food safety practices.

Ackah, Gyamfi, Anim, Osei, Hansen and Agyeman (2011) conducted a study which focused on the economic profile, knowledge of hygiene and food safety practices among street food vendors in some parts of Accra. The researchers identified lack of funds, non-awareness, and lack of strict enforcement of food safety practices by authorities which resulted in the inability to acquire certificates for medical examination as major barriers that inhibited the practices of food safety.

Howells, Roberts, Shanklin, Pilling, Brannon and Barret (2008) conducted a study on restaurant employees' perception of barriers to food safety practices. The results indicated time constraints, inadequate training or knowledge and food handlers' indifferent attitude as some barriers to safe food practices. Also, resources such as sinks and thermometers in inconvenient locations made the food handlers reluctant in getting to them during food preparation and in some instance, the inadequacy of the resources. Furthermore, the lack of space, other task competing with each other, lack of desire to carry out practice, and the inconvenience associated with performing practices were also identified.

Pragle, Harding and Mack (2007) discussed food workers' perspective on hand washing behaviour and barriers to food safety in the restaurant environment with food handlers' focus groups in two Oregon states. The respondents reported the unavailability of supplies, inaccessibility of sinks and time pressure as major barriers that influenced their ability to practice food

safety. Further, high volume of business and stress, lack of accountability, the type of catering establishment, and inadequate food handler training were also reported.

Aziz and Dahan (2013) in Malaysia conducted a study to measure food handlers' attitude towards safe food handling and further explored their perceived barriers that influenced safe practices in School Canteens. Results from this study indicated that the majority of food handlers agreed they faced difficulties in carrying out food safety behaviour due to the inconvenient location of kitchen equipment. Also, the absence of formal food guidelines for reference in case any mishandling occurred was reported as a barrier to food safety practices. In addition, the food handlers indicated that small working space, insufficient dry and wet storage, lack of supervisor commitment and inadequate training pertaining to safe food handling led to a compromise of safe food practices.

Finally, in Kansas, Missouri, and Iowa in the United States of America, York, Brannon, Shanklin, Roberts, Barrett and Howells (2009) conducted a study to assess interventions to improve restaurant employees' food safety compliance rates. Results revealed lack of food safety training as a major barrier perceived by the food service employees in relation to complying with food safety guidelines.

Model Guiding the Study

A number of models from the behavioural sciences have been proposed to improve understanding (Rennie, 1995) or explain how human actions are guided and the relationship between food handlers' knowledge and

practice with regards to food safety. This study is guided by the model for food safety knowledge, attitude and HACCP practice (Ko, 2013).

Model for Food Safety Knowledge, Attitude and HACCP Practice

The relationship between knowledge, attitudes and behaviour is often explained through the knowledge, attitude and practice (KAP) model (Simelane, 2005). According to Glanz and Lewis (2002), knowledge accumulates through learning processes and these may be formal or informal instruction, personal experience and experiential sharing. The KAP model is based on the assumption that a person's behaviour or practice depends on knowledge and that the availability of information will influence a change in attitude and eventually a change in behaviour (Rennie, 1995). The food safety knowledge, attitude and HACCP practice model posits that, the more an individual's knowledge increases, the better the practices and attitude and this makes the individual more likely to put up the expected behaviour. Generally, this model focuses on directing the efforts of an individual towards practice.

The knowledge, attitude and HACCP practice model has its foundation in the KAP model which is based on the relationship between the major variables such as knowledge, attitude and behaviour inherent in the model. The existence of these relationships have been suggested by Schwart (1975) (cited in Ko, 2010), and these are;

- The relationship where knowledge can directly influence attitude but not directly influence behaviour.
- The relationship where knowledge and attitude influence each other at the same time.

- The relationship where knowledge and attitude independently influence behaviour.
- The relationship where knowledge shares direct and indirect influences on behaviour.

The model for food safety knowledge, attitude and HACCP practices developed by Ko, (2013) establishes the inter-relationship between knowledge, attitude and HACCP practices among restaurant employees (Figure 3). The model postulates that there is a strong inter-relationship between food safety knowledge, attitude and HACCP practice. Attitude is considered a vital factor to knowledge and performance and is important to reduce the risk of food-borne illnesses. This model is appropriate and has been adopted for the study since the study seeks to measure the food safety knowledge and practices of the food handlers in the school kitchens.

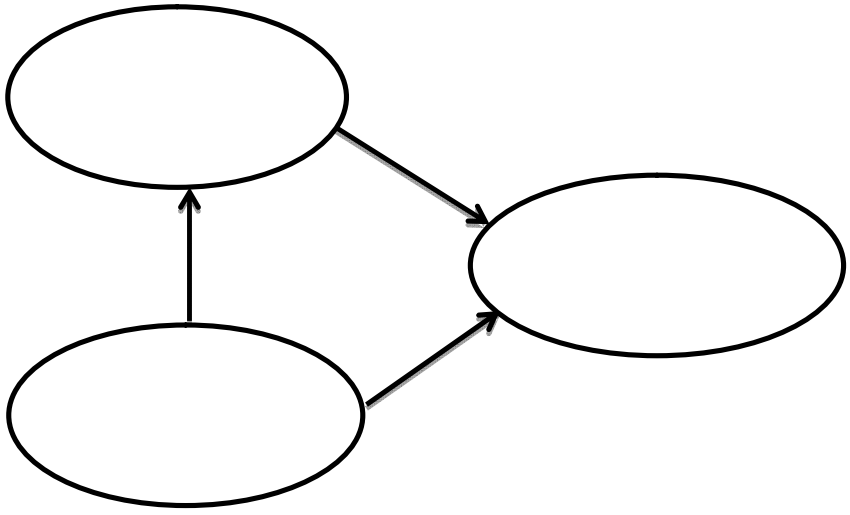

Figure 1: Model for Food Safety Knowledge, Attitude and HACCP Practice

Source: Ko, (2013)

Conceptual Framework

The study employed the model for food safety knowledge, attitude and HACCP practices and the concepts of the Flow of Food (FoF) as the guiding framework. These were considered suitable for the study based on their relationship with the objectives the study sought to achieve. The model of food safety knowledge, attitude and HACCP practice was adopted with some modifications made to make it suitable for the study. These modifications included the introduction of barriers to food safety, the replacement of HACCP practices with food safety practices and the elimination of the food safety attitude. Also, the concept of the FoF which constitutes the sources of contamination was adopted for the study. Basically, this concept reflects the nine major stages within which food product travels before arriving at the consumers table but for the purposes of their relevance to this study, three of the major stages were adopted i.e. food storage, preparation and service.

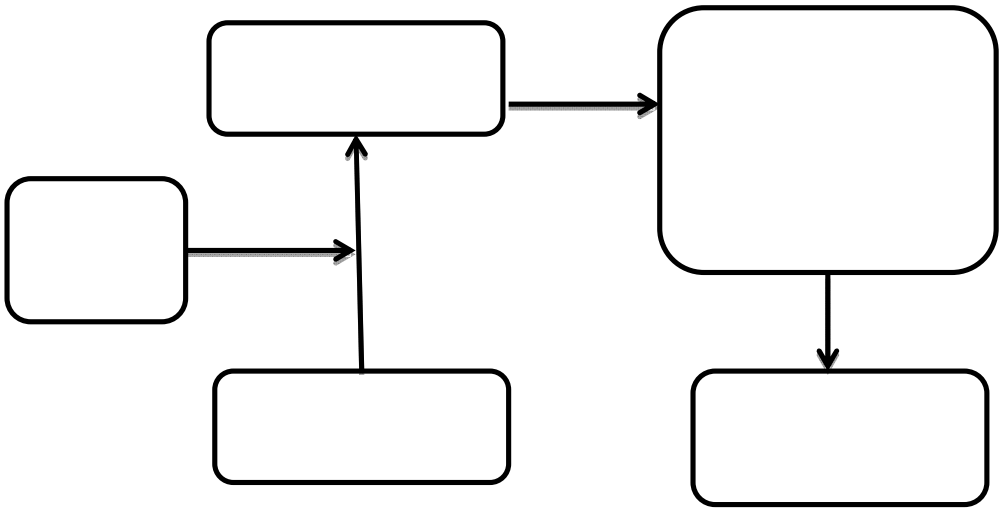

Figure 2: Framework of Food Handlers Food Safety Knowledge, Practices and the Microbiological Quality of prepared Food.

Source: Author's construct, (2016)

From the frame work above, four major variables were considered. These included food handlers' knowledge of food safety and their food safety practices which was measured in the areas of health and personal hygiene, food hygiene and environmental hygiene. The barriers that impeded their ability to practice food safety constituted irregular power supply, poor enforcement of rules and regulations by food supervision agencies, lack of training on appropriate food safety practices, lack of funds, inadequate space and the unenclosed nature of the kitchen which compromises food safety, busy work schedules, inadequate provision of equipment and resources as well as irregular water supply. Finally, the microbiological quality of prepared foods served to students was determined.

The framework established the relationship of these variables to the food safety practices of food handlers leading to the production of meals that are of acceptable microbiological levels to students (Figure 2). Consequently, the framework examined the association between the food safety knowledge and practices of food handlers and further looked at their practices in relation to the microbiological quality of prepared foods. In addition, the framework considered the relationship between the food safety practices and the microbiological quality of prepared food as well as the barriers that obstructed the practices of food safety by food handlers during the food preparation process.

Chapter Summary

This chapter reviewed related literature relevant to the study. The chapter commenced with a review of the concepts of food safety, food safety in the school setting as well as the microbiological quality of food. It further reviewed the concepts of the Flow of Food, food handlers' knowledge and practices of food safety and the barriers that led to the violation of food safety practices. A review of a relevant model was also done to explain how human actions are guided. The conceptual framework guiding the study was also discussed. The next chapter looks at the methodology guiding this study. It addresses issues in the study area, study design, target population, data processing and analysis in addition to the fieldwork and its related challenges.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter discusses the methods used in collecting and analyzing data. The issues covered included the study area, sources of data, the population used for the study, the population size and the sampling technique, research instruments and pre-testing, data collection, processing, analysis and presentation. Additionally, the fieldwork challenges and ethical considerations were also discussed.

Profile of the Study Area

The study was conducted in the Ho Municipality (Figure 3), the capital of the Volta Region of Ghana. It has a population of 177,281 representing 8.4 percent of the region's total population (GPHC, 2010). The Ho municipality shares boundaries with the Adaklu-Anyigbe District to the South, Hohoe District to the North, South-Dayi District to the West and the Republic of Togo to the East.

The municipality covers a total land area of 2,361 square kilometers, representing 11.5 percent of the region's total land area. There are about twenty (20) communities in the municipality with Ho described as the most developed settlement. The Municipality is characterized by large number of small-scale commercial and semi-industrial activities concentrated in the city centre with pockets of farming communities surrounding it. The main water supply in the municipality is the Ghana Water Company. The company covers close to 85percent of the entire population with the rest of the people depending on bore holes as their source of water supply.

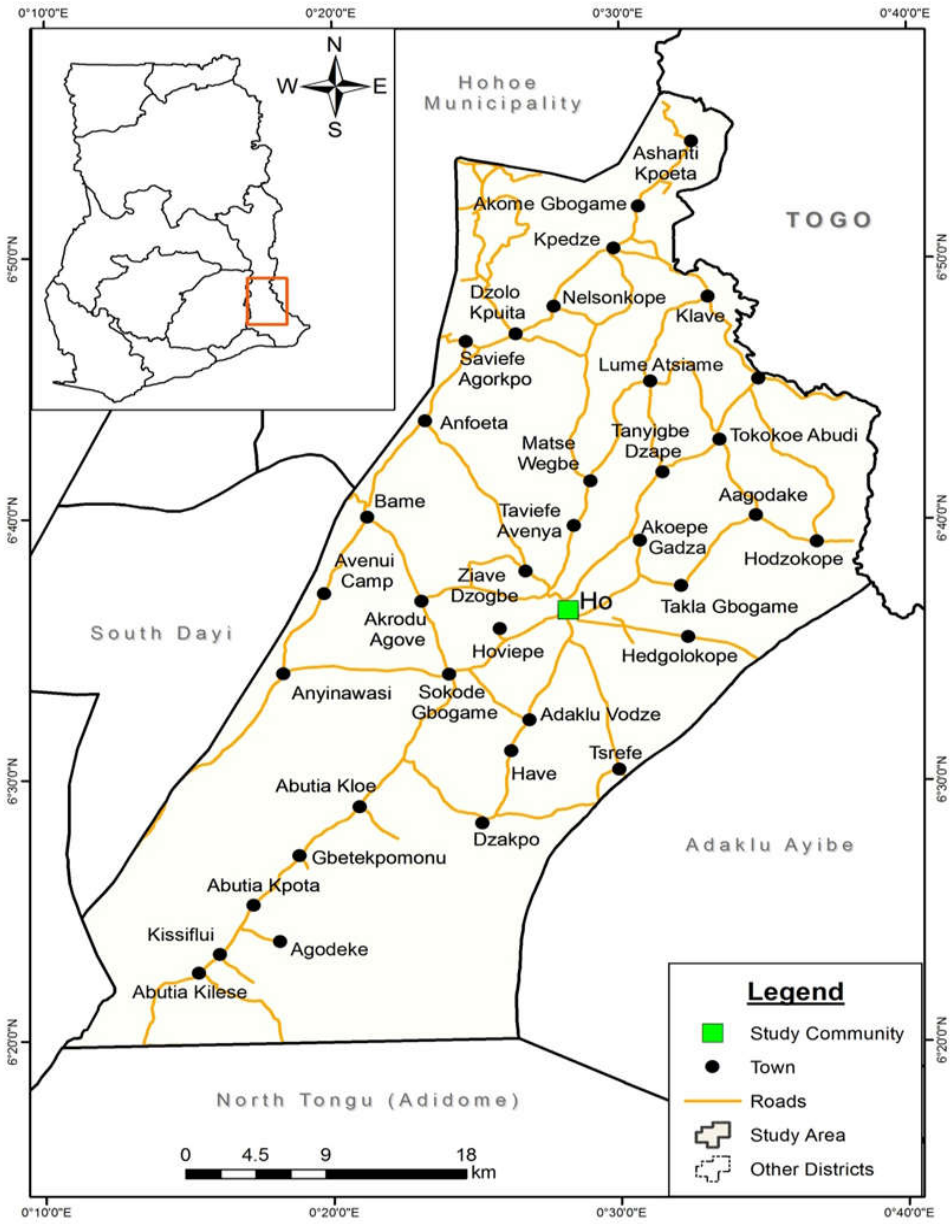

Figure 3: Study area in the Regional and National Context

Source: Department of Geography & Regional Planning, Remote Sensing and Cartography Unit, University of Cape Coast, (2015).

The Ho Municipality was the setting for this study. The total number of SHS registered with the GES, Ho is eleven (11) out of which seven (7) are public and four (4) private. From the total number of the senior high schools, only five (5) are registered with GES, Ho, as having boarding facilities. These

registered boarding secondary schools as part of their policy provide meals to students in the boarding house to cover the major sessions of the day; breakfast, lunch and dinner/supper. Cooked food ranging from 'waakye', banku or kenkey, beans and fried plantain (Redred), boiled rice amongst others dominate the menu served to students.

Study Design

This is the strategy, plan and structure of conducting a research project. According to Sarantakos, (2005), an important aspect of any research design is the logical sequence that connects the empirical data to the initial question of the study and ultimately to its conclusion.

The cross-sectional survey design was employed for the study. Unlike longitudinal studies where the population are studied over a period of time, the cross sectional survey design when employed in a study helps to gather information existing within the period of the study making it relatively fast and inexpensive in terms of cost and the space of time available as it avoids the challenges of loss encountered during follow-ups.

This design was therefore chosen for the study because it revealed information on the food safety knowledge and practices of food handlers, barriers to safe food practices as well as the microbiological quality of meals served as at the time the study was conducted.

Sources of Data

Data for the study were mainly obtained from primary sources. These constituted opinions and views of food handlers pertaining to food safety

issues. The use of primary data provided firsthand information on the food handlers regarding their actual knowledge, practices and barriers to food safety.

Target Population

The target population comprised all food handlers in the selected boarding senior high schools registered with the Ghana Education Service (GES) in the Ho Municipality as at September, 2015. In light of the inclusion criteria, the unavailability of official statistics on food handlers from the GES required a reconnaissance survey which was undertaken in September, 2015 to ascertain the actual number of food handlers in the selected schools. From the survey, ninety-seven (97) food handlers were identified in all the selected schools in the Ho municipality. Therefore, a census which involved a complete enumeration of the elements of a population was employed for the study.

With reference to data from the GES Ho, a total of eleven (11) SHS are currently registered and operational out of which seven (7) are public and four (4) private. From the total number of the senior high schools, only five (5) were registered with Ho GES as having boarding facilities as at the time the study was being conducted. This formed the basis for their selection considering the inclusion criteria of the study.

Table 1-*Number of food handlers in selected senior high schools*

	Schools	Number of food handlers
	Vavie SHS	6
	Tang SHS	5
	Lasa SHS	19
	Akowu SHS	24
	Lima SHS	43
Total	5	97

Source: Fieldwork, Appietu (2016)

Research Instrument

The study made use of both questionnaire and observation checklist to obtain data from the respondents. The questionnaire was made up of open and close ended questions with three major modules. These included the food safety knowledge of food handlers, the barriers to food safety practices and the socio-demographic characteristics and employment profile of respondents.

Information on the food safety knowledge of respondents were examined in three thematic areas such as health and personal hygiene (10 questions), food hygiene (10 questions) and environmental hygiene (5 questions). Respondents' food safety knowledge were measured on a 'true' or 'false' scale to which they were to indicate whether the statements were either 'true' or 'false'.

Concerning the barriers to food safety practices, ten (10) major barriers deduced from reviewed literature were listed and respondents were to tick as many of them that were applicable, resulting in their inability to practice food safety.

The socio-demographic information included gender, age, marital status, educational status, ethnic group and religion whiles the employment profile constituted their work status, work experience, source of knowledge regarding food preparation and the possession of a medical health certificate.

According to Sackmann (1991) cited in Altinay and Paraskevas (2008), observation as a method of data collection provides the researcher with rich, detailed and context specific descriptions which are close to the insiders perspective. Due to this advantage, the method was employed to gather data on the food safety practices of the food handlers which they were otherwise reluctant or incapable of providing. Specifically, a checklist which constituted food safety issues within the areas of health and personal hygiene (11 questions), food hygiene (5 questions) and environmental hygiene (4 questions) were used in gathering the data. To this, respondents were either scored 'yes' or 'no'. The reason for the choice of these two research instruments was that the questionnaire alone could not bring out the actual practices of the food handlers necessitating the use of the observation method in ascertaining them.

Microbial analysis was also conducted on food samples carefully collected from the participating schools. These food samples were subjected to the determination of their microbial loads using the Aerobic Colony Count microbial parameter (ACC) as well as some laboratory materials and equipment. Data from both sources were integrated during the analysis stage.

Food Sampling

A stratified sampling method was used to collect sixty (60) food samples from the selected schools for the study. Specific food samples which

included Banku, Boiled Rice, 'Waakye' and Beans were collected over a period of one (1) month from five selected schools. Food samples were collected using serving utensil from the schools' kitchen and carefully placed into sterile specimen container. These were immediately transferred in cooled packs, under aseptic condition and subsequently transported to the University of Health and Allied Sciences (UHAS) Ho, for microbiological analysis within thirty minutes of collection. These samples were subjected to microbial analysis for determination of their microbial loads. The results were subsequently compared with the acceptable levels provided by the ICMSF (1996).

Laboratory Materials and Methods

Ten grams (10g) portion of each food sample were macerated and centrifuged to get rid of the insoluble parts. and subsequently added to 90mL of phosphate buffered saline to make a 1:10 dilution. Further, tenfold serial dilution of the resultant was done to obtain 10^{-2},10^{-3},$10^{-4}$and 10^{-5} respectively. These were examined by means of the pour plate method (Mensah et al. 2002). Briefly, using the Aerobic Colony Counts (ACC) microbial parameter, each plate was carefully labeled on top and 1mL of diluted samples to be analyzed was pipetted into the petri dishes. In addition, 20mL of cooled molten Plate Count Agar (Oxide formula, Code: cm 0325) was poured over, swirled three times clockwise and three times anticlockwise to mix thoroughly the sample in the medium.

The medium was allowed to set on a flat top bench after which the petri dishes were incubated aerobically at 37°C for 18-20 hours. After overnight incubation, counts were made using a colony counting device. All plates were

counted but those showing colony counts between 30 and 300 were selected and their colony forming units per gram (CFU/g) were calculated by multiplying the count by the dilution factor (Harrigan & McCance, 1968; Thatcher & Clark, 1968).

$$\text{CFU/g} = \frac{\text{Number of colonies x dilution factor}}{\text{Volume of culture plate}}$$

Quality Checks/Controls

The quality control measures put in place to ensure quality laboratory results included making sure food samples collected were immediately placed into sterile specimen container, using distilled water, autoclaved media and sterilized petri dishes. A sterile environment was created using a bunsen burner and alcohol was used to swab field before dilution. Petri dishes were also sterilized and kept in sterile oven at 165°C for one hour.

Recruitment of Field Assistants

Field assistants were selected and trained in three days for the collection of the data. The assistants were HND students from the Department of Hospitality and Tourism Management, Ho Polytechnic. Their selection was based on their grade point average, their interest in food safety and their ability to express themselves fluently in the Ewe language. The training sessions considered the purpose of the study, the translation of the instruments into Ewe, the objectives of the study, the content of the instruments, plans in entering study areas, observational skills and other relevant issues.

Pre-Testing of Instrument

A pre-testing was carried out by the researcher within the Cape Coast Metropolis with twenty food handlers from randomly selected boarding secondary schools. The pre-testing stage was used to assess the clarity of the questions and layout, candidate instructions and time requirements. Results from the pre-testing required restructuring and elimination of some questions. It was important that the time required for completing the questionnaire was not perceived by the respondents as disruptive to the normal work pattern. The questionnaire was revised on the basis of the pre-test results and other recommendations. For example, a question regarding the preparation of food in an open space was vague and therefore had to be eliminated and used in the observation checklist. Also, their work activity had to be restructured to include assistant cooks and pantry.

Actual Field Work

In order to facilitate the data collection process, the researcher contacted the Municipal Education Director for an introductory letter which was presented to the participating schools. After permission had been granted by the school authorities for data collection to commence, the research team paid visits to the selected schools over the weekend to establish acquaintance with the food handlers and also observe how activities were conducted within the kitchen during food preparation processes. Participant observation was employed over a period of one month to observe the food safety practices of the food handlers' whiles they carried out their food preparation activities.

Further, food samples were collected between the fourth and the seventh week for the microbiological analysis. Based on their menu and the

type of food samples required for the study, each food sample was collected at three different intervals. This was necessary to ensure that the results from the laboratory analysis would not be by chance. After this stage, the research team returned to the schools to administer questionnaire to the food handlers.

Fieldwork Challenges

Collecting food samples from the schools was a difficult task as some of them were reluctant in granting the permission. Some were also getting irritated particularly with the continuous visits for the collection of food samples. However, the researcher managed to convince them and was eventually successful. In addition, transporting food samples over the period though short may have affected their microbial loads since temperature variations could cause a difference in microbial load. In spite of these challenges, the researcher ensured that ice packs were well packaged and their containers well sealed to avoid heat exposure.

Ethical Issues

This stage considers a discussion on the ethical dimension of the research and how they were addressed. This research took into account the issues of informed consent, anonymity and confidentiality. According to Neuman (2007), researchers must not compel anyone to participate in a research. Thus, a participant should take part in a research voluntarily at all times. Based on this, informed consent was sought from the selected school authorities before administering the instrument. The purpose of the study was clearly explained to the school authorities and the food handlers.

Secondly, the issue of anonymity was also assured. Anonymity protects privacy by not disclosing a respondent's identity. Food handlers were assured of their anonymity thus, their names were not associated with the responses given. Also, names of the participating schools were coded for the sake of anonymity.

Data Processing and Analysis

In order to ensure quality, the data were coded and entered into the statistical product and service solution (SPSS) version 21 for software analysis. Thus, the data were carefully edited (cleaned) to remove all outliers or extreme values which could have affected the validity of the results.

Descriptive statistics such as frequencies, percentages, graphs, line charts and cross tabulations were employed in analyzing the data. The descriptive statistics were used to describe the socio-demographic and employment characteristics of respondents, their food safety knowledge and practices as well as the barriers to food safety practices. Chi-square test (x^2) set at a 0.05 significance level was used to establish the relationship between the extent of food safety knowledge by their Socio-demographic characteristics and employment profile.

Chapter Summary

The focus of this chapter was to address the methodological issues used in the study. Areas considered included the study area, the study design, population size and the procedures followed in collecting and analyzing the data. Also, issues originating from the pre-test of the instrument and the actual fieldwork as well as the challenges encountered in the course of the data

collection and how they were addressed were also looked at. The subsequent chapters present the analysis, results, and discussion of the findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussion of the data collected for the study. The issues discussed are socio-demographic characteristics and employment profile of the food handlers as well as their knowledge and practices of food safety themes. It also discusses the barriers that impeded the practices of food safety and finally, the microbiological quality of some food samples analyzed.

Socio-Demographic Characteristics of Respondents

The socio-demographic characteristics considered in this study were gender, age, religion, marital status, educational status and ethnic group. These are presented in Table 2. Results indicate that the majority (79.4%) of respondents were females with the males constituting only 20.6 percent. This result is not unique to this study as several authors (Martins & Anelich, 2000; Tomlins & Johnson, 2004; Muinde & Kuria, 2005) have consistently reported higher female involvement in the hospitality industry than their male counterparts. Perhaps, the act of food preparation has originally been the responsibility of women within the African setting hence, their dominance within the food service sector.

Their ages ranged from 23 to 58 years with an average age of 42.2 years. About one fourth (39.1%) of them were within the range of 35 to 44 years. Respondents who were less than 25 years constituted the least proportion (12.4%).

With regard to their ethnic background, all the respondents belonged to the Ewe ethnic group. This could result from an influence of the study area.

Table 2-*Socio-demographic Characteristics of Respondents*

Socio demographic Characteristics	Frequency (N= 97)	Percent (%)
Gender		
Male	20	20.6
Female	77	79.4
Religion		
Christian	97	100
Age		
<25	12	12.4
25-34	16	16.5
35-44	38	39.1
45 and above	31	32.0
Marital status		
Unmarried	30	30.9
Married	67	69.1
Ethnic group		
Ewe	97	100
Educational status		
No formal education	15	15.5
Basic Education	72	74.2
SHS/Tertiary	10	10.3

Source: Fieldwork, Appietu (2016)

Also, results on their religious affiliation revealed that all of them were christians. This result was expected as most of the schools surveyed were established by churches and also due to the fact that food has a direct link to the religious beliefs of those who prepare them.

In all, the majority (69.1%) of respondents were married whiles those who were single constituted the minority (30.9%).

Education according to Gul (2012) is considered as an effective key determinant of acceptable food safety and hygiene practices. In this study, the

educational status of respondents showed that the majority (74.2%) of them had basic education whiles the least proportion had SHS/tertiary education (10.3%) and no formal education (15.5%). This finding has brought to light that the educational level of food handlers cuts across all levels with few having tertiary education. Indeed, it is essential that food handlers possess some level of education in order to ensure safe food practices particularly within the school catering setting in the Ho Municipality.

Employment Profile of Respondents

The employment profile surveyed in this study included work status, work experience, source of knowledge on food preparation, possession of medical health certificate and routine medical examination (Table 3). With respect to the work status of respondents, the Cooks constituted the majority (76.2%) while the Matrons constituted the least proportion (10.3%) of the sample. More than half of the respondents had been working for more than five years (66%).

The results indicated that respondents in senior high schools in the Ho Municipality undertake medical examination regularly as the majority (96.9%) had participated a year ago and had certificates to that effect. According to the Ho Municipal Assembly regulations regarding routine medical examination, all food handlers in any sector of the food service industry are expected to undergo medical examination annually. In line with this, they have been compliant.

Table 3-*Employment Profile of Respondents*

Characteristics	Frequency (N=97)	Percent (%)
Work status		
Matron	10	10.3
Cooks	74	76.3
Pantry	13	13.4
Work experience		
1-4 years	33	34.0
5 years and above	64	66.0
Source of knowledge on food preparation		
Observation	84	86.6
Formal training	13	13.4
Possession of medical health certificate		
Yes	94	96.9
No	3	3.1
Routine medical examination		
None	3	3.1
A year ago	94	96.9

Source: Fieldwork, Appietu (2016)

This is in contrast with the findings of Musa and Akande (2002) and Omemu and Aderoju (2008) who reported low participation of their respondents in routine medical examination. Perhaps, adequate knowledge possessed by respondents in this study and compulsion of medical examination by the regulating authorities responsible which were not reported in the earlier studies could account for the higher results recorded in this study.

Table 3 shows that the majority (86.6%) of respondents acquired their knowledge on food preparation through observation whiles about 13 percent gained it through formal education. This is similar to the findings of Muinde

and Kuria (2005) in Kenya that depicts that only a few of their respondents had formal training in food preparation.

This implies that food handlers may learn both good and bad practices from those they observe and may see these practices as normal. Eventually, their objectivity in identifying and changing these unhygienic practices learnt may be affected thereby putting the health of students at risk. To this end, the FAO (1997) recommends that every food handler undergoes a basic training in food safety and hygiene which will serve as a source of knowledge before being given the opportunity to work in any food service industry.

Areas of Food Safety Knowledge of Respondents

Knowledge of food handlers in food safety issues is an important prerequisite to safe food handling practices as this tends to minimize the incidents of food-borne illnesses. Table 4 presents the areas in which the food safety knowledge of respondents was examined. In all, twenty-five items were employed to gauge the food safety knowledge of respondents. Specifically, ten of the items were focused on their health and personal hygiene while five tested their knowledge on environmental and the rest on food hygiene (Table 4).

With respect to health and personal hygiene, the respondents could be said to have high knowledge (75.5%). In specific terms, they exhibited higher knowledge regarding the importance of wearing short fingernails (94.8%) during food preparation. Ninety percent or more of them knew that it was important to wash hands in between food preparation processes (92.8%) and also abstain from food preparation when suffering from cold or cough (91.8%). A higher proportion (85.6%) of the respondents knew that hands are safe when washed thoroughly with water and soap whiles a similar rate (84.5%) knew that

food handlers should only be allowed to prepare food when using hair restraints. In addition, about seventy percent of the respondents were knowledgeable on the need to avoid wearing jewelries when handling food as well as tasting food using the fingers.

On the other hand, respondents exhibited insufficient knowledge in the areas relating to using a clean serviette to dry hands after washing instead of a kitchen napkin (56.7%), the need to use gloves (55.7%) when serving cooked food and the need to cover a cut on a finger with an appropriate dressing before handling cooked food (45.4%).

The Ho Municipality as part of its guidelines expects that the environment where food preparation is undertaken is always clean and hygienic (HMA, 2012). As a way of examining respondents knowledge on cleanliness in the food preparation environment, five (5) environmental hygiene-related items were used (Table 4).

On the whole, respondents demonstrated a very high level of knowledge on environmental hygiene (96%). The majority (96.9%) of them knew that domestic animals such as goats, sheep, dogs, cats etc. should not be allowed to move freely in food preparation areas, dust bins should be kept away from food preparation areas (100%) and also food preparation environment should be cleaned before food preparation commences (97.9%).

Table 4-*Areas of Food Safety Knowledge of Respondents*

Food safety aspects	Frequency (N = 97)	Percentage of correct responses (%)
Health and personal hygiene		
Wearing short fingernails during food preparation is necessary	92	94.8
It is necessary to wash hands in between food preparation processes	90	92.8
A chief cook suffering from cold or cough cannot be allowed to prepare food	89	91.8
Safe hands are those washed with water and soap	83	85.6
A chief should only be permitted to prepare food using hair restraints	82	84.5
A matron should not be permitted to wear jewelries whiles preparing food	72	74.2
A chief cook should not be allowed to taste food using the fingers	70	72.2
Using a kitchen napkin to dry hands is safer than using a clean serviette	55	56.7
Wearing hand gloves when serving cooked food is necessary	54	55.7
A cut on a finger covered with a piece of cloth can be used in handling cooked food	44	45.4
Overall percentage	75	75.5
Environmental hygiene		
Certain domestic animals should not be allowed to move freely in food preparation areas	94	96.9
It is not hygienic to keep a dust bin in food preparation area to keep waste	97	100
Food preparation can begin after cleaning the environment	95	97.9

Table 4 continued

The presence of flies and dust in food preparation areas is harmful	97	100
It is important to carry out food preparation in an enclosed environment	97	100
Overall percentage	96	96.0
Food hygiene		
Cleaning work surfaces in between uses is necessary	85	87.6
Using a clean knife to clean fish and cut vegetables is not hygienic	84	86.6
Using separate utensils to handle raw and cooked food is important	84	86.6
Washing green leafy vegetables under cool running water is hygienic	56	57.7
Freshly prepared soup should be allowed to cool overnight in the kitchen before refrigerating	53	54.6
Meat bought from the open market is not safe	45	46.4
Sanitizing work surface after cleaning is necessary	23	23.7
Raw meat wrapped in a polythene should not be stored at the top part of a fridge	23	23.7
Frozen poultry needed for food preparation should not be thawed on the kitchen counter	15	15.5
The correct temperature for a refrigerator is< 1°C	6	6.2
Overall percentage	47	48.8

Source: Fieldwork, Appietu (2016)

Also, all of the respondents knew that the presence of flies in food preparation areas is harmful and that food preparation should be carried out in an enclosed environment.

With reference to the food hygiene domain, Table 4 indicates that in all, respondents fared worse (48.8%) compared to the others. More than half of them displayed sufficient knowledge on the need to clean work surfaces in between uses (87.6%), use separate knife to handle fish and vegetables (86.6%) and the importance of handling raw and cooked food with separate utensils (86.6%). Specifically, they exhibited poor knowledge in terms of proper washing of vegetables (57.7%), storing of soup in the refrigerator (54.6%), procurement of wholesome meat (46.4%), correct storage of raw meat in the refrigerator (23.7%) and the importance of sanitizing work surfaces after cleaning (23.7%).

In addition, knowledge on the correct method of thawing frozen foods also revealed that, less than one third (15.5%) of the respondents in this study knew that frozen poultry should not be thawed on the kitchen counter at room temperature. This knowledge was lower in studies conducted by Osaili et al. (2013) and Bolton et al. (2008). Again, less than one third (6.2%) of respondents in this study knew the correct temperature of a refrigerator. On the contrary, Bolton et al. (2008) and Garayoa, Vitas, Díez-Leturia and García-Jalón (2011) reported higher knowledge in this regard.

Extent of Food Safety Knowledge of Respondents

The awareness of food safety by food handlers is closely related to the depth of knowledge they possess. Considering the twenty-five items used in measuring the areas of food safety knowledge of respondents, the number of

correct responses a respondents obtained out of the twenty-five items was considered as his/her level of knowledge about food safety. The scores ranged from 0 to 25 points with scores above 15 representing “high knowledge”, 8 to 14 for “moderate knowledge” and 0 to 7 for “low knowledge”. Figure 4 presents the extent of respondents’ knowledge on food safety.

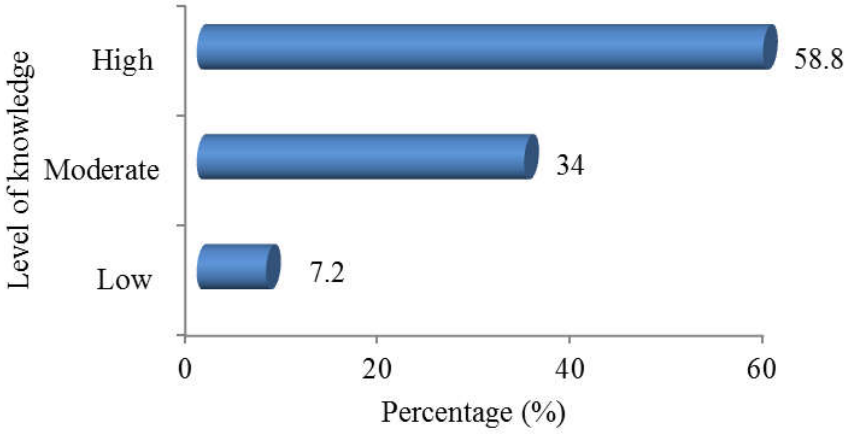

Figure 4: The Extent of Food Safety Knowledge of Respondents

Source: Fieldwork (2016)

As evident from Figure 4, the food safety knowledge of respondents ranged from low, moderate to high. In specific terms, more than half of the respondents possessed high (58.8%) food safety knowledge whiles those with moderate knowledge constituted 34 percent and the least proportion (7.2%) possessing low knowledge.

Extent of Knowledge of Food Safety by Socio-Demographic Characteristics and Employment Profile of Respondents

The food safety knowledge of food handlers has been found to be closely associated with their socio-demographic characteristics (Osaili et al., 2013) and employment profiles. As a result, the associations between respondents knowledge of food safety by their gender, age, educational status, marital status, source of knowledge of food preparation, work experience as well as the type of schools were explored (Table 5). Chi-square statistic was employed to determine whether significant relationship existed between the extent of respondents' knowledge of food safety and these variables.

With the exception of gender ($p = 0.016$), no significant relationship was established for the rest of the variables (Table 5). In terms of gender, eighty-six percent of the female respondents' demonstrated high knowledge in the overall food safety themes measured compared to their male counterparts with only fourteen percent of them possessing high level of knowledge. This results collaborates the findings of Sanlier and Konaklioglu (2012) who reported higher food safety knowledge scores for their female respondents than the males.

Although no significant relationships were established for the other variables, some relative differences were observed in their level of knowledge on food safety with respect to educational status, marital status, source of knowledge on food preparation, work experience and the type of schools in which the kitchen staff worked. Though results on the age showed that respondents within the age range of (35-44: 40.4%) and above (45: 31.7%) displayed significantly high knowledge on the subject, the middle aged

respondents (35-44: 40.4%) appeared to be more knowledgeable on food safety than the older respondents (45 and above: 31.7%).

Table 5-*Extent of Food Safety Knowledge by Socio-demographic Characteristics and Employment Profile of Respondents*

Socio-demographic (N = 97)	Levels of food safety knowledge			x^2
	Low	Medium	High	(p value)
Gender				
Male	0.0	36.4	14.0	8.326
Female	100.0	63.6	86.0	(0.016*)
Educational Status				
Formal education	85.7	90.9	80.7	1.674
No Formal Education	14.3	9.1	19.3	(0.433)
Marital Status				
Unmarried	28.6	24.2	35.1	1.170
Married	71.4	75.8	64.9	(0.557)
Age				
< 25	0.0	15.2	12.3	4.579
25-34	28.6	15.2	15.8	(0.599)
35-44	14.3	42.4	40.4	
45 and above	57.1	27.3	31.6	
Source of knowledge on food preparation				
Observation	85.7	87.9	86.0	0.071
Formal Training	14.3	12.1	14.0	(0.965)
Work Experience				
< 5 years	42.9	27.3	36.1	0.910
5 years and above	57.1	72.7	64.9	(0.635)
School				
Vavie SHS	14.2	9.1	3.5	3.924
Tang SHS	0.0	3.0	7.0	(0.864)
Lasa SHS	28.6	21.2	17.5	
Akowu SHS	28.6	24.2	24.6	
Lima SHS	28.6	42.5	47.4	

Source: Fieldwork, Appietu (2016)

Food Safety Practices of Respondents

It is noted that food handlers most often carry food-borne pathogens in their hands, cuts or sores, mouth, skin, and hair and gradually transfer them onto food during its preparation (Adams & Moss, 2008). Good personal hygiene practices therefore constitute one sure way for the prevention of microbial contamination of prepared foods. Table 6 presents a summary of the food safety practices of respondents during the food preparation processes. With the use of an observation checklist, eleven (11) health and personal hygiene-related practices were employed to determine the health and personal hygiene practices of food handlers within the Municipality.

Results from Table 6 show that in all, about a third (38.4%) of the respondents practiced health and personal hygiene during the food preparation processes. Specifically, it was noticed that less than one third (28.9%) of the respondents wore aprons during food preparation while none used hand gloves in the process of handling cooked foods. It is important to indicate that food handlers who do not use gloves when handling cooked foods can inoculate food items with infected excreta, respiratory drippings, pus or other infectious discharges being a major source of contamination and ultimate sources of health risks (Kaferstein, 2003). Thus, it is desirable that the use of hand gloves which serve as a barrier between bare hand contact and cooked foods during food service (Green & Selman, 2005) be encouraged among food handlers. Nonetheless, the majority of the respondents wore hair restraints (85.6%) and clean uniform (81.4%) during food preparation.

Table 6-*Food Safety Practices of Respondents*

Areas of concern	Frequency (N = 97)	Percentage in practice (%)
Health and personal hygiene		
Food handler avoids wearing jewelries during food preparation	88	90.7
Food handler wears hair restraint during food preparation	83	85.6
Food handler wears clean uniform during food preparation	79	81.4
Food handler washes hands in between food preparation processes	43	44.3
Food handler wears neatly trimmed fingernails during food preparation	43	44.3
Food handler washes hands with water and soap before food preparation	38	39.2
Food handler wears apron during food preparation	28	28.9
Food handler suffering from cold and cough at the time of visit	4	4.1
Food handler had a cut on the finger at the time of visit	4	4.1
Food handler wears hand gloves when handling cooked food	0	0.0
Food handler cleans hands with clean serviette instead of kitchen napkin after washing	0	0.0
Overall percentage	37	38.4
Food hygiene		
Food handler uses separate utensil to handle raw and cooked food	87	88.7
Food handler cleans work surfaces in between uses	73	75.3
Food handler tasting food using the fingers	61	63.9

Table 6 continued

Food handler sanitizes work top after cleaning	0	0.0
Food handler eating whiles food preparation is ongoing	0	0.0
Overall percentage	44	45.6
Environmental Hygiene		
Food handler carries out food preparation in a clean environment	78	75.7
Food handler carried out food preparation in an environment devoid of dust and flies	0	0.0
Absence of dust bins in the food preparation area	97	100
Food preparation carried out in an enclosed environment	0	0.0
Overall percentage	43	43.9

Source: Fieldwork, Appietu (2016)

Though the hand of a food handler is regarded as a major vehicle for the transfer of microorganisms from faeces, nose, skin or other sites to food (WHO, 1989) and as such hand washing acts as an effective way of preventing the spread of these organisms, the practice of hand washing among respondents was not encouraging. A little above one third (39.2%) of them washed their hands with water and soap before commencing food preparation. Whiles in the preparation process, only 44.3 percent washed their hands. Still on the lower side, a similar rate (44.3%) of the respondents wore neatly trimmed finger nails to prevent harbouring of microorganisms which could influence contamination during the food preparation processes.

On the positive side, the majority (90.7%) of respondents were without jewelries during food preparation. Also, less than one tenth (4.1%) of

the respondents suffered cold and cough as well as had cuts on their fingers during food preparation processes.

With respect to food hygiene practices, five (5) important items were used to assess the food hygiene practices of respondents during food preparation processes. On the whole, less than half (45.6%) of the respondents' engaged in food hygiene practices during the food preparation processes. As indicated in Table 6, a higher proportion (88.7%) of the respondents used separate utensils to handle raw and cooked foods. More than half (75.3%) of them cleaned their work surfaces in between uses. This practice according to the NRAEF (2006) helps to minimize the risk of cross contamination of food products during preparation. However, to utterly prevent its occurrence, the foundation highly recommends effective sanitization after cleaning as this ensures the optimum removal of all microorganisms that may linger after cleaning. Interestingly, none of the respondents was involved in any form of sanitization.

In addition, more than half (63.9%) of the respondents were observed tasting food using their fingers. This practice was mostly noted during the peak hours of food preparation where respondents were busy cooking in order to serve food on time. In all, the practice of eating whiles food preparation was ongoing was not observed among the respondents.

Maintaining proper sanitation in food preparation areas is a basic step to ensuring the preparation of safe foods. Four (4) items were used to measure environmental hygiene practices of respondents during the food preparation processes (Table 6). In all, less than half (43.9%) of the respondents practiced environmental hygiene. Although food preparation was carried out in a designated area, this was of a semi-enclosed structure with block work

constructed from the ground level and wood work surrounded with wire mesh from the midway to the roof. These structures encouraged the entry of flies, dust as well as pests into the food preparation area thus, compromising food safety.

During the observation processes, certain incorrect practices such as lack of calibration of thermometers (Henroid & Sneed, 2004), improper holding temperatures of cooked food (USA, Food and Drugs Administration, 2000) and the improper washing and sanitizing of food processing utensils and equipment (Oranusi, Galadima, Umoh, & Nwanze, 2007; Henroid & Sneed, 2004) which were reported in literature as contributing significantly to most school-related food poisoning were investigated bearing in mind the stages adopted from the concept of the flow of food.

It was noticed that none of the schools surveyed had food temperature measuring devices in the kitchen and therefore cooking, holding and serving temperatures of cooked foods were never monitored. The unavailability of temperature measuring devices in these schools indicates that respondents are not aware of the importance of acquiring and using the device.

Again, it was observed that even though cooked foods were transported to the dining hall under covered conditions, these were held at room temperature for at least forty-five minutes before students consumed it. According to the WHO (1989), the preparation of food long before its consumption is among the factors that contributed to food poisoning outbreaks.

Another incorrect practice observed was with regard to the improper handling of food-processing equipment. As a best practice, food processing utensils and equipment meant for handling food should be thoroughly cleaned, sanitized and colour-coded for a specific use. From observation, none of the

surveyed schools had their food preparation equipment and utensils colour-coded for a specific use. Thus, all equipment were used for all purposes once they were washed. This practice encourages cross contamination particularly amongst potentially hazardous foods which can eventually lead to food poisoning.

In addition, it was also observed that utensils for serving students' food particularly those used to serve roasted groundnut for porridge and gari for beans were not usually washed after each use. These were rather dry cleaned with a kitchen napkin and kept for the next use whiles those that contained the soups and stews were washed. In all, none of the washed equipment was sanitized and with the absence of drying racks, washed serving utensils were stacked in each other and stored in unenclosed areas creating favourable conditions for external contamination.

Food Safety Knowledge as Against Practice

Knowledge gradually accumulates through learning processes and these may be formal or informal instruction, personal experience and experiential sharing (Glanz & Lewis, 2002). According to the FAO (1995) cited in Abdalla, Suliman and Bakhit (2009), the food safety knowledge and practices of food handlers in any food service institution is critical for the prevention of microbiological contamination and spoilage of food which leads to food-borne illnesses of various forms. In consonance with the conceptual framework guiding the study, it is expected that the food safety knowledge of respondents would be translated into practice. Figure 5 presents the food safety knowledge of respondents as against their practices.

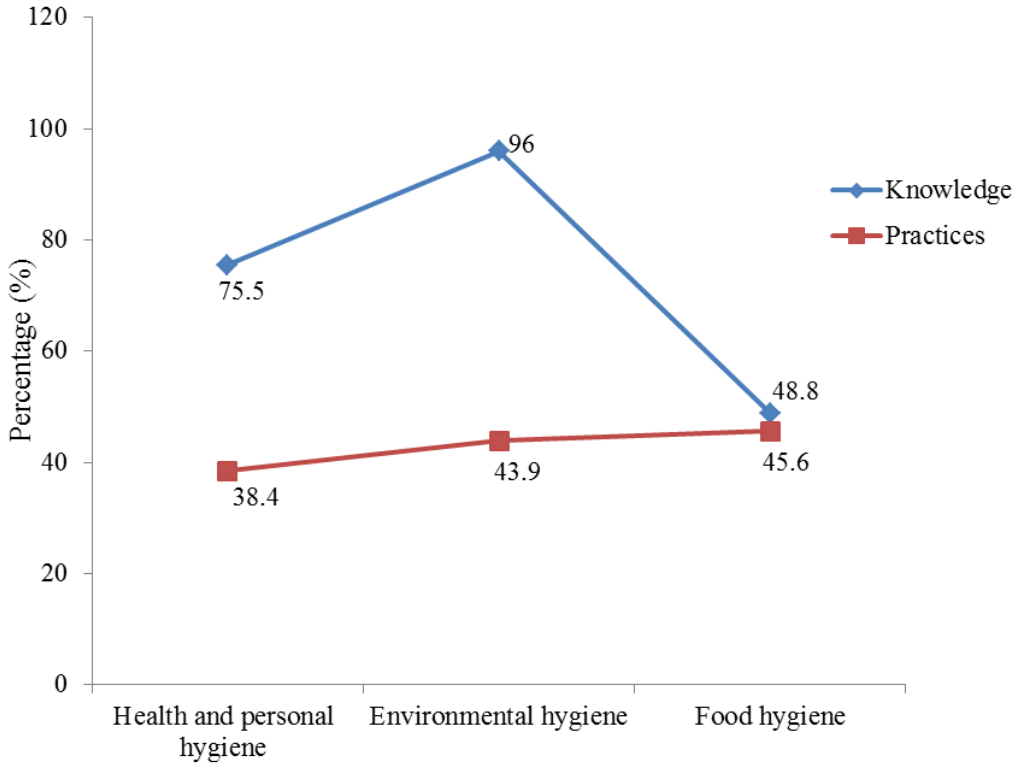

Figure 5: Food Safety Knowledge of Respondents as against their Practices

Source: Fieldwork (2016)

Evidence from Figure 5 revealed that the majority (96%) of the respondents knew that there was the need for them to carry out food preparation in a clean and hygienic environment. However, less than half (43.9%) of the respondents practiced environmental hygiene. In addition, it was also realized that the knowledge of respondents with respect to food hygiene was on the low (48.8%) side. Indeed, this level of knowledge reflected in their practice with regard to food hygiene as only about one fourth (45.6%) of the respondents practiced food hygiene during the food preparation processes. These finding could be attributed to the busy work schedules the food handlers underwent during food preparation processes such that, because of time

constraints amongst other factors, respondents consciously or unconsciously engaged in practices that compromised food safety.

Again, the results showed that respondents had a higher knowledge in terms of health and personal hygiene (75.5%) but only the minority (38.4%) of them practiced this act of food safety. In all, although most of the respondents exhibited high knowledge (73.4%) in food safety, in reality, this did not translate into practice (42.6%). This therefore suggests that there is still an existing gap between what food handlers know and what they do. Probably, these food handlers may think that their ability to contaminate food is outweighed by their culinary prowess or that they have sufficient knowledge and experience with foods such that they can control the degree of risk.

Barriers to Food Safety Practices among Respondents

In several situations, food safety practices among food handlers are frequently obstructed by some form of barriers. As presented in Table 7, there were a number of factors that impeded the practice of food safety by the food handlers in the surveyed schools within the Ho Municipality. As also indicated in the conceptual framework, these barriers are expected to prevent the food handlers from translating the high knowledge and positive practices that they had on food safety into practice. On the whole, the respondents identified eight barriers to safe food practices (Table 7).

Result from Table 7 revealed that the majority (96.9%) of respondents are unable to practice food safety due to the inadequate provision of equipment and resources which hindered them from carrying out proper food storage, preparation and service procedures. Similarly, a higher proportion of the respondents (94.8%) also identified irregular supply of water as a major barrier

to carrying out food safety practices during food preparation processes. This was expected as water shortage is one of the major challenges in the Ho Municipality necessitating the students to go in search of water for food preparation in the kitchens.

Table 7-*Barriers to Food Safety Practices*

Barriers to food safety practices	Frequency (N = 610)	Percentage in acceptance (%)
Inadequate provision of equipment and resources	94	96.9
Irregular water supply	92	94.8
Inadequate space and the unenclosed nature of the kitchen	90	92.8
Busy work schedules	89	91.8
Lack of funds	84	86.4
Lack of training and education on food safety practices	72	74.2
Poor enforcement of rules and regulations by appropriate authorities	57	58.8
Irregular power supply	32	33.2

Source: Fieldwork, Appietu (2016)

Respondents flagged inadequate space and the unenclosed nature of the kitchen as a major barrier to carrying out food safety practices during food preparation. The unenclosed nature of the kitchens was reported as the main source of dust, pests, and insects. Also from the observation sessions, it was noted that some equipment and service utensils were stored in the open after cleaning. Clearly, this could probably be due to the fact that the available store rooms were not spacious enough for their storage.

Furthermore, another major barrier that contributed to the inability of respondents to practice food safety was busy work schedule (91.8%). Indeed,

considering the larger number of students in some of the surveyed schools, it was obvious that respondents were working under pressure leading to some of the food safety practices being compromised. It appears that this barrier is a key issue within the hospitality industry as Hertzman and Barrash (2007) also reported busy work schedule as a major barrier to food safety practices among their respondents who worked in the kitchen and dining rooms of a catering company.

Again, eighty-six percent or more of the respondents also identified the lack of funds as a barrier to food safety practices in the school kitchens. Certainly, most of the schools studied were public institutions and therefore depended heavily on government subventions. Unfortunately, the inadequate provision of financial resources to these schools is currently being seen as impediments influencing the practice of food safety among the respondents studied. In accordance with this result, Ackah, Gyamfi, Anim, Osei, Hansen and Agyeman (2011) reported the lack of funds among others as a major barrier that inhibited the practices of food safety among their respondents. Respondents were also of the view that, the lack of regular training and education on food safety practices (74.2%) was a barrier to them.

Over half of the respondents identified the poor enforcement of rules and regulations by appropriate authorities (58.8%) as a barrier to food safety practices. Like most countries, there are rules and sanctions for non-compliance with food safety practices. However, due to the failure of authorities within the Municipality to implement these sanctions, it was observed that respondents were reluctant in wearing protective clothing such as aprons and hand gloves as well as maintaining proper environmental hygiene in the food preparation areas.

About a third (33.2%) of the respondents reported irregular power supply as a barrier to food safety practices. Notably, in many developing countries such as Ghana and Nigeria, irregular power supply amongst others has been a major factor that contributed to the downfall of many industries. But with the current implementation of intervention programmes particularly in Ghana, power supply seem to be stable at the time the study was conducted hence, respondents did not see it as a major challenge to food safety practices in their schools.

Microbiological Analysis

The microbial quality of food has a direct link to the level of food safety practices employed during its preparation processes. Adhering to correct food safety practices therefore will lead to acceptable microbial levels in prepared foods. However, the use of incorrect practices will negatively influence its microbial quality. According to the International Commission for Microbiological Specification for Foods (ICMSF, 1996), the microbial quality of ready-to-eat foods can only be termed 'acceptable' if its plate count is between 0-10^3 CFU/g. In addition, ready-to-eat food with a plate count of 10^4-$\leq 10^5$ CFU/g is 'tolerable'; however, plate count of ready-to-eat foods beyond or equal to $\geq 10^6$ CFU/g is 'unacceptable'. Results from the microbial analysis in this study were compared with these standards.

In determining the microbiological quality of selected food samples, the Aerobic Colony Count (ACC) microbial parameter was employed. This parameter allows the growth of all microorganisms present in a particular food

sample. Figure 6 depicts the overall levels of microbial contamination in relation to the ACC microbial parameter.

Evidences from Figure 6 show that the ACC microbial parameter had higher levels of contamination. In specific terms, out of the sixty food samples that were analyzed, thirty-five percent of them were of acceptable quality, whiles less than one third (23.3%) were of tolerable quality. In all, more (41.7%) of the samples were of unacceptable quality.

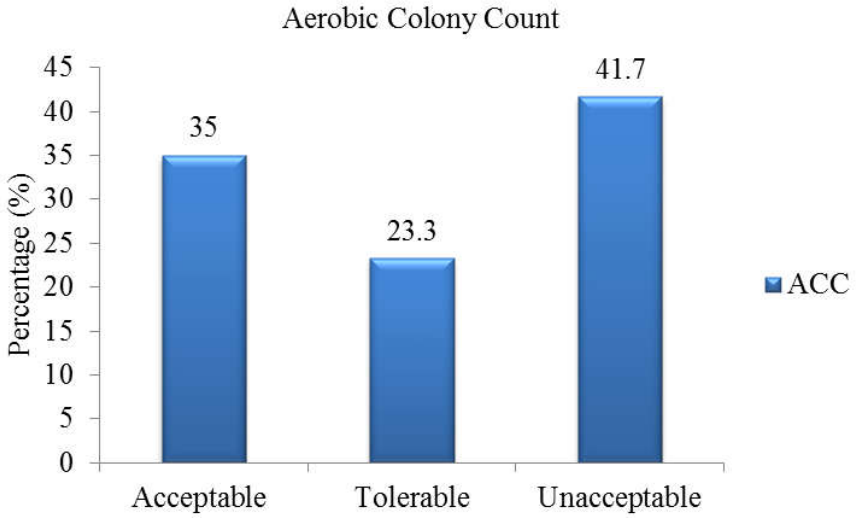

Figure 6: Overall Levels of ACC Microbial Contamination in Food Samples

Source: Fieldwork, (2016)

Microbial Contamination in relation to Food Samples

Table 8 presents the Aerobic Colony Count levels of microbial contamination in relation to the food samples analyzed. In all, more (46.7%) of beans and banku prepared in the boarding school kitchens were of acceptable (0-10^3) quality whiles 20 percent were found to be tolerable (10^4-$\leq 10^5$) and about one third (33.3%) were of unacceptable ($\geq 10^6$) quality.

Less than half (46.7%) of waakye samples were of unacceptable ($\geq 10^6$) quality. In addition, forty percent were of acceptable quality (0-10^5) whereas the residual (13.3%) were of tolerable quality.

Table 8-*Levels of Microbial Contamination in Selected Food Samples*

Food Sample	N	Acceptable (%)	Tolerable (%)	Unacceptable (%)
Beans	15	46.7	20.0	33.3
Banku	15	46.7	20.0	33.3
Boiled Rice	15	20.0	40.0	40.0
Waakye	15	40.0	13.3	46.7

Source: Fieldwork, Appietu (2016)

Boiled Rice on the other hand, showed higher levels of contamination with as much as forty percent of the samples being of unacceptable quality. However, a similar rate (40%) of them were tolerable with a minority (20%) being of acceptable quality. The higher level of microbial contamination recorded among these food samples could partly be attributed to the fact that they are considered potentially hazardous thus, they have the tendency to encourage the growth of microorganisms under favourable conditions. Juxtaposing this characteristic to the kitchen staff practices observed during the food preparation processes, it is not surprising that these levels of microbial contamination were recorded.

Comparison between Food Safety Practices of Respondents and the Microbiological Quality of Food Samples analyzed from Surveyed Schools

In line with the conceptual framework guiding this study where it is expected that the food safety practices of respondents will eventually impact on

the microbiological quality of meals prepared and served to students, the practices of respondents in relation to the microbiological quality of food samples from selected schools were examined (Table 9).

Table 9-*Food Safety Practices of Respondents and the Microbial Quality of Food Samples*

Schools	Percentage in Practice (%)	Microbial quality (%)		
		Acceptable	Tolerable	Unacceptable
Vavie SHS	31	33.3	41.7	25.0
Tang SHS	37	41.7	16.7	41.7
Lasa SHS	57	50.0	16.7	33.3
Akowu SHS	42	50.0	25.0	25.0
Lima SHS	59	50.0	33.3	16.7

Source: Fieldwork, Appietu (2016)

Results from Table 9 revealed that food handlers from Lima SHS (59%) and Lasa SHS (57%) exhibited a high practice of food safety during the food preparation processes compared to the others. These results significantly impacted on the microbial levels of their food as half (50.0%) of them were of acceptable levels.

In addition, less than half (42%) of food handlers of Akowu SHS practiced food safety during the food preparation processes. Comparing these results to the microbial levels, half (50.0%) of their food samples were of acceptable levels even though 25 percent of the food samples were unacceptable compared to microbial levels of Lima SHS.

In all, results from Table 9 indicate that food handlers of Vavie and Tang SHS displayed considerably unsatisfactory level of practices during the food preparation processes. In reality, these reflected in the microbial levels of

their food samples as a higher of them were of tolerable and unacceptable quality respectively.

Chapter Summary

This chapter has presented firsthand report of food handlers' knowledge and practices on food safety in surveyed schools. In addition, specific mention has been made of the barriers that impeded the practices of food safety among the food handlers together with laboratory results presented on the microbial analysis conducted on some food samples from the surveyed schools. This study noted that although respondents had good knowledge with respect to food safety, their observed practices were on the lower side and this was as a result of the barriers respondents identified as obstructing their ability to practice food safety. Subsequently, this impacted on the microbiological quality of the food samples analyzed. The next chapter summarizes the study's major findings, draws conclusion and makes constructive recommendations and suggesting further research areas.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

A summary of the main findings of the study is presented in this chapter. Further, conclusions are drawn based on the results and recommendations made towards the improvement of food safety knowledge and practices of food handlers in boarding secondary schools within the Ho Municipality.

Summary

The purpose of this study was to assess food safety in boarding secondary schools within the Ho Municipality. The conceptual framework guiding the study was adapted from the concept of the Flow of Food (NRAEF, 2006) and the model for food safety knowledge, attitude and HACCP practice (Ko, 2013).

The study adopted a cross sectional study design and a mixed method approach to data collection and analysis. All food handlers (97) in the boarding secondary schools registered with the GES, Ho were recruited for the study. Data on the food safety knowledge of food handlers and the barriers to food safety practices were obtained using questionnaire. An observation checklist was used to collect information on food safety practices of food handlers in surveyed schools. Laboratory analysis was conducted on some selected food samples from the school kitchen to determine their microbial quality.

Chi-square test was carried out to establish the relationship between the extent of food safety knowledge of respondents by their socio-demographic characteristics and employment profile.

Main Findings

On the whole, respondents had an appreciable knowledge of all the food safety themes tested. In particular, the majority (96%) of the respondents were knowledgeable as far as the need to ensure environmental hygiene in food preparation areas was concern. More than two-thirds of the respondents had high level of knowledge on the practices in relation to health and personal hygiene (75.5%) whiles their knowledge in terms of food hygiene measures were below average (48.8%).

The majority of respondents (87%) acquired their knowledge of food preparation through observation. A higher proportion (96.9%) of the respondents' were noted to have undergone a routine medical examination and had certificates to that effect.

The results showed that more than half (58.8%) of the respondents had high knowledge whiles seven percent had low knowledge.

Respondents in surveyed boarding secondary schools in the Ho Municipality had an appreciable knowledge of the issues regarding food safety but their practices were below average. In spite of the fact that the majority (75.5%) of respondents were knowledgeable in the area of health and personal hygiene, only about one third (38.4%) of them were able to translate this knowledge into practice.

In addition, only 43.9% of environmental hygiene was practiced by respondents in the surveyed schools even though almost all (96%) the respondents knew about the practice. The practice of food hygiene also saw less than half (45.6%) of the engagement of respondents. This was not surprising as they equally exhibited poor knowledge (48.8%) in this area.

Among the reasons that accounted for the differences between food safety knowledge and practices were the inadequate provision of equipment and resources (96.4%); irregular water supply (94.8%); inadequate space and the unenclosed nature of the kitchen (92.8%) and busy work schedule (91.8%).

With regard to the microbiological quality of food samples, results from the ACC microbial parameters used indicated higher unacceptable levels (41.7%). Food samples also showed varied levels of contamination with respect to the ACC microbial parameter. Specifically, more (46.7%) of 'Waakye' food samples were of unacceptable quality. A similar rate (40%) of Boiled rice samples were also of unacceptable quality. In all, samples of Beans (46.7%) and Banku (46.7%) showed higher levels of acceptable quality.

Further, a comparison between the levels of food safety practices of respondents and the microbiological quality of the food samples from selected schools revealed that respondents failure to practice what they knew influenced the quality of meals served to students at the time the study was conducted.

Conclusions

Based on the findings of the study, the following conclusions are drawn: In general, respondents in surveyed schools have high knowledge in the area of food safety. However, their knowledge on the appropriate method of thawing frozen foods was low.

There is a gap between food safety knowledge and practices of respondents.

Multiple factors prevented the respondents from translating their food safety knowledge into practice as the study showed issues such as the inadequate provision of equipment and resources, irregular water supply,

inadequate space and the unenclosed nature of the kitchen as well as busy work schedule. These subsequently influenced the microbial quality of meals served to the students.

It is further concluded that, the food safety measures taken during food preparation processes by the respondents is inadequate as most of the schools surveyed did not take into consideration the specific sanitation requirements needed for the varied stages of food preparation leading to higher levels of microbial contamination in prepared foods served to students.

Recommendations

In accordance with the findings of this study, a recommendation is made to the Ho Municipal Assembly (HMA) to initiate a suitable intervention which is aimed at improving the personal hygiene, food hygiene and sanitation conditions under which food is prepared in boarding secondary schools within the Municipality. Specifically, health educational programmes should be organized in collaboration with the local government, academia and the Health Directorate of the Municipality at least every quarter so as to help address the challenge of poor personal, food and environmental hygiene this study revealed.

In addition, the health and sanitation officers in the environmental health department of the Ho Municipality should appropriately design strategic plans and policies towards the effective regulation and monitoring of the activities of food handlers particularly in boarding secondary schools in order to ensure safe feeding of students in schools within the Ho Municipality. Also, the effective implementation of the food service systems (GHP and SOP) during food preparation processes in the surveyed schools is imperative.

It is further recommended that school authorities and management should not only be content with their attainment of large enrollment and the structural design of their schools but also be informed of the extent of food safety knowledge and hygiene practices of their kitchen staff and appropriately design and implement internal programmes to improve their quality in terms of food safety knowledge and practices.

Additionally, routine microbial analysis of cooked foods served to students should be carried out at regular intervals, so as to be informed of their microbial quality thereby adopting measures that will help reduce health risks along feeding in boarding secondary schools within the Municipality.

Finally, policy makers and planners including government are advised to also give utmost attention to the institutional food service industry particular boarding schools by providing adequate funds, equipment and resources necessary to improve upon their food safety practices thereby overcoming the barriers identified in the study.

Suggestions for Further Research

This study has focused on the food safety knowledge and practices of kitchen staff considering the KAP model. It is proposed that further research should focus on the attitude of food handlers with regards to food safety practices in order to establish the exact relationship that exist in the model.

Regarding the inclusion criteria, this study only focused on boarding secondary schools which were registered with the GES, Ho. Thus, further studies should include those not registered so as to generate more data on the knowledge, practices, barriers as well as the microbiological quality of school meals within the Municipality.

Furthermore, studies should be conducted to determine the microbial quality of the water and equipment used in food preparation within these schools. In addition, food handlers should be screened in order to ensure those who are asymptomatically ill are taken care of.

Finally, this study was unable to identify specific microorganisms present in the food samples and their resistance to antibiotics. It is therefore suggested that using Polymerase Chain Reaction (PCR), DNAs' of pathogenic microorganisms can be isolated and subsequently determine their resistance to antibiotics. This will partially fill the gap in knowledge regarding the quality of meals in the institutional sector of the hospitality and tourism industry.

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APPENDIX A

UNIVERSITY OF CAPE COAST

FOOD SAFETY QUESTIONNAIRE FOR FOOD HANDLERS

DEPARTMENT OF HOSPITALITY AND TOURISM MANAGEMENT

Topic: Food Safety in Senior High Schools in the Ho Municipality

Dear Sir/Madam

The aim of this study is to assess food safety in Senior High Schools in the Ho Municipality. It would be greatly appreciated if you could make time to assist in the completion of this questionnaire. The data would be solely used for academic purposes and would be kept confidential. You are also assured of anonymity as your name will not be associated with the responses.

Thank you.

Module I: Food handlers' knowledge on food safety and hygiene

Instruction: Please indicate (x) whether the following statements are **'True' or 'False'**

Food safety aspects	True	False
Health and personal hygiene		
Wearing short fingernails during food preparation is necessary		
It is necessary to wash hands in between food preparation processes		
A chief cook suffering from cold or cough cannot be allowed to prepare food		
Safe hands are those washed with water and soap		
A chief should only be permitted to prepare food using hair restraints		
A matron should not be permitted to wear jewelries whiles preparing food		
A chief cook should not be allowed to taste food using the fingers		
Using a kitchen napkin to dry hands is safer than using a clean serviette		
Wearing hand gloves during when serving cooked food is necessary		
A cut on a finger covered with a piece of cloth can be used in handling cooked food		

Environmental Hygiene		
Certain domestic animals should not be allowed to move freely in food preparation areas		
It is not hygienic to keep a dust bin in food preparation to keep waste		
Food preparation can begin after cleaning the environment		
The presence of flies and dust in food preparation areas is harmful		
It is important to carry out food preparation in an enclosed environment		
Food hygiene		
Cleaning work surfaces in between uses is necessary		
Using a clean knife to clean fish and cut vegetables is not hygienic		
Using separate utensils to handle raw and cooked food is important		
Washing green leafy vegetables under cool running water is hygienic		
Freshly prepared soup should be allowed to cool overnight in the kitchen before refrigerating		
Meat bought from the open market is not safe		
Sanitizing work surface after cleaning is necessary		
Raw meat rapped in a polythene should not be stored at the top part of a fridge		
Frozen poultry needed for food preparation should not be thawed on the kitchen counter		
The correct temperature for a refrigerator is < 1°C		

Module II: Barriers to food safety (Please tick all that apply)

I am unable to practice food safety the way I would have preferred because of;

1. Irregular power supply { }

2. Poor enforcement of rule and regulations by food supervision agencies { }

3. Lack of training and education on appropriate food safety practices { }

4. Lack of funds { }

5. Inadequate space and the unenclosed nature of the kitchen { }

6. Irregular water supply { }

7. My unconcerned attitude towards food safety { }

8. Inconvenient location of equipment such as sinks etc. { }

9. Busy work schedules { }

10. Inadequate provision of equipment and resources { }

11. Any other please specify……..……

Module III: Socio-demographic characteristics

1. Gender (1) Male { } (2) Female { }

2. Age……

3. Marital status (1) Single { } (2) Married { } (3) Widowed { } (4) Divorced { }

4. Highest Level of Education (1) None { } (2) Primary { } (3) JHS{ } (4) SHS { } (5) Voc. /Technical { } (6) Tertiary { }

5. Ethnic group …….

6. Religion (1) Christian (2) Muslim (3) Other (please state)…….

Employment profile

7. Work status (1) Matron { } (2) Chief cook { } (3) Cook { } (4) Pantry { } (5) Assistant cook { } (6) Others (please specify)……..

8. Work experience (1) ……..years (2)…….. Months

9. How did you learn how to prepare food (1) Through observation { } (2) Formal training { } (3) Family business { } (4) Other (please state) ……..

10. Do you have a medical health certificate? (1) Yes { } (2) No { }

11. When was the last time you had a routine medical examination? ……

APPENDIX B

UNIVERSITY OF CAPE COAST

DEPARTMENT OF HOSPITALITY AND TOURISM MANAGEMENT

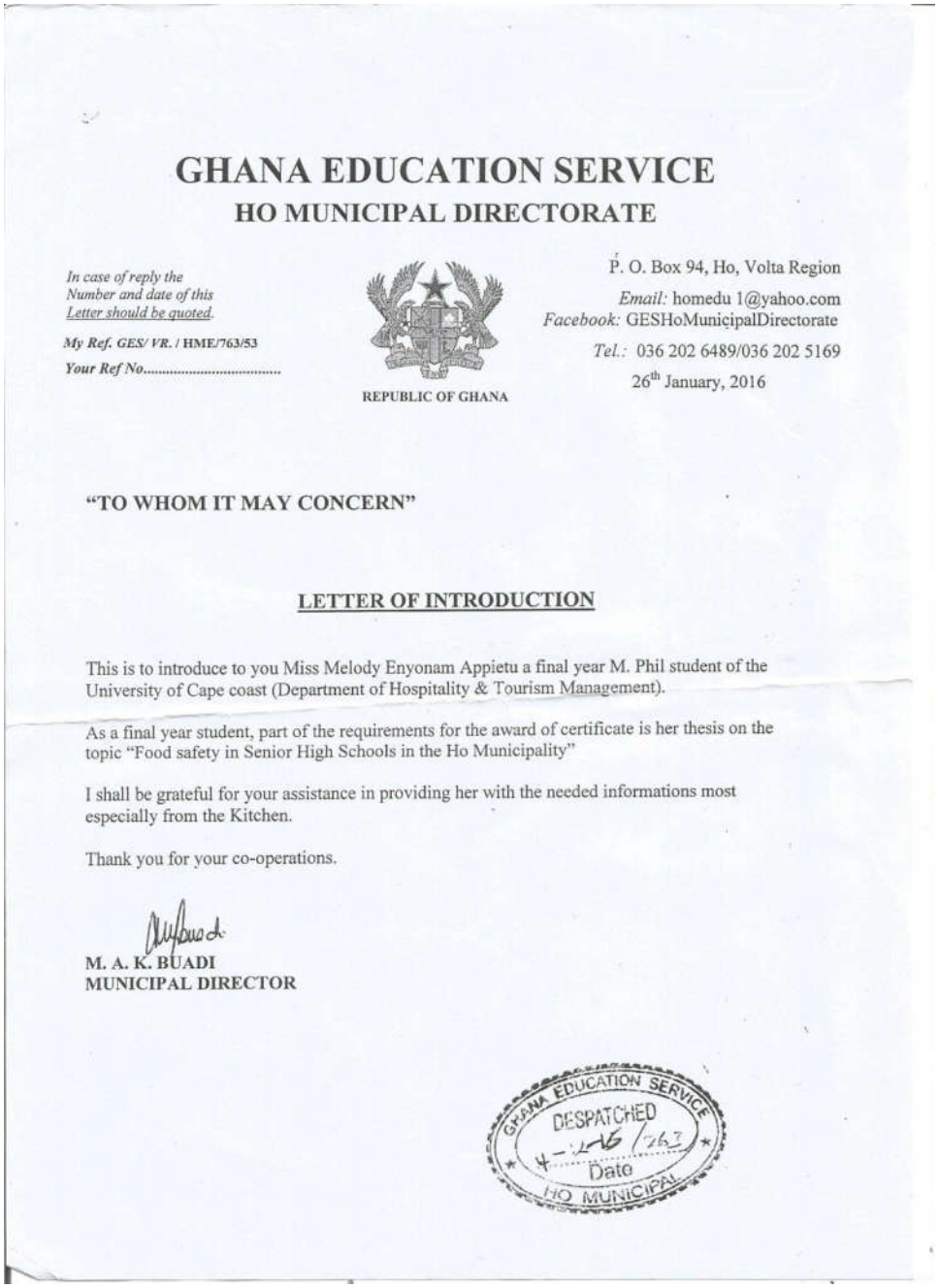
OBSERVATION CHECKLIST – FOOD HANDLERS PRACTICES ON FOOD SAFETY

Name of School:…….Date:……

Food safety practices of food handlers

Areas of concern	Yes	No
Health and personal hygiene		
Food handler avoids wearing jewelries during food preparation		
Food handler wears hair restraint during food preparation		
Food handler wears clean uniform during food preparation		
Food handler washes hands in between food preparation processes		
Food handler wears neatly trimmed fingernails during food preparation		
Food handler washes hands with water and soap before food preparation		
Food handler wears apron during food preparation		
Food handler suffering from cold and cough at the time of visit		
Food handler had a cut on the finger at the time of visit		
Food handler wears hand gloves when handling cooked food		
Food handler cleans hands with clean serviette instead of kitchen napkin after washing		
Food hygiene		
Food handler uses separate utensil to handle raw and cooked food		
Food handler cleans work surfaces in between uses		
Food handler tasting food using the fingers		
Food handler sanitizes work top after cleaning		
Food handler eating whiles food preparation is ongoing		
Environmental Hygiene		
Food handler carries out food preparation carried in a clean environment		
Food handler carried out food preparation in an environment devoid of dust and flies		
Absence of dust bins in the food preparation area		
Food preparation carried out in an enclosed environment		

APPENDIX C



GHANA EDUCATION SERVICE
HO MUNICIPAL DIRECTORATE

In case of reply the Number and date of this Letter should be quoted.

***My Ref. GES/ VR. /* HME/763/53**

Your Ref No.....

REPUBLIC OF GHANA

P. O. Box 94, Ho, Volta Region
Email: homedu 1@yahoo.com
Facebook: GESHoMunicipalDirectorate
Tel.: 036 202 6489/036 202 5169

26th January, 2016

"TO WHOM IT MAY CONCERN"

LETTER OF INTRODUCTION

This is to introduce to you Miss Melody Enyonam Appietu a final year M. Phil student of the University of Cape coast (Department of Hospitality & Tourism Management).

As a final year student, part of the requirements for the award of certificate is her thesis on the topic "Food safety in Senior High Schools in the Ho Municipality"

I shall be grateful for your assistance in providing her with the needed informations most especially from the Kitchen.

Thank you for your co-operations.

M. A. K. BUADI
MUNICIPAL DIRECTOR

GHANA EDUCATION SERVICE
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