FOOD SAFETY PRACTICES AND DETERMINANTS IN PRIMARY, SECONDARY AND POST-SECONDARY LEARNING INSTITUTIONS IN NAIROBI, KENYA

Dr. Philip Ngere, BDS; PGD-PPM (UoN)

H57/7511/04

A thesis submitted in partial fulfillment of the requirements for the award of the Master of Public Health (MPH) degree of the University of Nairobi

2010

DECLARATION

I, Philip Ngere, do declare that this thesis is the result of my original work and it has never been submitted either wholly or in part to any other university for the award of a degree or diploma.

Signature _____ Date 11/11/2010

Dr. Philip Ngere, BDS; PGD-PPM (UoN)

APPROVAL

This thesis has been submitted for examination with our approval as supervisors:

I. School Supervisors:

Signature _____ Date 11/11/2010

Prof. Mutuku A. Mwanthi, BSc; MSEH; PhD

Associate Professor, School of Public Health

University of Nairobi

Signature _____ Date _____

Dr. Peterson J. Muriithi, BDS; MPH

Lecturer, School of Public Health

University of Nairobi

II. External Supervisor

Signature _____ Date 11/11/2010

Prof. Jackson N. Ombui, BVM; MSc; PhD

Associate Professor, Department of Public Health, Pharmacology and Toxicology

University of Nairobi

III. The Director, School of Public Health, University of Nairobi

Signature _____ Date 11/11/2010

Dr. Dismas O. Ongore. BSc; MBChB; MPH; PhD

DEDICATION

This work is dedicated to Dr. Irene Nafula Ogali; my friend, companion and wife, who has taught me well the meaning of the word persistence. "I swear ... ... to hold him who taught me this art as dear to me as my parents ..." Hippocrates.

ACKNOWLEDGEMENTS

This project could not have been successful but for the effort of many people who in one way or the other made worthwhile contributions.

First, I am grateful to the Lord for giving me the strength and hope to pursue this project to its conclusion. I wish to also thank the Government of Kenya and the University of Nairobi for the sponsorship and the opportunity to study respectively.

I am indebted to my supervisors, Professor Mutuku A. Mwanthi, Dr. Peterson J. Muriithi and Prof. Jackson N. Ombui for willingly accepting the burden of supervision and more so for their patience during the entire project period.

I am also grateful to the Commission for Higher Education, Ministry of Education and the City Council of Nairobi for allowing me carry out this project within their academic institutions. The same appreciation is also extended to all the administrators and the food handlers of the academic institutions which participated in the exercise for their time and support.

A special mention goes to my wife, Irene and sons, Philip and Mathew, who patiently persevered loneliness as I pursued the training. I believe my absence was not in vain.

To all my colleagues, I wish to register my appreciation for the team work and moral support during this programme.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

µg	:	microgram
Cap.	:	Chapter
CCN	:	City Council of Nairobi
CBS	:	Central Bureau of Statistics
CDC	:	Centre for Disease Control and Prevention
CHE	:	Commission for Higher Education
EEL	:	Equipments Evaluation Log
FAO	:	Food and Agriculture Organisation
FBDs	:	Food Borne Diseases
FBIs	:	Food Borne Illnesses
FDCSA	:	Food, Drugs and Chemical Substances Act
FIFO	:	First In First Out System
FSPs	:	Food Service Processes
GoK	:	Government of Kenya
HACCP	:	Hazard Analysis Critical Control Point
KAQ	:	Knowledge Assessment Questionnaire
KNBS	:	Kenya National Bureau of Statistics
MOEST	:	Ministry of Education Science and Technology
MoH	:	Ministry of Health
°C	:	Degrees in Celsius
PHA	:	Public Health Act
PHFs	:	Potentially Hazardous Foods
POC	:	Practices Observation Checklist
ppm	:	Parts per million
RTE	:	Ready to eat
PASW	:	Predictive Analytic Soft Ware
UN	:	United Nations
USDA	:	United States Department of Agriculture
WHO	:	World Health Organisation

DEFINITIONS OF TERMS USED IN THE TEXT

Carrier: A person who harbours and may pass on harmful microorganisms without showing signs of illness.

Contaminant: An objectionable matter present in food.

Cross contamination: Transfer a contaminant from one food item to another.

Food borne disease: Illness caused by micro-organisms that are carried by the food or water but do not necessarily need the food to live and survive.

Food chain: The stages through which raw, processed and prepared food stuffs pass through from production to consumption.

Food contamination: The introduction of a contaminant into food which makes it unsuitable for consumption.

Food handler: Any person who manages or influences the management of the food chain.

Food hygiene: Keeping of food free from disease-causing or food spoiling contaminants.

Food poisoning: Illness caused by eating food that contains either harmful substances or micro-organisms living and growing on the food.

Food service operator: A food handler who directly carry out the food service processes.

Food service supervisor: A food handler who oversee the implementation of food safety policies and standard operating procedures.

Food spoilage: The process of food becoming damaged or rotten.

Mass catering: Food service procedures involving handling of large quantities of food.

Potentially hazardous food: Food items that may contain pathogenic microorganisms and / or is capable of supporting their rapid and progressive growth.

Private academic institutions: Academic institutions that do not receive any grant from the central government.

Public academic institutions: Academic institutions which are maintained primarily by the central government.

ABSTRACT

Every year millions of people worldwide suffer food borne illnesses making it a major public health concern. The learning institutions are at a great risk of food borne illnesses due to their student population that require mass catering which has inherent risks associated with bulk handling of food. Furthermore, the food handlers who carry out the food service processes within the institutions are critical to food safety outcomes hence their food safety knowledge and practices need to be monitored. Finally, the adequacy and reliability of institutional financing determines its ability to source safe food items, procure necessary food safety equipments and to hire appropriate personnel.

The general objective was to determine the food safety practices and their determinants in primary, secondary and post-secondary learning institutions of Nairobi and to suggest ways of improving food safety outcomes.

This was a cross-sectional study employing quantitative methods. The study was carried out in Nairobi Kenya which had 110 learning institutions with feeding programmes. These were first stratified based on their level of education into primary, secondary and post-secondary and then based on ownership into public and private institutions. A proportionate stratified random sampling method was used to select 30 institutions for the study. The study utilized Knowledge Assessment Questionnaire (KAQ), Practice Observation Checklist (POC) and Equipment Evaluation Log (EEL) to collect data. The mean percentage scores for every institution was then calculated and entered into the Predictive Analytic Soft Ware (PASW) statistical programme which was also used to carry out the descriptive and associational analyses of the study variables.

A total of 30 institutions participated of which 43.3% were primary schools and 63.3% were private institutions. The mean percentage score for food safety practices for all the institutions was 48.7%. This, however, varied across the level

and ownership of the learning institutions. The latter turned out to be a significant determinant of food safety knowledge ($p=0.017$), food safety equipment ($p=0.000$) and food safety practices ($p=0.001$).

The study established that food handlers' food safety knowledge is an important determinant of food safety practices. The conditions of the food safety equipments also had a positive association with the food safety practices within the institutions. While the institutional ownership directly affects the food safety practices with privately funded institutions having better food safety practices, the level of institution has no direct influence on the food safety practices.

There is need to empower the food handlers with the correct knowledge on food safety. The functional conditions of the food safety equipments within the institutions also need to be improved. The policy makers in the education sector need to develop job placement criteria for food handlers setting minimum academic, professional and experience requirements.

CHAPTER ONE : INTRODUCTION

1.1 Background information

Everybody expects to be provided with safe food free of contaminants. Unfortunately this is not always the case and every year, millions of people worldwide suffer from food borne illnesses (WHO, 2007). Good food safety practices leads to safe food while poor food safety practices end up with unsafe or contaminated food which is associated with adverse health and socioeconomic outcomes.

The food borne illnesses (FBIs) are a major public health problem (Redmond et al, 2003; Koopmans et al, 2002; FAO, 2003). Through the globalisation of food marketing and distribution, contaminated food products can affect the health of people in numerous countries at the same time (WHO, 2008). Moreover, FBIs appear to be emerging more frequently than ever before and the capacity of public health authorities to apply conventional control measures does not seem to be developing at the same rate (WHO, 2007). Approximately 30% of all emerging infections over the past 60 years were caused by pathogens commonly transmitted through food (Jones et al, 2008). Diarrhoeal diseases alone, a considerable proportion of which is food borne, kill 2.2 million people globally every year (WHO. 2008), but the burden arising from all FBIs is clearly larger.

The heaviest share of the disease burden occurs in poor countries (UN, 2008). Even though everybody is at risk, some people or groups are at greater risk such as the young; the elderly; the immune-suppressed; those institutionalized such as schools and learning institutions, health care facilities and homes for the elderly (Finch and Eileen, 2005; Charlebois, 2002).

Outbreaks of FBIs may result in substantial costs to schools, students, and the community. They include medical costs, attorney's fees, insurance costs, additional training or equipment to improve food safety, and lower participation in

the school programs (Barbara and Jeannie, 2003). Other possible outcomes of FBIs outbreaks include closures of the institutions, loss of learning hours due to absenteeism by ill students, death in severe cases, spoilage of food, bad reputation of the institutions affected, and loss of wages to the food handlers in the event of closure (Emily and Nicole, 2004; Finch and Eileen, 2005). Unfortunately, most of these FBIs are under-reported because attention is focused on the large scale FBI outbreaks at the expense of individual cases which hardly catch attention (Ombui et al, 2001; Medeiros et al, 2001).

Safe food in learning institutions is a product of several factors that need to be controlled due to the potential risks of food contamination associated with them. Some of these factors are related to the food handlers, the food handling process, the learning institutions themselves and the food handling regulations.

The food handlers are categorized into food service supervisors and food service operators (Barnes, 1997). In the learning institutions, the former include the principals, superintendents, managers, proprietors and chef managers who do not directly handle food but whose support is important for successful implementation of food safety policies and standard operating procedures. The latter include chefs and cooks who directly carry out the food service processes. These food handlers can introduce food contaminants into food at any point between the farms/production and the table through poor safety practices (Pemberton et al, 2004; Troller, 1993) or deliberate adulteration (FAO, 2003). They need to be well trained to understand the ever-changing technologies of food safety (Worsfold, 2006) to minimize the risk of FBIs.

Many raw food items especially of animal origin are contaminated with pathogens (Cuiwei et al, 2001; WHO, 1989). Food items can also be further contaminated through usage of waste water for irrigation (Asheena et al, 2003) and non potable water for food handling processes (Duncan, 1975). The food service supervisors therefore need to adhere to food safety practices during procurement.

The large population in learning institutions necessitates volume processing and preparation of food to efficiently and economically provide meals. However, this accentuates effects of contamination (Marriot, 1985; Minor, 1989; Charles 1983). The bulk food processing also requires appropriate equipments to ensure food safety (Snyder, 1999; Bryan, 1992). The institutions need to also ensure food sanitation through communicable disease control among food handlers, personal hygiene, efficient waste management and supervision (Marriot, 1985).

Learning institutions reflect a student population of diverse cognitive abilities across the primary, secondary and post-secondary levels. The pupils in primary schools are not likely to comprehend food safety issues as much as their counterparts in secondary and post-secondary institutions who may be able to understand the food safety risks hence agitate for good food safety practices in their institutions. These different levels of institutions therefore represent population with different vulnerabilities to FBIs.

In Kenya, it is a legal requirement for pre-placement medical examinations for food handlers working in public food premises including learning institutions with at least subsequent annual post-placement medical examinations (GoK, 1986). This is an approach used to detect infected food handlers and prevent them from contaminating food. The extent to which the institutions adhere to this requirement and to which the public health officers ensure compliance to the regulation is therefore likely to determine the degree of risks of FBIs.

The food safety in learning institutions is capital intensive in terms of hiring, retaining and developing the necessary human resource and also procuring the appropriate food safety equipments. The reliability and adequacy of the institution's financing system is therefore likely to determine its food safety outcomes. The private learning institutions draw their funds primarily from the student fees, while in public learning institutions, the students' contributions is minimal and supplement recurrent funding from central government (Eshiwani,

2002). The former, other than being more reliable and adequate, puts a lot of financial pressure on the parents and guardians. The parents and guardians in private learning institutions are therefore likely to demand more accountability and value for their money from the institutions' managements thus influencing food safety outcomes.

Most of these FBIs can be avoided through food safety practices (CDC, 2000). The food handlers in the learning institutions need to ensure cleanliness, separation of food items, proper cooking and keeping of food at the right temperatures to minimize the chances of FBI outbreaks. However, this can only be realized against a background of adequate food safety knowledge (Knight and Warland, 2005), adherence to recommended food safety practices (USDA, 2006) and the support of appropriate food safety equipments (La Graca, 1988). This study therefore determined the level of food safety practices and its determinants in primary, secondary and post-secondary learning institutions in Nairobi. The findings of this study contribute to the knowledge of food safety within the learning institutions. It also recommends food safety strategies that can reduce risks of food contamination and subsequent adverse health and socioeconomic outcomes within the institutions.

1.2 Conceptual Framework

The food safety outcome in learning institutions is a product of several factors grouped as background and proximate determinants (Figure 1).

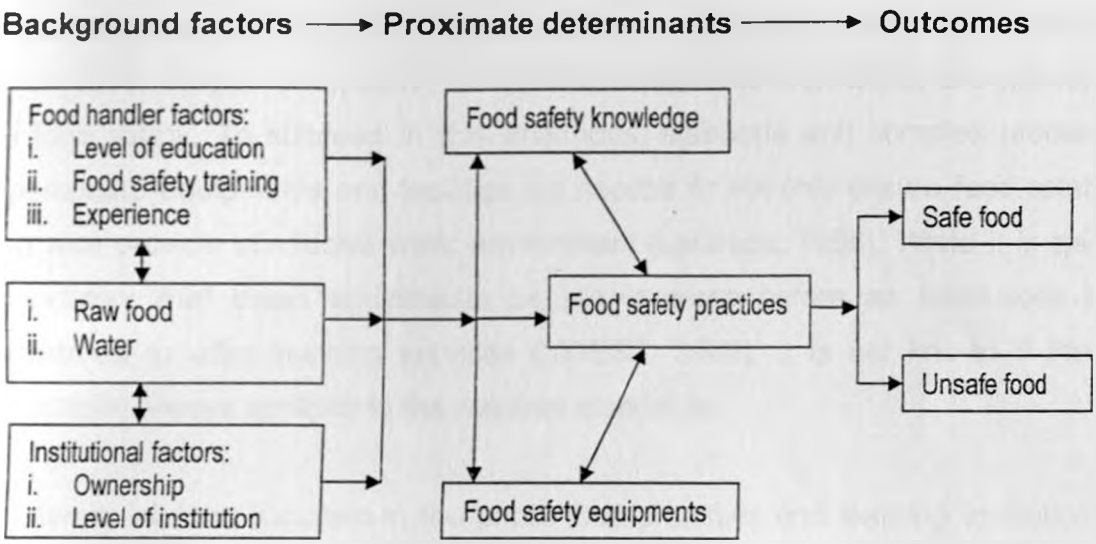

Figure 1: Determinants of food safety outcomes

1.3 Research Problem

Food safety has been the focus of several researches resulting in the development of various approaches of preventing food contamination (Wu and Fung, 2006; Arnout et al, 2005) yet FBIs is still a major public health problem worldwide (Redmond and Griffith, 2003). Previous studies have also pointed out that food handlers' educational background and training are key to food safety (Hislop and Shaw, 2009) yet the Ministry of Education Science and Technology (MOEST) has no guidelines for the placement of the food handlers. There are chances that any person can therefore be employed as a food handler irrespective of their education backgrounds, professional training or knowledge which is a potential risk to food safety.

The learning institutions handle large quantities of food and given that any incident can affect a high number of students (Santos et al, 2008). The food service processes such as storage, preparation, cooking, and serving should conform to the food safety standards to avoid food contamination (Roday, 1999; Pemberton et al, 2004; Uhlich et al, 2006; Trikett, 2002). Food sanitation (Mikkelsen and Søndergård, 2006); pest control (Betty and Roberts, 1993); food

handlers personal hygiene and be in good health (Günter and Axel, 2004; White et al, 2003; Clayton et al, 2003; GoK, 1992; Koopmans et al, 2002) are also key to food safety. To succeed in this enormous, elaborate and complex process appropriate equipments and facilities are needed to not only ensure food safety but also provide conducive work environment (LaGraca, 1988). While it is also mandatory that these equipments be put in place before an institutions is registered to offer learning services (MOEST, 2002), it is not known if their conditions always conform to the required standards.

In Kenya, all food handlers in the public food premises and learning institutions are required to undergo pre-placement and annual post-placement medical examinations (GoK, 1986) to prevent them from contaminating food. However, this has significant limitations (Bryan, 1992). It does not address all the food service processes and not all microorganisms transmitted by food are sought during routine examination (Appendix H). Again, food handlers who are diagnosed as not infected may be in incubatory phase of a disease (Michaels et al, 2004; Lin et al, 1988), or may have mild, abortive or an atypical illness leading to pre-symptomatic (carrier) status thus causing food contamination without the food handlers' knowledge. Infections also may be acquired and terminated between one medical examination and the subsequent one and the food handlers may also not report any illness to their supervisors in between the scheduled examinations (Michaels et al, 2004). The level of food safety and health practices therefore need to be determined among the food handlers.

1.4 Significance of the Study

Children worldwide now are spending longer periods of their lives in educational institutions (Ivatts, 1992) where they have little or no feeding options other than the institution's kitchens. They also have little or no control over the food safety practices thus any food handling error is likely to expose them to risks of FBIs. Unlike the pupils and students in learning institutions, non institutionalised patrons only visit public food establishments occasionally, for only short durations

and are free to shun those that may appear to pose any risk (Worsfold, 2006). The pupils and students in learning institutions are thus vulnerable due to the fact that they are contained behind fences with little or no feeding options; lack cognitive ability to comprehend food safety issues especially primary school pupils; and may not afford alternative food options where they exist.

Over 98% of public food service premises including learning institutions handle potentially hazardous foods (PHFs) (ANZFA, 2001). The PHFs support the growth of harmful bacteria hence need to be cooked to correct temperature, correct duration of time and not kept at room temperature for more than two hours (Uhlich et al, 2006). The menus of the learning institutions contain these PHFs which include: all cooked meat and poultry; cooked meat products; milk, cream, artificial cream, and dairy products; cooked eggs and products made with eggs; fish and other sea-foods and cooked rice and cereals. Ombui et al (2001) also showed that most food borne disease outbreaks in Kenya involved these potentially hazardous food items. Improving the food safety practices therefore reduces the risk of FBIs.

Despite the fact that the food handlers' position is crucial when it comes to food safety within the learning institutions, no studies have been done in Kenya to find out if their food safety practices conform to the food safety requirements. It was important that this study to focus on the food safety practices and established the extent of the problem within the academic institutions. The findings form a basis for public health interventions to improve the management of the food service processes so as to reduce risks of FBI related problems in these institutions. It is also an important basis for strengthening the standard operating procedures for food safety.

1.5 Study Objectives

1.5.1 General Objective

The general objective of this study was to determine the level of food safety practices and determinants in primary, secondary and post-secondary learning institutions in Nairobi.

1.5.2 Specific Objectives

The specific objectives of the study were to:

1. Establish the level of the food safety practices in the learning institutions;
2. Determine the influence of food handlers' education on food safety practices;
3. Determine the influence of professional training on food safety practices;
4. Establish whether work experience influences food safety practices;
5. Establish if institutional ownership affects the food safety practices; and
6. Determine the effect of level of institution on food safety practices.

1.6 Hypotheses

The following five (5) null hypotheses were explored:

1. Level of education does not influence food safety practices;
2. The professional training has no influence on food safety practices;
3. Work experience does not influence food safety practices;
4. Institutional ownership does not affect the food safety practices; and
5. Level of institution is not related to food safety practices.

CHAPTER TWO : REVIEW OF LITERATURE

2.1 Introduction

This chapter presents an insight to some of the literature relevant to this study. Section 2.2 looks into the food hazards that raise food safety concerns in the food handling process. Section 2.3 presents the food safety hazards critical control points in the food handling process. Section 2.4 addresses the food safety requirements for food service premises. Section 2.5 presents literature on the food safety practices in the learning institutions while section 2.6 looks into the cases of food borne disease outbreaks. Finally, section 2.7 makes a conclusion of the findings of the various literatures reviewed.

2.2 Food safety hazards

Food safety hazard is defined as microbial, chemical or physical food contaminant or a biological condition of food with the potential of causing an adverse health effect (Barbara, 2003). The commonest of these food contaminants are the microbial agents (Ombui et al, 2001; Walsh et al, 2005; Mahon et al, 2006). The microbial agents include bacteria especially *Campylobacter jejuni*, *Salmonella* species, *Escherichia coli* O157:H7, *Clostridium perfringens*, *Clostridium botulinum*, *Staphylococcus aureus*, *Staphylococcus intermedius*, *Listeria monocytogens*, *Vibrios vulnificus*, *Shigella*, and *Bacillus cereus*. Staphylococcal food poisoning is the most prevalent FBDs in Africa (Karsten et al, 2001; Duncan, 1975).

Other microbial agents are protozoa, viruses, parasites and fungi. Protozoa include *Toxoplasma gondii*, *Cryptosporidium parvum,* and *Clonorchis sinensis*. Viruses especially enteroviruses such as *hepatitis A* virus and *Norwalk* virus are also responsible for many FBD outbreaks (Michaels et al, 2004; Koopmans et al, 2002; Bidawid et al, 2000; Riordan et al, 1984). Parasites, especially zoonotic infestations, such as *Taenia solium, Taenia saginata, and Trichenella spiralis* are also a source of microbial contamination (Duncan, 1975). Most plant products

are substrates for fungal growth leading to toxic or carcinogenic fungal mycotoxin contamination of food. Five important mycotoxins are aflatoxins, ochratoxins, fumonisins, zearalenone, and trichothecenes. Crops such as peanuts, corn, pistachio, walnuts, and copra are very susceptible to mycotoxin contamination (FAO, 2003). Aflatoxins producing fungi includes *Aspergillum flavus*, *Aspergillum parasiticus*, *Fusarium* species, *and Penicilium* species. Four major aflatoxins B_1, B_2, G_1 and G_2 occur in plants contaminated with fungi. Exposure to aflatoxins is known to cause acute liver failure and aflatoxin B_1 is a well known cofactor in the causation of hepatoma (WHO, 2004) and has a well established relationship with primary liver cancer (FAO, 2003).

Mycotoxin food poisoning is of paramount importance mainly due to aflatoxin involving cereals, pulse, nuts and other food that form the bulk of the menus of academic institutions. Fatal cases resulting from consumption of contaminated cereals with high levels of aflatoxin B_1 and B_2 have been reported (Muture and Ogana, 2005). Maize and its products constitute the staple food of most communities and learning institutions in Kenya hence the occurrence of aflatoxicosis in these foods is a major concern due to their toxicity and carcinogenicity. In an assessment of magnitude of aflatoxin contamination of maize in Kenya's North Eastern province, over 54.4% of maize were found to be above the maximum permissible limit of 20µg/Kg of maize and regarded as unfit for human consumption (Muture and Ogana, 2005).

Biological contamination occurs naturally in plants and animals. Contamination from these natural toxins may be due to limited dietary repertoire leading to eating food which would otherwise be regarded as unfit for human consumption or lack the resources to process the food effectively into a safe form. These include wild mushrooms of the *Psilocyb* and *Amanita* genera which are both cardiotoxic and hepatotoxic and wild yam (*Dioscorea hispida*) which contains the toxic alkaloid dioscorine (Azanza, 2006; Gaman and Sherrington, 1981). Green and sprouting potatoes contain solanine and chaconine which are both toxigenic

and teratogenic (WHO, 1992; Longree and Gertrude, 1971). Toxigenic and teratogenic cyanogenic glycosides also occur in edible parts of plants used for human consumption such as amygdalin in almonds, dhurrin in sorghum, linamarin and lotaustralin in cassava, lima in beans, prunasin in stone fruit and taxiphyllin in bamboo shoots (WHO, 1992; WHO, 1997). Some animal products also harbour inherent toxins especially sea foods. Shellfish, mussels and clams cause poisoning due to their feeding on poisonous plankton while puffer fishes contain the neurotoxin tetradotoxin in its skin, liver, blood and gonads (Azanza, 2006; Longree and Gertrude, 1971).

Chemical contamination of food often leads to acute food poisoning but is fortunately rare. These chemicals include pesticides, food additives (preservatives, colours, and flavours), toxic metals, cleaning chemicals, and polishes (Ombui et al, 2001). Mercury contamination is known to occur when it gets into the food chain such as water planktons fed on by fish (Gaman and Sherrington, 1981; Hightower and Moore, 2003). Contamination also result from the leaching of potentially accumulatively toxic compounds (such as vinyl chloride, phthalates, dioxins) from packaging material into foods, especially those with a high fat content. Poisonous metals such as cadmium, mercury, antimony, lead, zinc, and copper may get into the food chain through the equipments, utensils and containers. Contamination of food with synthetic chemicals substances can also arise from pesticides, herbicides and growth promoting antibiotics. Unintentional contamination of food with agricultural chemicals used for crop protection and food preservation is the most common type of chemical food poisoning (Ombui et al, 2001; Mwangi, 1985; Duncan, 1975). Chemical contamination of food also occurs if food is stored where it comes into contact with poisonous substances such as pesticides and detergents.

Physical contaminants such as glass, tacks, soil, pieces of metal, steel wool, hair, non edible garnish, and toothpicks are not uncommon but are never acute and can easily be controlled. These can be due to food handling mistakes or

deliberate adulteration by the food handlers. Adulteration of milk and milk products, honey, spices, edible oils, and the use of colours to mask product quality to cheat the consumer is common (FAO, 2003).

Water is essential in the food handling process; however, since it is subject to various forms of pollution, it is a common vehicle for food contaminants (Duncan, 1975). Wastewater use in agriculture is often associated with significant health risks because of the presence of high concentrations of enteric human pathogens such as bacteria, viruses, protozoa and helminths (Palese et al, 2009). Where no restrictions exist for surface waters, which are often badly contaminated, for irrigation of vegetables normally eaten uncooked the risk of contamination is high. Cryptosporidiosis, an enteric illness caused by faeco-oral transmission of the oocysts of *Cryptosporidium*, is frequently waterborne (Asheena et al, 2003).

2.3 Food Safety Critical Control Points

A critical control point (CCP) is a point, step, or procedure in the food chain at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level (Sanders, 1999). This is a holistic approach to the control of food safety hazards which can enter the food chain at the point of production and can continue to be introduced or exacerbated at subsequent points in the chain. Williams et al (1990) identified the food safety critical control points in the "farm to fork" food chain as food production; food supply, distribution and sale; food storage; food preparation; and food serving.

Present production methods cannot totally prevent food contamination, and the complexity of food handling and processing provides ample opportunity for contamination as well as survival and growth of pathogenic organisms (Molins et al, 2001). This has brought about the need to embrace a more cost-effective, preventive method that is known as hazard analysis and critical control point (HACCP) in ensuring food safety. HACCP is an approach to establishing good

production and handling practices that produce safe foods by identifying points (CCP) susceptible to food hazards and designing control measures (Unnevehr and Jensen, 1999).

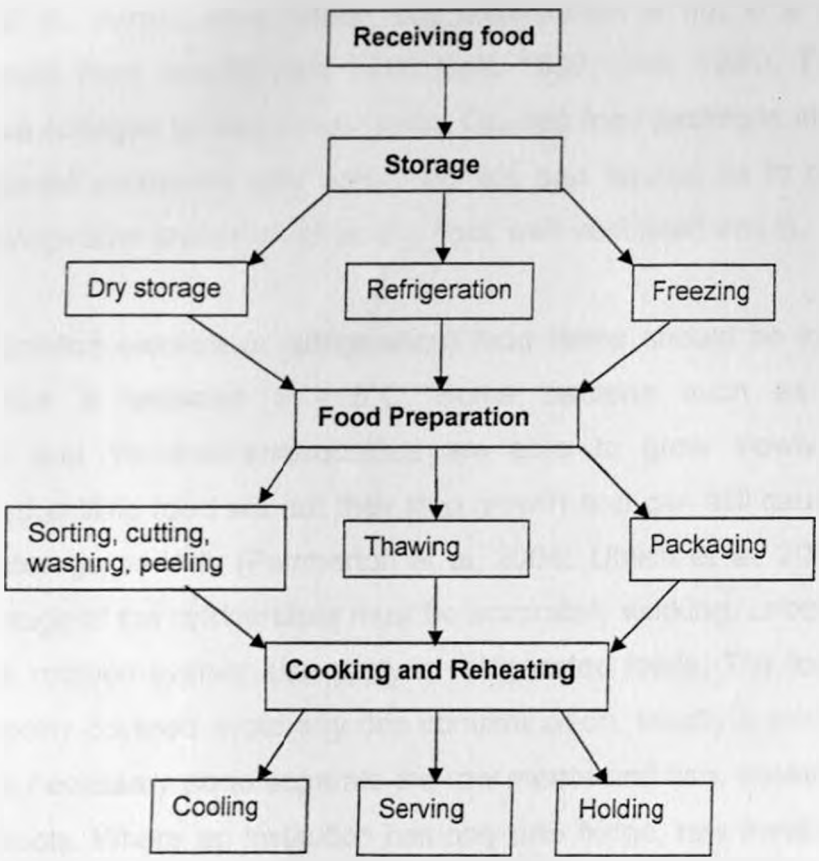

Figure 2: A flow diagram showing some of the food safety CCPs
Source: Williams et al, 1990

2.4 Food safety requirements for food service establishments

2.4.1 Food Storage

Due to the large student populations in the learning institutions, they make bulk purchases of food stuffs which call for proper storage facilities and practices. Food items should be stored promptly in an approved, clean and sanitary area to protect it from possible contamination. Subsidiary legislations of the FDCSA cap 254 under section 28 (GoK, 1992) of the act permits only licensed premises to be used for the purposes of preparing, selling, packaging, and storing of food.

Dry storage food items such as cereals and flour need to be labeled with the date of receipt to enable the adoption of First-In-First-Out (FIFO) system of stock rotation. The food should be stored at least 6 inches off the floor on approved shelving or racks and at least 18 inches away from the walls in dry, cool, ventilated, well lit, vermin proof, clean, tidy store which is not in a state of disrepair (Graham-Rack and Binsted, 1973; GoK, 1992; GoK. 1986). The store should not have spillages to discourage pests. Opened food packages should be stored in approved containers with tight-fitting lids and labeled as to contents. The fruits and vegetable store should be dry, cool, well ventilated and lit.

Cold storage (chilled storage or refrigeration) food items should be kept at a temperature that is between 1 - 5°C. Some bacteria such as *Listeria monocytogens* and *Yersinia enterocolitica* are able to grow slowly at low temperatures so chilling food will not their stop growth and can still cause FBDs in prolonged storage periods (Pemberton et al, 2004; Uhlich et al, 2006). The temperature gauge of the refrigerators must be accurately working. Labelling and the FIFO stock rotation system also apply to refrigerated foods. The food items should be properly covered avoid any drip contamination. Ideally a minimum of three fridges is necessary so to separate the raw meats and fish; cooked foods; and dairy products. Where an institution has only one fridge, raw meat and fish should be at the bottom shelves, cooked foods on the centre shelves, and dairy products on the top shelves (Mahon et al, 2006; Hazelwood and McLean, 1991). Fish should be stored below 3°C since the *Clostridium botulinum* type E found in fish grows slowly at temperatures above 3.5°C. However, at these low temperatures, psychrophilic spoilage organisms grow faster than *Clostridium botulinum* and make fish unpalatable before it becomes poisonous.

Food items stored frozen should be kept at a temperature of -18°C or less. The bacteria that cause food poisoning cannot multiply in or on frozen food, so provided that the temperature of the freezer is maintained at -18°C or less, there

is no danger of frozen food becoming a health hazard. However, its eating qualities, that is, taste, colour, and texture will deteriorate hence the recommended duration of freezing (Table 1) limits changes in a food's eating quality (Trikett, 2002).

Table 1: Recommended Duration of Freezing of Selected Food Items

Food	Freezing time (months)
Beef	12
Lamb and veal	9
Pork	6
Mince, offal, sausages	3
Chicken and turkey	12
Duck and game birds	6
White fish	6
Oily fish	3
Bread and cakes	6
Fruits	9
Vegetables	12

Source: Trikett, 2002

Chemicals, including pesticides or non-food related items should be stored in a separate area, away from food and utensils. Chemical containers must be properly-labeled and used in a manner consistent with the label and should not be kept in empty food or drink containers. All pesticides must be approved for use in a food facility.

2.4.2 Food Preparation

Food preparation involves thawing, cutting, processing, cooking, assembling, cooling, reheating and serving. The entire processes of food preparation require strict temperature control to limit FBD outbreaks (Blanchfield, 2001). The potential for bacterial growth is present in each of these steps leading to food contamination or cross-contamination. Many raw foods, particularly of animal origin, are heavily contaminated with pathogenic microbes such as *Campylobacter*, *Salmonella*, and pathogenic *Escherichia coli* which colonise the gastrointestinal tracts of animals (Cuiwei et al, 2001; WHO, 1989). The hands

and utensils or equipments can transfer considerable quantities of these contaminants from raw to RTE food during food preparation. Raw food should therefore be kept separate from RTE foods (Teague and Anderson, 1995).

A Republic of Ireland study (Gorman et al, 2002) looked at the incidence of potential food pathogens and their cross-infection in the domestic kitchen during the preparation of a Sunday roast chicken lunch. Key contact sites in the domestic kitchen were sampled, including the chicken carcass before and after the preparation of a roast chicken meal. Twelve contact sites in twenty-five domestic kitchens were analyzed and tested for aerobic plate count, *Salmonella*, *Campylobacter*, *Escherichia coli* and *Staphylococcus aureus*. The findings identified the ability of FBD microorganisms to become disseminated from infected foods, such as fresh chickens, to hand and food contact surfaces in the domestic kitchen.

PHFs should be thawed only: in the refrigerator; under running potable water of sufficient velocity to flush loose particles and at a temperature of 24°C for a period not exceeding two hours; in a microwave oven; or as part of the cooking process (Teague and Anderson, 1995). Where possible, food should be prepared in small batches to reduce the time the food is kept in the temperature danger zone (5°C to 65°C). Cross-contamination should be avoided by washing and sanitising utensils and equipment after use, washing and sanitizing cutting boards after every task and washing hands frequently and thoroughly.

It is important to note that thorough cooking of food effectively kills organisms that cause FBDs such as *Clostridium perfringens* gastroenteritis (Gross et al, 1989; Duncan, 1975). Inadequate cooking or holding temperatures for foods enhance growth and multiplication of bacteria leading to FBDs (Michaels et al, 2004). Food handlers should therefore ensure that all food items attain specified internal temperatures during cooking (Table 2).

Table 2: Recommended internal cooking temperatures for selected food items

Food	Internal cooking temperature
Ground/chopped meats	68°C (155°F)
Eggs	63°C (145°F)
Pork	68°C (155°F)
Poultry/fish	74°C (165°F)
Ground beef / pork / veal / lamb	71°C (160°F)
Ground poultry	74°C (165°F)
Whole cuts beef / pork / veal / lamb	77°C (170°F)
Whole birds poultry	82°C (180°F)
Poultry - breasts	77°C (170°F)
Poultry - legs, thighs, wings	82°C (180°F)
Fresh ham	71°C (160°F)
Cooked ham	60°C (140°F)
Fish and shellfish	63°C (145°F)
Egg dishes	71°C (160°F)
Stuffing, stews, leftovers, others	74°C (165°F)

Source: Osornio et al, 2008

The cooking temperature of the food should be monitored with precision using a food thermometer to ensure food safety and not by "eyeballing" food for change in its color or texture. Hunt et al (1995) in Kansas State University study found out that a sufficient number of ground beef patties were turning brown before they achieved the safe internal cooking temperature of 70°C making color an unreliable food safety practice indicator. The United States Department of Agriculture's (USDA) Agricultural Research Service further examined the color of ground beef in relation to safety. Their finding was that 25% of hamburgers turn brown before being cooked to a safe internal temperature (USDA, 1998).

Temperature-time control is important since most FBI causing pathogens multiply at a conducive temperature range of 5°C to 65°C, that is, the danger zone temperature. Potentially hazardous food items (PHFs) should be held above or below and never within this range of temperature for more than two hours (Ingham et al, 2004). A study in England and Wales between 1970 and 1979 showed that of the 1044 analysed FBI outbreaks, 67% were caused by foods

prepared on large scale and in more than 60%, the foods were prepared at least half a day before consumption and were held at improper temperature ranges. While serving food to the consumers, the temperatures for PHFs should be maintained at 65°C or above for hot foods and 5°C or below for cold foods. Disease causing pathogens such as the *Vibrio cholerae* O1 and non-O1 strains which though are heat labile are able to survive hot holding temperatures of between 45°C to 60°C (Wu and Fung, 2006; Makukutu and Guthrie, 1986).

Food items and utensils should be prevented from contamination by providing proper protection (such as sneeze guards) to food items that are exposed to the consumers and serving food on clean utensils. Even with education and exclusion of ill workers, FBDs will still occur since several pathogens can cause pre-symptomatic (or long-term carriage) contamination of food without the food handlers' knowledge (Michaels et al, 2004). Certain pathogens such as *Norwalk* virus have very low infectious doses and even conscientious hand hygiene may not eliminate contamination. For this reason, bare hand contact of RTE foods should be reduced or eliminated through proper use of clean single-use gloves, tongs, serving spoons, single-use serviettes or deli tissue or bakery papers, spatulas and other dispensing or food handling utensils (Teague and Anderson, 1995). However, food handlers assembling sandwiches, salads, or plating RTE food may minimally contact the food with their bare hands but should use utensils as often as possible.

In a Japanese survey, Satoshi et al (2000) assessed the prevalence and contamination levels of *Listeria monocytogenes* in retail foods. The bacteria were isolated from 12.2, 20.6, 37.0 and 25.0% of 41 minced beef, 34 minced pork, 46 minced chicken and 16 minced pork–beef mixture samples, respectively. The organism was also isolated from 5.4% of the 92 smoked salmon samples and from 3.3% of 213 ready-to-eat raw seafood samples. None of the 285 vegetable samples were contaminated with *L. monocytogenes*. These findings indicated that ready-to-eat foods were at risk of contamination.

When necessary, food should be rapidly cooled after preparation especially the PHFs (Charles, 1983). This should entail cooling hot foods from 65°C to 20°C within 2 hours and from 20°C to 5°C within 4 more hours. One or more of the following cooling methods can be used: placing the food in shallow, heat-conducting pans (filled 2 to 3 inches deep), separating the food into smaller or thinner portions, using rapid-cooling equipment (blast chiller or frozen stir stick), using containers that aid in the cooling of foods such as shallow metal pans, ice-water bath and stirring frequently or adding ice as an ingredient. When reheating PHFs, special care must be given to reheat it properly. Reheating food to 74°C kills most bacteria. However, this reheating requirement does not apply to food from an approved processing plant in its original sealed container. This food is usually heated and maintained to at least 65°C for hot holding. There are no minimum temperatures if the food is going to be immediately served.

2.4.3 Cleaning

Proper cleaning and sanitation that can maintain sanitary and hygienic levels in catering kitchens is an important routine to prevent FBDs (Mikkelsen et al, 2006). Dishwashing can be manually be accomplished by using the three compartment sink. It involves pre-rinsing utensils thoroughly to remove particles; washing with soap and hot water; rinsing in plain water to remove detergent; sanitising; and letting the utensils air dry (draining). A dishcloth should be avoided since it is the most difficult to disinfect (Barker et al, 2003). Even after sanitisation with 500 ppm of hypochlorite for up to 5 min dishcloths still remain positive for disease causing microorganisms. Woven cotton dishcloths tend to trap particles which are difficult to remove hence it can be an important disseminator of bacteria when it is used to dry utensils and surfaces.

Sanitising may be accomplished by using hot water or chemical sanitizers. Hot water sanitisation is achieved by complete immersion of the utensils into water maintained at least 82°C for at least 30 seconds. In chemical sanitisation, items

must be immersed for a specified duration of time in an approved sanitising solution at the recommended concentration. Some examples of these chemical sanitizers and their recommended time-concentration levels include 100 ppm chlorine for 30 seconds, 25 ppm iodine for 1 minute, and 200 ppm quaternary ammonium for 1 minute. Cetylpyridinium chloride is a versatile sanitizer that can be used in ready-to-cook, RTE and processed food stuffs and is effective against many pathogens, including *Salmonella*, *L. monocytogenes*, *Campylobacter* and *Escherichia coli* O157:H7 (Özdemir et al, 2006). Chemical test strips or test kits are required to verify the chemical concentration of the sanitizers being used. Concentrations below minimum levels will not sanitize effectively, while sanitizers used in concentrations above the recommended levels can leave toxic residues. Dishwashing can also utilise commercial dishwasher machines, however, the manufacturer's manual should be adhered to. Correct temperature settings should be observed and the levels and concentrations of the detergent and sanitizer should be maintained.

Overall general cleanliness is important in all food places. The sink compartments and drain boards must be large enough to accommodate the largest utensil to facilitate proper washing and sanitising. The bottom shelves should be elevated at least 6 inches from the floor. All surfaces that come into contact with food or utensils must be cleaned and sanitised to prevent contamination of food, equipment and food-contact surfaces. Food areas should be kept clean. The ventilation hoods and filters should be cleaned regularly. The rest rooms should be clean and provided with sinks, single-use towels in dispensers, easily cleanable waste containers, soap dispensers filled and operational, and a sign directing employees to wash their hands be posted.

Pest and animals should be kept out of a food establishment. They can be vehicles for contaminants or be infested with pathogen bearing insects such as *Yersinia pestis* (Betty and Roberts, 1993) borne by fleas found on rats, cats and dogs. Rats may also carry agents of other diseases such as leptospirosis, viral

and food-borne infections. Closing external doors and screening all windows and openings keeps flies and cockroaches away. The practice of good housekeeping also eliminates their breeding places. This includes; keeping exterior garbage containers tightly closed, removing food wastes and spills promptly, and disposing food wastes in tightly sealed bags. Elimination of potential nesting places by removing all piles of rubbish, inside and outside the premises also keeps the rodent and flies away. Use of an approved pesticides, baits and traps while always following directions carefully is also effective. However, sprays should not be used near any food or food contact surface.

2.4.4 Personal Hygiene

Personal hygiene practices help prevent food borne pathogens from entering the food chain (White et al, 2003). In a historical study whose goal was to develop an understanding of the dynamics of transmission from the food handler in a risk assessment framework identified activities contributing to the risk of transmission in food service situations (Michaels et al, 2004). It explored various personal hygiene intervention measures including exclusion of ill food handlers, vaccination against hepatitis A virus, hand washing, use of instant hand sanitizers and wearing of gloves. The results attributed the FBD outbreaks to food worker infective status (symptomatic or asymptomatic); bare hand contact with food product; poor personal hygiene; lack of food handling equipments and poor hand hygiene among other things.

In the entire food chain, good personal hygiene practices are critical for the food safety. Poor personal hygiene is one of the leading contributory causes of FBDs (Michaels et al, 2004). This includes the absence of proper hand hygiene; inappropriate hand contacts; and poor personal habits. Ensuring good personal habits such as bathing daily; keeping hands away from mouth, nose, arms and any other source of contamination while working; and not eating, drinking or smoking in the food preparation area is important (Troller, 1993). Hair contributes greatly to sanitation problems in a food establishment. Most people lose fifty to

seventy five strands of hair a day and can only be kept out of food by wearing cap/net/scarf to confine hair to the head. Food handlers' uniforms are supposed to be clean, washable and white for easy detection of dirt.

Intestinal, nasal and skin related microbial food hazards have been isolated from swabs carried out under the finger nails (Betty and Roberts, 1993). Hands of healthy persons in the community are usually colonized with gram-negative bacteria and hands of healthy adults may increasingly become one reservoir for antimicrobial resistance (Larson et al, 2003). The commensal flora of the hands, usually *Staphylococcus* species, cling to the skin surface and persist in the hair follicles, pores, crevices and lesions caused by breaks on the skin and are not easily completely removed (Betty and Roberts, 1993). *Salmonella typhi,* non typhi *Salmonella* species, *Campylobacter* species and *Escherichia coli* can survive on finger tips and other surfaces for varying periods of time and in some cases even after hand washing (Barker et al, 2003). *Staphylococcus* cannot be removed from the hands by washing when they form part of the resident flora (WHO, 1989).

Handling food with bare hands leads to contamination and cross-contamination of food. Contaminants from raw food, food handlers' body or other equipment and utensils' surfaces can be transferred to ready-to-eat (RTE) food items resulting in FBDs or food spoilages. This can be minimised only if proper hand washing, use of gloves and other food safety equipment such as tongs is exercised. Hand washing has been shown to be the single most important and effective measure of preventing FBDs (Michaels et al, 2004; Pemberton et al, 2004; Günter et al, 2004; White et al, 2003; Emily et al, 2004; Clayton et al, 2003). The efficiency of the process is a combined result of the washing (soap, warm water, rubbing for at least 20 seconds and rinsing) with liberal usage of water (Bidawid et al, 2000) and then drying. Transmission of FBD pathogens has been found to be much more efficient from wet hands rather than dry hands (Michaels et al, 2004) hence more emphasis on hand drying is important to

reduce risks of FBDs. The hand hygiene antimicrobial preparations work synergistically with the mechanical process and should at least have activity against bacteria, yeasts, and coated viruses. The best efficacy can be achieved with ethanol (60 to 85%), isopropanol (60 to 80%), and n-propanol (60 to 80%). Their activity is broad and immediate (Günter and Axel, 2004). Others are chlorhexidine (2 to 4%) and triclosan (1 to 2%). Plain soap and water has the lowest efficacy of all.

Lynch et al (2005) in a study to determine whether the levels of selected microorganisms differed on foods handled by gloved and bare hands at food restaurants purchased three hundred seventy-one plain flour tortillas from fast food restaurants. These were analysed for *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* species, coliform bacteria, and heterotrophic plate count bacteria. The results, however, showed no statistically significant differences in the presence of the bacteria in samples handled by gloved workers and those handled by bare hands. This was attributed to the tendency of food handlers to wear the same pair of gloves for extended periods, wash hands less when using gloves and complacency which may have made the use of gloves counterproductive.

It is also easier to remove bacteria from natural fingernails than artificial nails and this is significantly improved when a fingernail brush is used in the hand washing process. The food handlers should therefore keep short trimmed natural fingernails with no nail polish but if present should be clear. Hand washing should be done before preparing food, before dispensing or serving food or handling utensils, between working with raw food and working with RTE food, after touching bare human body parts, after using the toilet and bathing rooms, after each break, after handling soiled utensils or equipment, and after coughing, sneezing, using tobacco, eating or drinking.

Gloves should always be worn while preparing food, however, they should be worn on clean hands, changed between raw and RTE foods, when torn, when interruptions occur and changed at least every four hours of continuous use (Courtenay et al, 2005). Gloves limit cross contamination of food by reducing both bacterial transfer from food to the hands of foodservice workers and in subsequent transfer from hands back to food (Montville et al, 2001). Hand sanitizers and single-use gloves are not substitutes for hand washing (Courtenay et al, 2005). Only after proper hand washing has been completed, should hand sanitizers or gloves be used. If used correctly, both can provide additional food protection. However, if used incorrectly, they can become another source of food contamination.

Jewels, perfumes and aftershaves are not acceptable when preparing food (Troller, 1993; Gaman et al, 1981). These are likely to taint food items especially those high in fat (Hazelwood and McLean, 1991). Earrings, watches, brooches, and finger rings are positive dirt traps. They can also be dislodged wholly or in part and get lost in food.

2.4.5 Health

Persons involved in handling food should be in good health especially when it comes to communicable diseases. *Hepatitis A* virus and *Norwalk* virus excreting food handlers, especially those with poor hygienic practices, can contaminate the foods (Koopmans et al, 2002; Bidawid et al, 2000), the subsequent consumption of which can result FBDs. It is a legal requirement in Kenya for all food handlers to undergo pre-placement medical examination and subsequent annual checkups by a government medical officer of health. Subsidiary legislations under section 28 of the FDCSA cap 254 (GoK, 1992) forbids persons with communicable diseases from handling food and directs that pre-placement medical examinations be followed by annual checkups. Any employee engaged in handling food who is suffering from a communicable disease including a cold should be off the job until cleared by a physician. They need to report cold

symptoms or any illness to their supervisor and avoid contact with food and utensils. Gloves should be worn to touch food and food contact surfaces if a food handler has any cuts, sores, rashes, casts or wears nail polish, artificial nails or jewelry.

2.5 Food Safety Practices in Learning Institutions

A single food safety mistake by the food handlers in mass catering units such as schools and higher learning institutional kitchens can result in large scale FBI outbreaks (Koopmans et al, 2000). According to the United States food safety experts, the most common food handling mistakes made by food handlers include; serving contaminated raw food, cooking or heating food inadequately, obtaining food from unsafe sources, cooling food inadequately, allowing more than two hours between preparation and eating, and poor hygiene practices (Bruhn, 1997). This is in agreement with a study in England and Wales that analyzed 1479 FBI outbreaks also noted contributing factors as: preparation of food too far in advance; food storage at ambient temperature; inadequate cooling; inadequate reheating; contaminated processed food; undercooking; contaminated canned foods; inadequate thawing; cross contamination; raw food consumption; improper hot holding; infected food handlers; food prepared in large quantities; and use of leftovers (Betty and Roberts, 1993). It is also estimated that 97% of all food poisoning cases are the result of improper food handling in the United States, with 79% percent of the cases occurring in commercial or institutional establishments including learning institutions.

Bolton et al (2008) surveyed two hundred head chefs and catering managers, responsible for food hygiene in catering establishments, throughout the island of Ireland to establish their knowledge of food safety management and practice. They conducted face to face interviews to obtain data on training, food storage and delivery, food handling, personal hygiene and cleaning, food preparation and knowledge of relevant bacterial pathogens. The study found that: 20% of kitchen staff had no formal training; formal training did not result in improved food safety

practices: 78% of head chefs were unaware of current food safety legislation including their specific responsibilities; the concept and application of hazard analysis and critical control point (HACCP) was poorly understood; 22.5% of head chefs did not report safe practices in defrosting frozen and common microbial food borne pathogens, such as Salmonella, were familiar to most interviewees, although few could name the source of these bacteria. The results of this study suggest that although most Irish restaurant head chefs/catering managers have a fundamental knowledge of some aspects of food safety and food safety practice, significant gaps remain, posing real risks to consumer health.

Thorough cooking alone does not guarantee food safety. In a study whose objective was to evaluate the bacterial safety of food items sold by street vendors in Ethiopia to institutions including schools, most street foods were found to have aerobic mesophilic bacteria (Muleta and Ashenafi, 2001). The high aerobic mesophilic count on cooked food items was indicative of post cooking contamination. There is therefore need to put more emphasis of food hygiene to reduce the risk of cross contamination of ready-to-eat food items. In a further challenge study, *Salmonella typhimurium, Shigella flexeri,* and *Staphylococcus aureus* grew in street vended food samples to hazardous levels within 8 – 12 hours. The health hazards from these foods may be significantly by adhering to proper holding temperatures (Ombui and Nduhiu, 2005).

An FDA study (2000) was conducted to develop baseline data on the risk factors for food borne illness in retail foodservice operations, including schools, hospitals, nursing homes, restaurants, and retail food stores. Improper holding and time/temperature relationships were the area with the lowest compliance (60.5%) and personal hygiene was next at 74.2% compliance. For cold foods, 45% of schools did not hold them at a cold enough temperature. Improper or inadequate hand washing was seen at 36% of those schools that were out of

compliance for personal hygiene, while 27% of the sites did not take steps to prevent hand contamination.

Ana et al (2009) in a study whose aim was to assess the hygiene practices of food handlers in municipal schools of Natal, Brazil, evaluated 27 public schools using a checklist and microbiological analysis of hands. The study found that 74.1% of the handlers did not receive periodic training, 51.9% did not undergo annual health examinations and 100% did not practice proper hand hygiene. This reflected significantly ($p < 0.05$) in hand contamination, in which faecal coliforms were detected on 55.6% of the hands of food handlers analyzed. This study concluded that the schools studied did not have appropriate hygienic conditions and suggesting the need for interventions that ensure the quality of school food served to the children.

De Noya et al (2008) carried out an epidemiological investigation following an increase of medical consultations and absenteeism among students and workers of a municipal school in Caracas after trypomastigotes of *Trypanosoma cruzi* were noticed on stained blood smears of one patient. The epidemiological pattern was typical of an orally-transmitted, outbreak. The study incriminated a contaminated fresh juice prepared under unsanitary conditions exposed to wild infected vectors.

Gilmore et al (1998) developed and tested a food quality model for school foodservice operations. They conducted observations in eight school kitchens in Iowa and Minnesota, reviewing receiving practices, food production sanitation steps, and food-handling techniques during food production. Many sanitation practices were good, including clean uniforms, short and unpolished fingernails, appropriate use of utensils/gloves for handling food, sanitizing of work surfaces, and the thawing of foods. However, handwashing was infrequent, hair restraints were not used, and jewelry was not limited to a watch and wedding band. The

food handlers were also using reusable towels to dry dishes/utensils in some kitchens.

Giampaoli et al (2002) observed employees in 15 school districts in the Silicon Valley, Calif. They found that proper hand washing techniques often were not used, that the majority of employees did not wear hair restraints, and that employees were observed eating and drinking in the kitchens. Some food storage practices were inappropriate, such as boxes being stored on the floor, raw meats stored above other food items, and inadequate labeling and dating of food in storage. Sanitizing issues, such as not checking temperature/sanitizer concentrations and not using sanitizing agents on food contact surfaces, also were identified.

In a study of 40 Iowa school districts, Henroid et al (2003) identified several food-handling issues. About one-third of the observed employees either did not wash their hands frequently enough or use appropriate handwashing techniques. Temperatures (food, refrigeration, freezer, and dishwashing machine) frequently were not taken and even less frequently were recorded. Calibrated thermometers often were not used (and employees often were not aware of calibration procedures). Researchers checked temperatures of both hot and cold food items at the time of service and found more problems with appropriate cold food temperatures than hot food temperatures.

In a study of time and temperature control in a Kansas school district that was in transition from a centralized conventional system to a centralized cook-chill system, Kim and Shanklin (1999) identified a number of food safety concerns. Researchers found inconsistencies in reheating methods and observed extended periods of holding for hot foods, especially in the cook-chill foodservice system. Time and equipment constraints caused much of the temperature problems, and demonstrated the need for standard operating procedures and continual training and supervision.

Two Australian surveys were done in 2001 with the objective of establishing the awareness and food safety knowledge vis a vis food safety practices by food handlers within Australia. Its results showed that most food handlers knew about food safety though this food safety knowledge did not always match actual food safety practices (ANZFA, 2001). This study thus suggests that food safety knowledge is not necessarily an indicator of adherence to food safety practices. However, Pemberton et al (2004) in a separate Trinidad and Tobago study, evaluated food safety using the Hazard Analysis Critical Control Points (HACCP) principles within a children's home. This study found that whereas some components of foodservice had good food safety indices; personal hygiene, distribution, safety and sanitation had poor indices. The study attributed the findings to food handlers' lack of food safety knowledge.

Disregard for food hygiene measures by food handlers may result in food contamination and adverse consequences. A descriptive cross sectional study designed to assess the knowledge and practice of food hygiene by randomly selected food handlers in a Nigerian University Campus revealed a poor knowledge and practice of food hygiene among food handlers providing food for the undergraduates (Okojie et al, 2005). Out of the 102 respondents in this study, only 31 (30.4%) had had pre-employment medical examination and only 49 (48%) had had received any form of health education. The practice of storing and reheating leftovers was low as agreed to by 15 (14.7%) of the respondents. There was a very low frequency of hand washing. Inspection of food handlers also showed a low level of personal hygiene.

In an Irish study designed to investigate consumer food-handling practices in regard to minced beef, a sample of 485 minced beef consumers, who were also the main shoppers and food handlers in their homes, were interviewed (Mahon et al, 2006). It was found out that many failed to store minced beef on the correct shelf of the fridge and to use the correct procedures for defrosting meat. The

same study also indicated a variation in these food safety practices across the socio-economic status and levels of education of the food handlers. Those with a higher level of education and socio-economic status adhere to food safety practices better than those with only primary level education and from low socioeconomic backgrounds.

2.6 Food borne disease outbreaks

The learning institutions are the most common risky settings for FBI outbreaks (Cretikos et al, 2008; Todd et al, 2007; Azanza, 2006). An analysis of outbreak data in England and Wales from 1992 to 2002 (Gillespie et al, 2005) revealed that most outbreaks of *Salmonella enteritidis* infection were associated with schools and residential institutions. *Norwalk* virus, a microbial food contaminant, was first discovered in faecal samples collected during an outbreak of gastroenteritis in an elementary school in Norwalk, United States in 1968. A decade later, the first convincing association of this virus with disease came from a study of 'winter vomiting disease' in a school in London (Koopmans et al, 2002). Even the introduction of these viruses into the household is by children who acquire the infection in schools (Michaels et al, 2004).

Despite the burden of FBIs being on the rise (Michaels et al, 2004), they are generally under-reported because attention is often focused on the large scale FBD outbreaks at the expense of individual cases which hardly catch attention (Ombui et al, 2001; Medeiros et al, 2001). This is due to the fact that large scale FBI outbreaks in commercial food-service settings are likely to receive more publicity and scrutiny than those that isolated individual cases (Azanza, 2006). Moreover, the victims may also not seek medical attention; patients and their doctors may not recognize the cause of the illness; doctors may not notify the public health departments; and that resources to identify the contaminants may be lacking. Again, surveillance of FBIs in the developing countries (such as Kenya) is limited by its high costs (Bryan, 1992) and also grossly underestimates the burden (Koopmans et al, 2002). This leads to a tendency of relying heavily on

the few reported cases to design interventions hence a lot of deserving cases remain unattended.

Martin (1989) attributed increase in the incidence of bacterial food poisoning in Britain changing food habits such as increase in feeding from public premises as opposed to homes. Statistics then showed that most general outbreaks were from communal feeding establishments such as school canteens, 20 per cent; works canteens, 19 per cent; restaurants, 17 per cent; hospitals, 22 per cent; and other institutions, 22 per cent. Ombui et al (2001) in a Kenyan study found that most incidences of food poisoning involved food prepared in restaurants, hotels, clubs, hospitals, institutions and canteens supporting the earlier British study.

2.7 Conclusions

The literature identifies several food safety hazards including microbial, chemical, physical and biological contaminants (Mahon et al, 2006; Azanza et al, 2006; Walsh et al, 2005; Ombui et al, 2001WHO, 1997; Owen, 1996). These food contaminants can be endogenously present in food or introduced into the food chain or exacerbated through poor food safety practices (Finch et al, 2005; Pemberton et al, 2004; Troller, 1993; FAO, 2003).

Good food safety practices within the food handling premises entail appropriate food storage facilities (Uhlich et al, 2006; Trikett, 2002; GoK, 1992; GoK, 1986); proper food preparation (Osornio et al, 2008; Michaels et al, 2004; Gorman et al, 2002; Bloomfield et al, 1997;Teague et al, 1995); cleanliness (Mikkelsen et al, 2006; Barker et al, 2003); good personal hygiene among the food handlers (Lynch et al, 2005; Michaels et al, 2004; White et al, 2003; Larson et al, 2003; Troller et al, 1993) and optimal health of the food handlers (Koopmans et al, 2002; GoK, 1992).

These institutions are faced with challenges of inappropriate storage practices (Mahon et al, 2006; Giampaoli, 2002) and generally inadequate food handling

equipments and facilities (Henroid et al, 2003; Kim et al, 1999). The food preparation and hygiene practices are poor (De Noya, 2008; Okojie et al, 2005; ANZFA, 2001; Muleta et al, 2001; FDA, 2000; Gilmore et al, 1998). The food handlers also have limited education (Mahon et al, 2006; Finch et al, 2005), inadequately trained (Ana et al, 2009; Bolton et al, 2008; Pemberton et al, 2004, ANZFA, 2001) and are not always supervised (Kim et al, 1999) and the institutions rarely supervised (Bryan, 1992).

The learning institutions are therefore risk settings for FBD outbreaks (Cretikos et al, 2008; Todd et al, 2007; Azanza, 2006; Martin, 1978). Many FBD outbreaks have been associated with these institutions (Gillepsie et al. 2005; Michaels et al, 2004; Koopmans et al, 2002; Martin, 1978). Many also go unreported because attention is often focused on the large scale FBD outbreaks at the expense of individual cases which hardly catch attention (Ombui et al, 2001; Medeiros et al, 2001).

CHAPTER THREE : METHODOLOGY

3.1 Study design

This was a cross sectional study employing quantitative methods to determine food safety practices and determinants in primary, secondary and post-secondary learning institutions in Nairobi. It assessed the food safety knowledge among the food handlers, observed the food safety practices and evaluated the conditions of the food safety equipments.

3.2 Study area

The study was conducted in Nairobi, the capital city of Kenya. Nairobi covers an estimated area of 700 km^2 and currently has a population of over three million (CBS, 2002). According to the Kenya 1999 population census, Nairobi city had a total of 424,589 children aged five years and above attending school with the peak being around the primary school going age, that is, 5 to 14 years (CBS, 2002). This figure has since then tremendously increased due to the introduction of free primary education, establishment of bursary and constituency development funds which assist the poor students to pursue education. The registration of more private universities and the explosion of parallel degree programmes at the public universities which offer training at relatively affordable fees have further expanded the student population (Ngare et al, 2008).

By the year 2003, primary school enrolment for Nairobi city alone was 230,096 pupils while that of secondary schools was 20,300 students (CBS, 2004). Currently the city has 308 primary schools with 7 public and 39 private schools having boarding facilities. Then city also has 148 secondary with 21 public and 15 private schools having boarding facilities. There are also 14 public and 14 private post-secondary institutions with boarding facilities (Appendix G).

3.3 Study population

The study population comprised the primary, secondary and post-secondary learning institutions in Nairobi with boarding facilities. A representative sample was drawn from this study population.

3.4 Selection of study participants

3.4.1 Inclusion Criteria

The recruitment of the participants in this study was voluntary based on the willingness to participate. The participating institutions had feeding programmes and the food handlers had to be employees of the participating institutions.

3.4.2 Exclusion Criteria

The institutions without feeding programmes were excluded from the study. Non food handlers, such as security personnel working in the food areas were also excluded. The food handlers or institutions who declined to participate and food handlers who were not working in the participating institutions were also excluded.

3.5 Sampling

3.5.1 Sampling Unit

The sampling unit was a formal public and private school or higher learning institutions at primary, secondary and post-secondary levels. This formed the unit of analysis in the study. The units of observation however comprised the food handlers during food safety knowledge assessment and practices observation; and the institutions during the food safety equipments evaluation.

3.5.2 Sampling frame

The sampling frame was constituted by all the formal learning institutions at primary, secondary and post-secondary levels in Nairobi (Appendix G).

3.5.3 Sampling design

The primary goal of this sampling design was to obtain a representative sample of food handlers that would provide reliable information on food handling practices within the academic institutions. The study employed a proportionate stratified random sampling method.

3.5.4 Sample size determination

The sample size (n) for this study was drawn using the sample size determination formula for social science research (Mugenda et al, 2003).

$$n = \frac{Z^2pq}{d^2}$$

where:

n = the desired sample size.

Z = the reliability coefficient corresponding to 5% level of significance (1.96).

p = hypothesized prevalence of institutions that handle potentially hazardous food (PHF) items (98%). This is based on the Australia New Zealand Food Authority's food safety standards survey of 2001 which observed that over 98% of food service premises including schools handled PHFs (ANZFA, 2001).

q = 1-p

d = the degree of precision (0.05).

$$= \frac{1.96^2*0.98*0.02}{0.05^2} = 30.118$$

This gives a sample size of 30.118 which was rounded off to 30 learning institutions.

3.5.5 Sampling procedure

In this study, lists of one hundred and ten (110) academic institutions with feeding programmes were obtained from the authorities in charge of education in

the study area. These were the City Council of Nairobi (CCN) for fourty six (46) primary schools, the Ministry of Education Science and Technology (MOEST) for thirty six (36) secondary schools, and the Commission for Higher Education (CHE) for twenty eight (28) post-secondary institutions as shown on Figure 2. The lists constituted the sampling frame.

These institutions were stratified into three based on the level of education they offer, which is, primary, secondary and post-secondary. This was necessitated by the fact that the levels represent student populations of different cognitive abilities and are likely to agitate for and influence the food safety practices in their institutions differently.

Each of these levels was further stratified into two categories based on their ownership, that is, public or private. This was necessitated by the fact that these categories differ in their source, adequacy and reliability of financing, which is likely to influence food safety practices through type of procurement, staffing and equipments.

These stratifications finally gave six groups of institutions. Thirty (30) learning institutions were randomly selected from these groups. The strength of each group in the selected 30 institutions was proportionate to that of the study population as indicated in Figure 2.

A total of four (4) food handlers were randomly selected from each of the thirty participating institutions for the administration of the knowledge assessment questionnaire. The four included one food service supervisor and three food service operators giving a total of one hundred and twenty participants (30 food service supervisors and 90 food service operators).

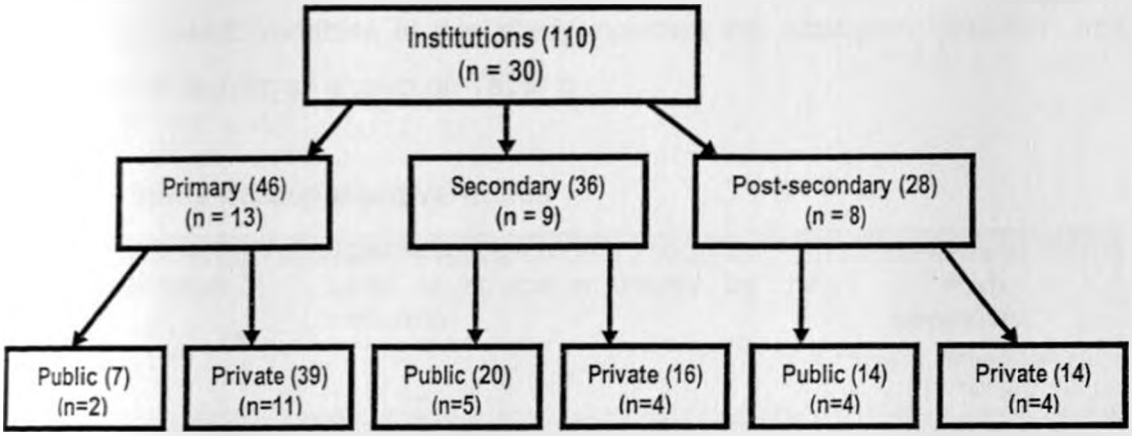

Figure 3: Sampling procedure

3.6 Study variables

3.6.1 Dependent variable

The dependent variable in this study was food safety practice (Table 3)

Table 3: Study dependent variable

Variable	Operational definition	Indicator
Food safety practices	Food safety practices within the institutions	Percentage scores of correct food safety practices

3.6.2 Intermediate variables

The intermediate variables in this study were food safety knowledge and food safety equipments as shown in Table 4.

Table 4: Study intermediate variables

Variable	Operational definition	Indicator
Food safety knowledge	Level of food safety knowledge among the food handlers	Percentage score of correct food safety knowledge among the food handlers
Food safety equipments	Condition of food safety equipments within the institutions	Percentage score of food safety equipments whose functional conditions meet required standards

3.6.3 Independent variables

The independent variables in this study included the academic institution and food handler factors as shown on Table 5.

Table 5: Study independent variables

Variable	Operational definition	Indicator
Level of institution	Level of education offered by the institution	• Post-secondary • Secondary • Primary
Institution's ownership	Category of the institution by ownership	• Public • Private
Training	Food handlers professional background	• Food handling • Others
Education	Food handlers highest level of education completed	• College • Secondary • Primary
Experience	Food handler's duration of continuous placement on the job	• Years

3.7 Data collection

A structured knowledge assessment questionnaire (KAQ), an on-site practices observation checklist (POC), and an equipments evaluation log (EEL) were used to collect data from the learning institutions that participated. These data collection instruments were developed in English. The collection of data was in the order of practices observation, followed by facilities evaluation then knowledge assessment. The data collection took place during the day covering all the food service processes. The exercise was also done during weekdays since some food service supervisors were not available over the weekends.

The POC was developed by the investigator based on the concepts of food safety captured in the background. The aim of the POC was to obtain data on the extent to which food safety practices were being carried out within the food premises of the institutions. The POC had a list of food services processes against which the investigator tallied for every correct and wrong food safety

practice observed (Appendix C). The percentage of correct food safety practices within every institution was then calculated to depict its score for food safety practices.

The EEL was a modification of the POC by the investigator based on the fact that food safety equipments may affect the food safety practices (LaGraca, 1988). It contained a similar list of food service processes as the POC but against which the investigator marked the condition of the equipment needed for the food service process (Appendix D) based on a set criteria (Appendix E). The percentage of equipments in their correct condition for food safety within the institutions was then calculated to depict the score for food safety equipments.

The KAQ was also developed by the investigator to assess the food handlers' knowledge on the five key areas of the food service processes. These are: food storage, food service, cleaning, personal hygiene and health. In addition the KAQ captured information on the level and category of the institutions and the education, training and experience of the food handlers. It had a list of fifty seven statements against which a mark was awarded for a correct response (Appendix B). The percentage score of the correct response was then calculated for every food handler and the mean percentage score for the four food handlers in every institution calculated to depict the level of food safety knowledge for that institution.

3.8 Research assistants

A research assistant who was a student of Institutional Management at the Kenya Polytechnic, Nairobi was recruited in this study. Fluency in both English and Kiswahili languages was considered during recruitment to ensure that translation of the questions and responses did not distort their meanings. He underwent a sensitization process to familiarise himself with the on-site observation method, ways of conducting equipments evaluation, and administration of questionnaire and the question routes.

His performance was supervised by the investigator so as to ensure the quality of the data collected. This was done by accompanying him for every third institution visited in each group.

3.9 Pre-test

Prior to the study, pre-tests were conducted in six academic institutions that were not selected for the study. These six institutions were purposively selected to represent each of the six groups. All the KAQ, POC, and EEL data instruments were used in the exercise. This helped detect any hitherto unforeseen logistical or methodological problems and also assessed the suitability of the recruited research assistant in carrying out the exercise. The data collection instruments were then revised after the pre-test.

3.10 Data processing and analysis

The data were pre-processed by numbering the KAQs, POCs, and EELs separately. They were also checked in the field to ensure that all the information had been properly collected and recorded to ensure completeness. The unusable data was eliminated, ambiguous answers interpreted and contradictory data verified.

The data were then coded using the preset criteria in the appendices E and F. The data were then entered using the Predictive Analytical Soft Ware (PASW) statistical programme.

The processed data were analyzed using PASW statistical programme for both the descriptive and association statistics. The information on the food handlers' background, food safety knowledge, condition of food safety equipments, and food safety practices was first presented in the tabular form (frequency tables) and discussed. The regression analyses to establish whether there was a relationship between the dependent and independent variables was then done

and the significance of the relationships tested using the chi-square test of statistics.

3.11 Minimising biases

The representativeness and adequacy in coverage of the population under study was ensured through the use of proportionate stratified random sampling method.

Four randomly selected food handlers were recruited into the study to represent the learning institution to minimise individual bias possible from a single food handler.

The research assistant was trained on the study objectives and methodology, assessed and supervised to control for the interviewer bias.
The research data collection instruments were constructed in a standard, objective and detailed manner to limit the misinterpretation by the assistant as much as possible.

A pre-test was done to validate the data collection instruments, assess the suitability of the assistant and detect any other methodological or logistical problem.

3.12 Ethical considerations

Permission to carry out the study was obtained from the ethical committees of the College of Health Sciences, University of Nairobi; Kenyatta National Hospital; and the Ministry of Education, Science and Technology.

The objectives and methodologies of the study were explained to various administrators of the education systems in Nairobi such as the Permanent secretary, MOEST; the vice chancellors of participating universities; and the

directors of education. Their permission was then obtained to carry out the study in the academic institutions.

The objectives and methodologies of the study were also explained to the administrators of the participating institutions and their consent sought before recruiting food handlers in these institutions into the study.

The objectives and the methodologies of the study were explained to the selected food handlers so as to ensure they were duly informed and consent to participate in the study sought.

The names of the participants were replaced with study codes to ensure confidentiality and alleviate the fears by the participants of being portrayed in bad light. This encouraged free and honest responses.

Respondents' information was not diverted from the purpose for which it is intended and was handled with utmost confidentiality.

The results of the survey will be communicated to the participating institutions to enable them use it to improve on their food safety practices.

The investigator offered on the spot advice on the food safety issues noted during the study to the foods service operators and food service supervisors.

3.13 Limitations of the study

The scope of this study was limited to the food safety practices within the food service premises of the primary, secondary and post-secondary learning institutions in Nairobi. The applicability of its findings is therefore limited by the probable differences in the management, level, ownership, clients and staffing.

Certain critical food safety practices applicable to the institutions were either not performed or seen during the one day period of the study. A longer period of study was necessary to capture more applicable food safety practices within the food service premises.

The exploration of the specific objectives in this study was based on several basic assumptions. The results would therefore only hold true if these assumptions are correct.

This study included an on-site observation of the food safety practices hence subject to a lot of bias. An attempt to control threats such as reactive effects of experimental arrangement was made through discreet observation. This however might not have completely eliminated the bias and the extent was not measured.

The categorization of the learning institutions does not completely control for the differences in economic status between the private and public institutions since there are low cost and high cost public and private institutions. This may have introduced some bias in the analysis.

The student population is a likely key determinant of food safety practices as it determines the financing, quantity of food handled and type of food safety equipments needed. This, however, was not explored in the study.

CHAPTER FOUR : RESULTS

4.1 Introduction

This study observed the food safety practices within the food premises of primary, secondary and post-secondary learning institutions in Nairobi. A total of 30 institutions were recruited in the study with the purpose of assessing the food safety knowledge of their food handlers, evaluating the conditions of their food handling equipments and carrying out an on-site observation of the food handlers' food safety practices.

The food handlers' background information and their food safety knowledge were obtained using a knowledge assessment questionnaire (KAQ) which was administered to 120 food handlers drawn from the 30 participating institutions. The conditions of the food safety equipments were evaluated using an equipment evaluation log (EEL) while the food safety practices were captured using the practice observation checklist (POC) within the food premises of the thirty 30 institutions.

4.2 Background information

A total of 30 institutions participated with 43.3% as primary schools and 63.3% as private institutions (Table 6 and 7).

Table 6: The distribution of academic institutions under study by level

Level of institution	Frequency (Number)	Percent (%)
Primary	13	43.3
Secondary	9	30.0
Post-secondary	8	26.7
Total	**30**	**100.0**

Table 7: The distribution of academic institutions under study by category

Category of institution	Frequency (Number)	Percent (%)
Public	11	36.7
Private	19	63.3
Total	**30**	**100.0**

The knowledge assessment questionnaire was administered to 120 food handlers who included 30 (25%) food service supervisors and 90 (75%) food service operators. Generally, 77 (64%) had gone through college level of education while 39 (33%) and 4 (3%) completed secondary and primary education respectively (Figure 4).

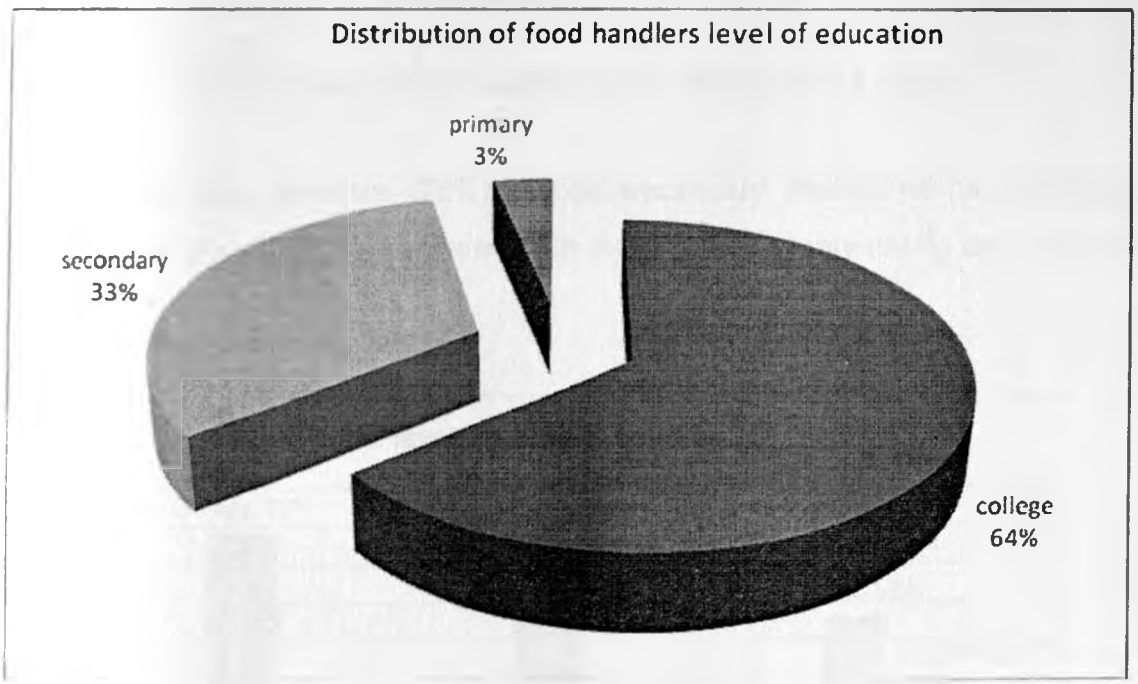

Figure 4: Distribution of food handlers by their level of education (n = 120)

All the 30 (100.0%) food service supervisors had gone through college compared to the food service operators' 47 (52.2%). The remaining 39 (43.4%) and 4 (4.4%) food service operators had completed secondary and primary schools respectively (Figure 5).

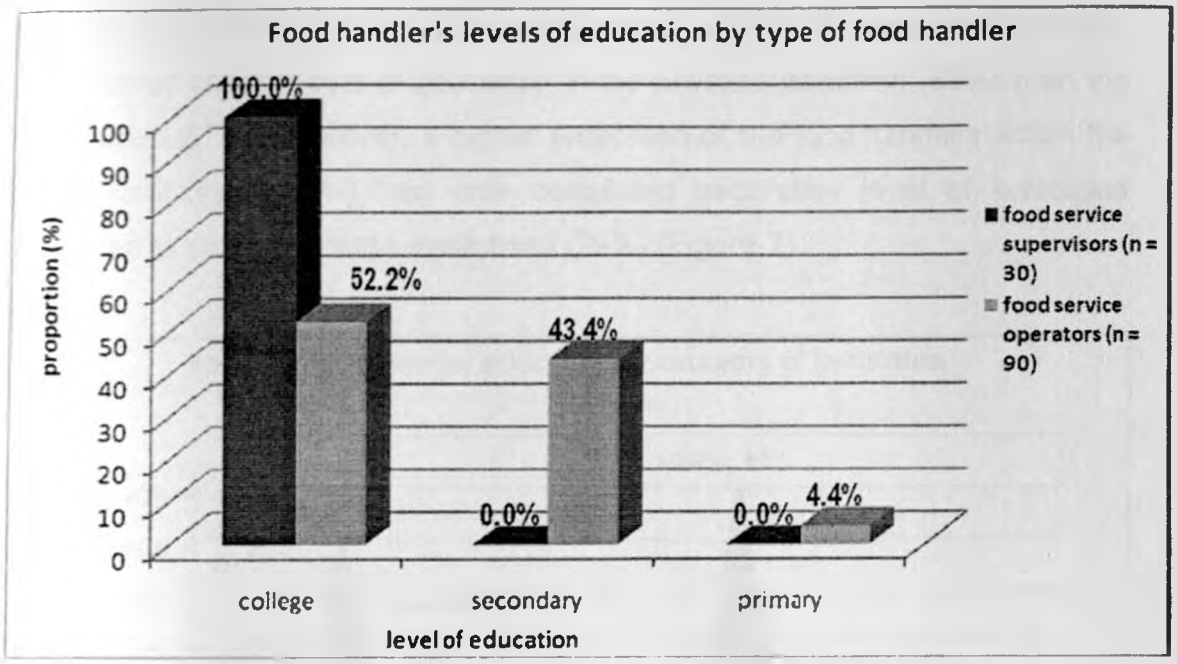

Figure 5: Distribution of food handlers' level of education by type

Most of the food handlers (78%) in post-secondary institutions had attained college level of education compared with those in secondary (64%) and primary (56%) institutions (Figure 6).

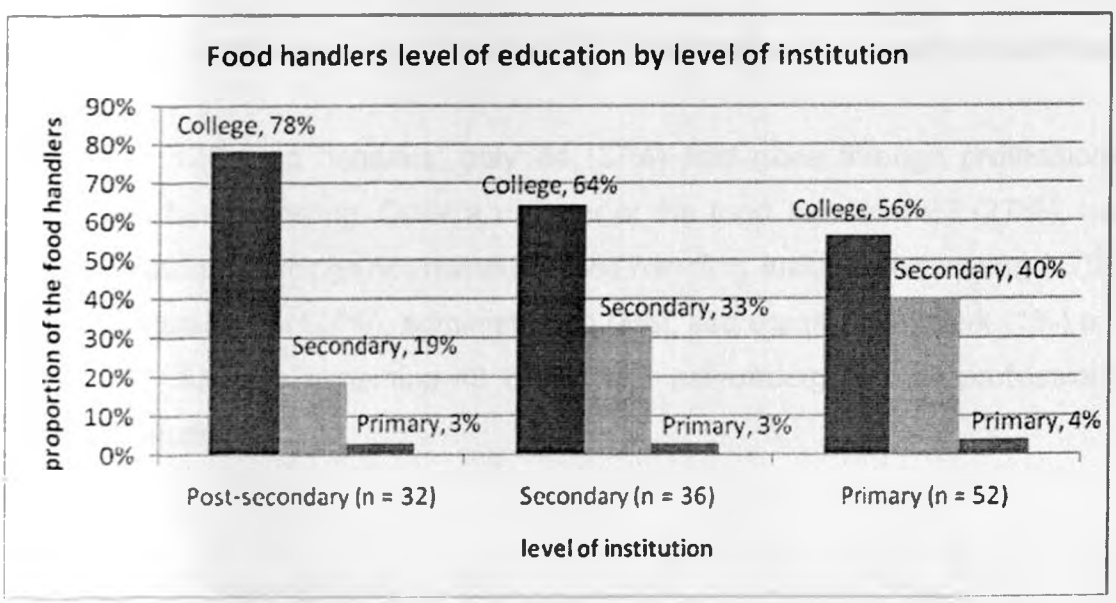

Figure 6: Distribution of food handlers' level of education by level of institution

On the basis of the category of the participating institutions, more food handlers had attained college level of education in the private institutions (68%) than the public ones (57%). However, a higher proportion of the food handlers within the public institutions (39%) had only completed secondary level of education compared to those of private institutions (29%) (Figure 7).

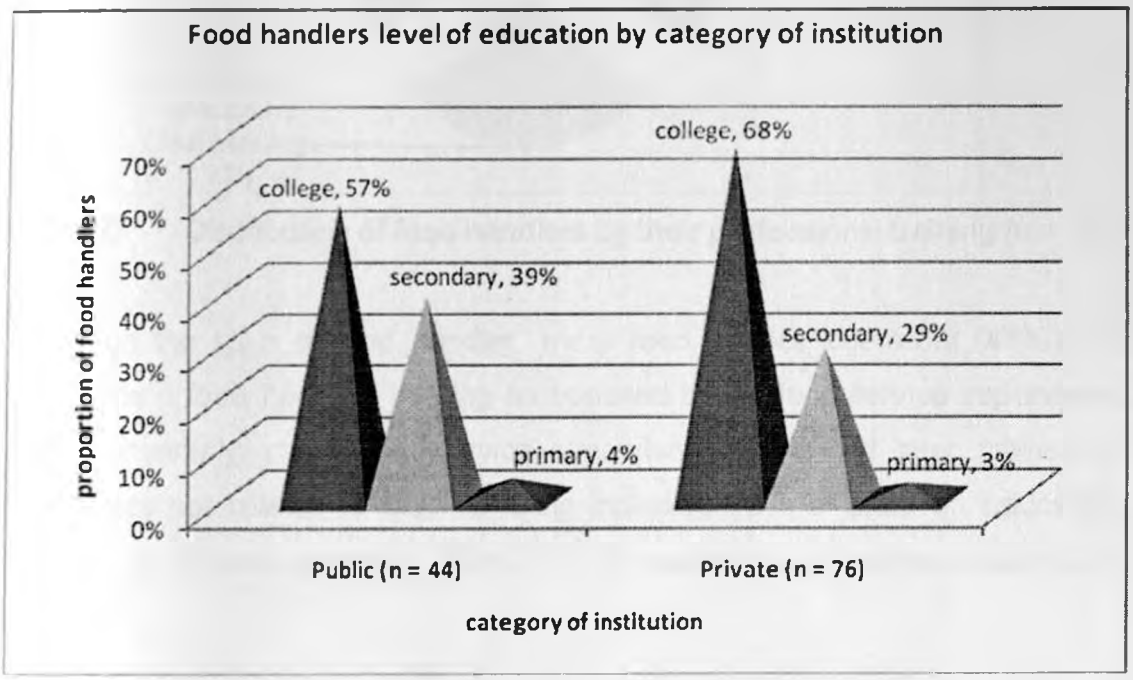

Figure 7: Distribution of food handlers' level of education by category of institution

Out of the 120 food handlers, only 44 (37%) had gone through professional training on food handling. Quite a number of the food handlers, 33 (27%), had had professional trainings not related to food handling including education (17%), supplies management (4%), administration (3%), secretarial (1%), clerk (1%) and accounts (1%). The remaining 43 (36%) had not undergone any professional training (Figure 8).

Figure 8: Distribution of food handlers by their professional training (n = 120)

Based on the type of food handler, more food service operators (41%) had undergone a food handling training as opposed to the food service supervisors' 23%. Conversely, many food service supervisors (77%) had been trained on other fields not related to food handling including 70% of them on education. Many food service operators (48%) had no professional training background (Figure 9).

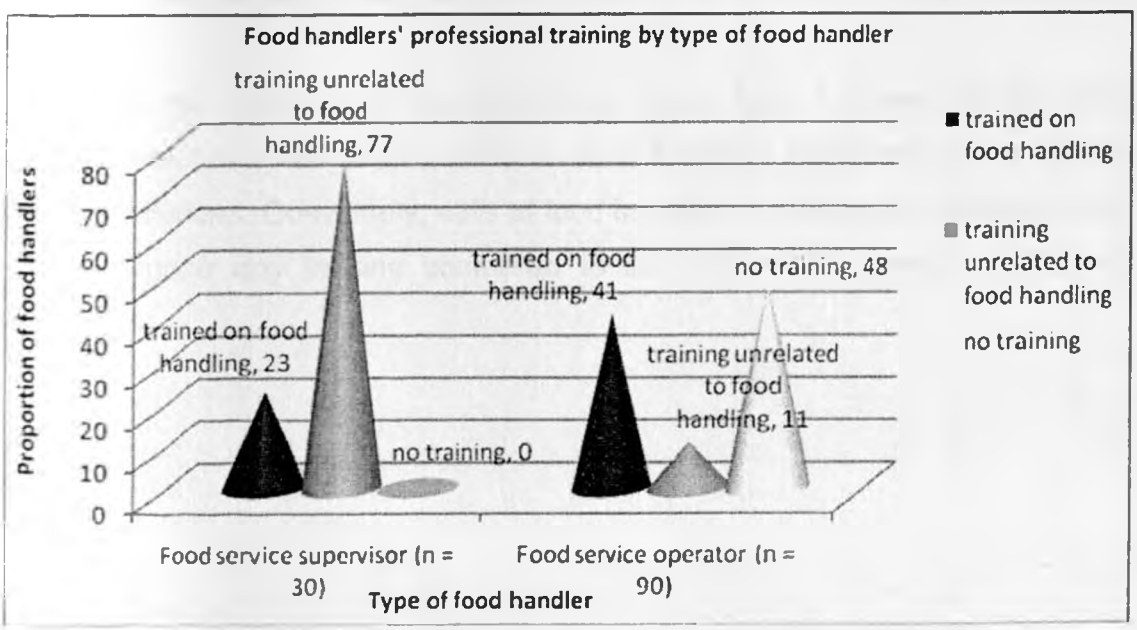

Figure 9: Distribution of food handlers' professional training by type

When looked at by the levels of the institutions, many food handlers (69%) within the food premises of the post-secondary institutions had been trained on food handling while many (44%) within the primary schools' food premises had had no professional training (Figure 10).

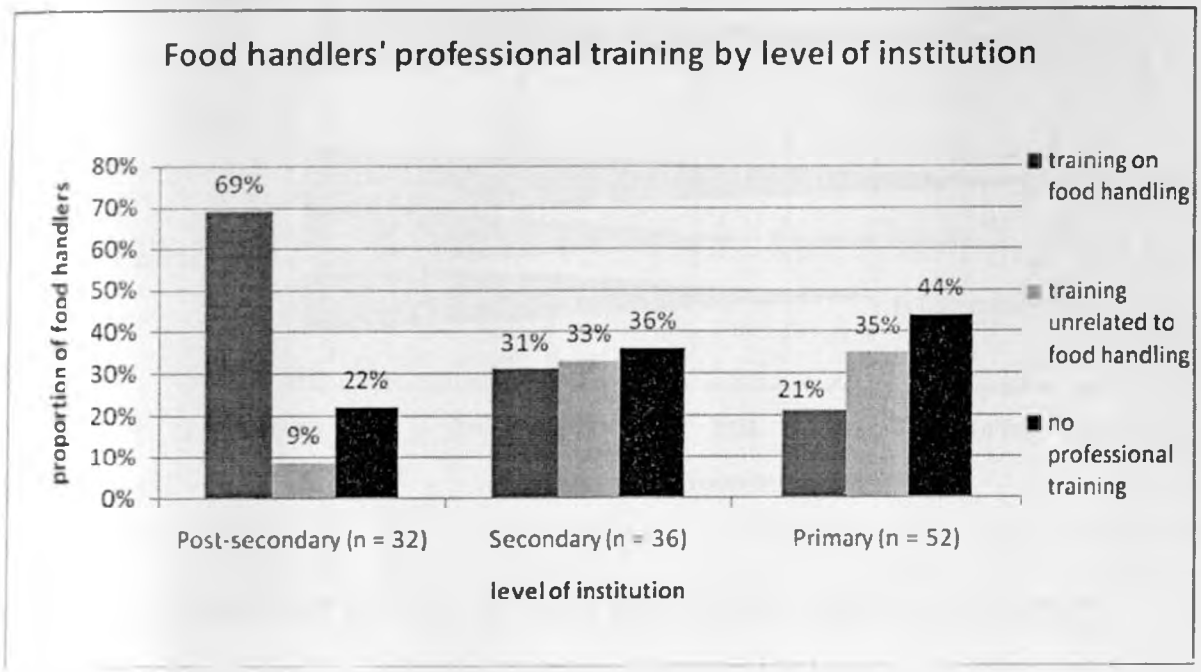

Figure 10: Distribution of food handlers' professional training by level of institution

Based on the category of the institutions, many food handlers (40%) within private institutions had been trained on food handling compared to the 32% in public institutions. Conversely, 43% of food handlers within public institutions had not undergone any training compared to the 32% of the private institutions (Figure 11).

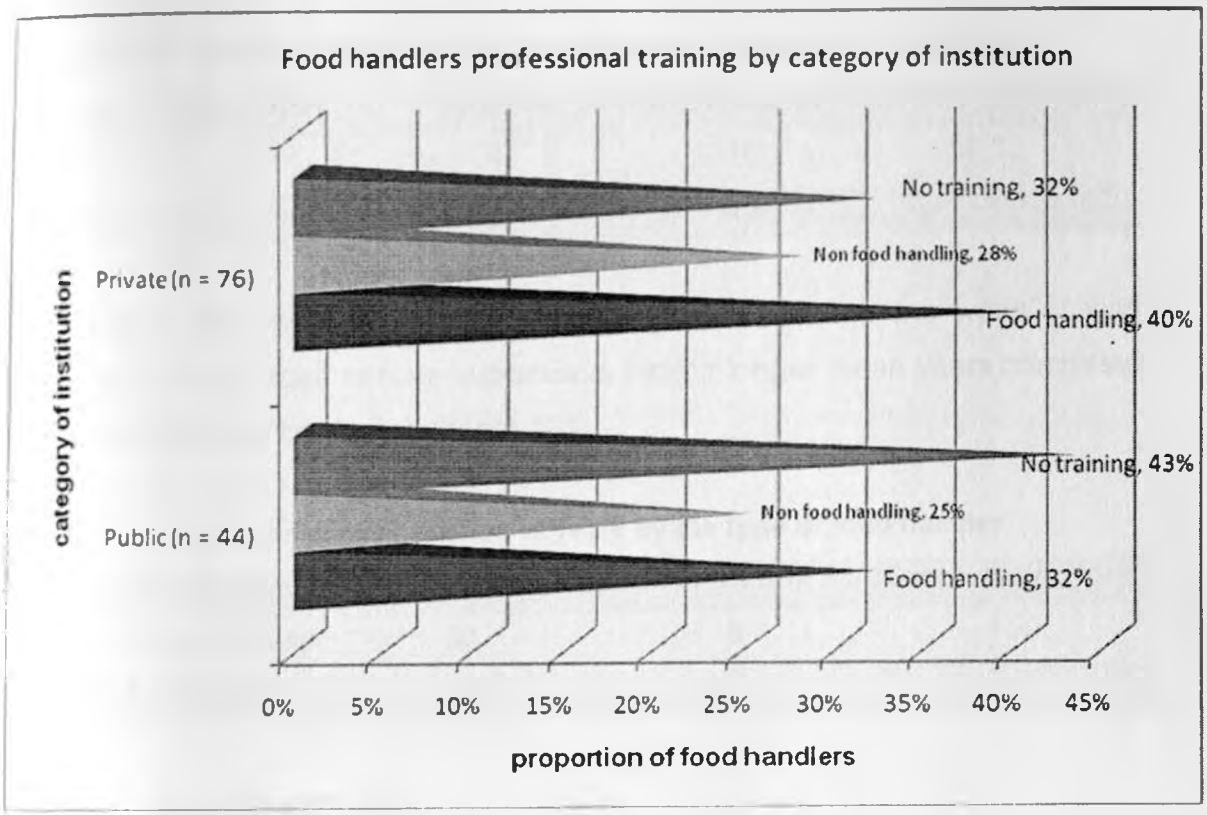

Figure 11: Distribution of food handlers' professional training by category

The study also looked at the working experience of the food handlers as the number of completed years while continuously placed on the job. This ranged from 0 to 25 years with a mean of 7.08 years and a standard deviation of 5.196. This, however, varied with the levels of the institutions and across the categories (Tables 8 and 9).

Table 8: Food handlers working experience in years by the levels of their institutions

Level of institution	Number	Mean (years)	Standard deviation
Primary	52	7.15	4.60
Secondary	36	5.61	3.96
Post-secondary	32	8.62	6.79

Table 9: Food handlers work experience in years by the category of their institutions

Category of institution	Number	Mean (years)	Standard deviation
Public	44	7.18	6.30
Private	76	7.03	4.48

There was also variation in mean work experience for the two types of food handlers with the food service supervisors having longer mean years completed while continuously on the job (Table 10).

Table 10: Food handlers experience in years by the type of food handler

Type of food handler	Number	Mean (years)	Standard deviation
Food service supervisor	30	8.73	4.99
Food service operator	90	6.53	5.17

4.3 Food safety practices

The food safety practices within the food premises of the learning institutions were captured using the POC. It had a list of food services processes indicating their critical control points against which the investigator tallied for every correct and wrong food safety practice observed. The percentage of correct food safety practices observed within every institution was then calculated from the total of all observed practices to depict its score for food safety practices.

The mean percentage score for food safety practices for all the institutions was 48.7% with a standard deviation of 12.1. This, however, varied across the level of the institutions with post-secondary institutions at (57.6%), secondary schools at (42.7%) and primary schools at (47.5%).

Table 11: Food safety practices scores by level of institution

Level of institution	Mean (%)	Standard deviation
Primary	47.5	5.3
Secondary	42.7	7.6
Post-secondary	57.6	18.5
All institutions	48.7	12.1

Based on the category of the institutions, the public institutions had a mean percentage score for food safety practices of 42.0% while the private institutions had 52.6%.

Table 12: Food safety practices scores by category of institution

Category of institution	Mean (%)	Standard deviation
Public	42.0	6.2
Private	52.6	13.0
All institutions	48.7	12.1

4.4 Food safety equipments

The conditions of the food safety equipments were evaluated using the EEL. It contained a list of food service processes indicating their critical control points against which the functional condition of the respective food safety equipment was marked. The percentage of the required equipments whose functional conditions met the set food safety criteria was then calculated to depict the score for food safety equipments for the institution.

The mean percentage score for food safety equipments for all the participating institutions was 41.4% with a standard deviation of 21.6. Post-secondary institutions had the highest score (65.5%) compared to the secondary and the primary schools (Table 13).

Table 13: Conditions of food safety equipments scores by level of institution

Level of institution	Mean (%)	Standard deviation
Primary	33.0	11.3
Secondary	32.0	10.5
Post-secondary	65.5	26.2
All institutions	41.4	21.6

The mean percentage score for food safety equipments also showed variation based on the category of the institutions with the public institutions scoring 32.3% against the private institutions' 46.6% (Table 14).

Table 14: Conditions of food safety equipments scores by category of institution

Category of institution	Mean (%)	Standard deviation
Public	32.3	10.8
Private	46.6	24.7
All institutions	41.4	21.6

4.5 Food safety knowledge

The KAQ was used to assess the food safety knowledge of four food handlers from every institution. It had a list of fifty seven statements against which a mark was awarded for a correct response. The percentage score for the correct responses was calculated for every food handler and the mean percentage score for the four food handlers in every institution calculated to depict the level of food safety knowledge for that institution.

In general, the mean percentage score on food safety knowledge for all the food handlers was 55.8% with a standard deviation of 17.9. However, this varied with the type of food handler, the level of institution, category of institution, food handlers' educational background and food handlers' professional training.

The food service supervisors had a mean percentage food safety knowledge score of 58.4% with a standard deviation of 17.95 which was slightly higher than

the food service operators' mean of 54.9% with a standard deviation of 17.84 (Table 15).

Table 15: Food safety knowledge scores by type of food handler

Type of food handler	Mean (%)	Standard deviation
Food service supervisor	58.4	17.95
Food service operator	54.9	17.84

The mean percentage score for food safety knowledge was higher (73.5%) for the food handlers within the food premises of post-secondary institutions than those within secondary (49.1%) and primary (49.5%) schools.

Table 16: Food safety knowledge scores by level of institution

Level of institution	Mean (%)	Standard deviation
Primary	49.5	13.6
Secondary	49.1	12.7
Post-secondary	73.5	17.2

The food handlers in private institutions had a higher mean percentage food safety knowledge score (57.1%) than their counterparts within the public institutions (53.7%).

Table 17: Food safety knowledge scores by category of institution

Category of institution	Mean (%)	Standard deviation
Public	53.7	12.8
Private	57.1	20.2

The food handlers who had attained college level of education had a mean percentage score for the food safety knowledge of 63.3% while their colleagues in secondary and primary schools had 42.9% and 36.3% respectively.

Table 18: **Food handlers' food safety knowledge scores by their level of education**

Level of education	Mean (%)	Standard deviation
Primary	36.3	11.7
Secondary	42.9	10.4
College	63.3	16.7

Those food handlers who had been trained on food handling had better mean percentage score (74.3%) for food safety knowledge than their colleagues who had undergone non food handling related professional training (47.8%). Those who had no professional training background at all had the least mean percentage score (42.3%) for food safety knowledge.

Table 19: Food handlers' food safety knowledge scores by their training

Professional training	Mean (%)	Standard deviation
Food handling	74.3	13.1
Not food handling related	47.8	2.5
No professional training	42.3	10.5

4.6 Bivariate and Multivariate analysis

4.6.1 Introduction

This section presents further analysis of results done to define and compare relationships between independent and dependent variables. The results of the cross tabulations are summarized in tables and text explanations provided. The dependent variable studied which define food safety outcome is safe food safety practices. The following intermediate variables were studied to help define the independent variables that characterize them: food safety knowledge and food safety equipments. The independent variables included level of institution, category of institution, food handlers' level of education, food handler's professional training and food handlers' work experience.

4.6.2 Definition of variables

Table 20: Independent variables for bivariate and multivariate analysis

Variable	Operational definition	Indicator
Students cognitive capacity	Level of education offered by the institution	• Post-secondary • Secondary • Primary
Institution's financing	Category of the institution by ownership	• Public • Private
Food handlers' training	Food handlers professional background	• Food handling • Others
Food handlers' education	Food handlers level of education completed	• College • Secondary • Primary
Food handlers' work experience	A food handler's duration of continuous placement on the on the job	• Years

Table 21: Outcome variables for bivariate and multivariate analysis

Variable	Operational Definition	Indicator
Food safety knowledge	Level of food safety knowledge among the food handlers	Percentage scores of correct food safety knowledge among the food handlers
Food safety equipments	Condition of food safety equipments within the institutions	Percentage scores of food safety equipments whose conditions meet required standards
Food safety practices	Food safety practices within the institutions	Percentage scores of correct food safety practices

4.6.3 Food safety knowledge

Table 22 shows the result of cross tabulation between the mean percentage food safety knowledge scores by the food handlers and the independent variables. The food service supervisors had a mean percentage food safety knowledge score of 58.4% while the food service operators had 54.9%. This difference in food safety knowledge between the two types of food handlers was found to be statistically significant ($p<0.05$).

The food handlers' food safety knowledge was found to be significantly associated with their level of education. The food handlers who had attained

college level of education had a mean percentage food safety knowledge score of 63.3% compared to 42.9% and 36.3% for those who had attained secondary school and primary school levels of education respectively. This was found to be highly significant ($p<0.001$).

Even though the food safety knowledge scores of the food handlers varied with the level of institution, category of the institution, food handlers' professional training and the duration of work experience, these were not significant with $p>0.05$.

Table 22: Cross tabulation between food safety knowledge and independent variables

Independent variables	% Mean	SD	χ2 value	df	p-value
Type of food handler					
Food service operators	54.90	17.841	44.347	29	0.034
Food service supervisors	58.43	17.950			
Level of institution					
Post-secondary	73.50	15.892	76.346	58	0.054
Secondary	49.22	4.024			
Primary	49.54	7.720			
Category of institution					
Public	53.64	6.622	39.231	29	0.097
Private	57.11	17.473			
Level of education					
College	63.31	16.671	102.389	58	0.000
Secondary	42.92	10.363			
Primary	36.25	11.673			
Professional training					
Food handling	74.32	13.138	232.924	203	0.073
Not food handling related	47.8	2.5			
No training	42.30	10.523			
Experience					
Years	7.08	5.196	597.606	551	0.083

Table 23a focuses on the six predictors, whether they are statistically significant and, if so, the direction of the relationship. The type of food handler (B = -8.101) is a significant (p=0.003) predictor of food safety knowledge. The level of institution (B=-8.582) is also a significant (p=.000) predictor of food safety knowledge. The category of institution (B = 5.447) is also a significant (p=0.017)

determinant of safe food handling knowledge indicating that as you move from public to private institutions, the knowledge increases. The food handlers' level of education (B=2.929) was not a significant (p=0.522) predictor but showed that as the food handlers moved from primary through secondary to college education, their food safety knowledge also increased. The food handlers' professional background (B= -3.572) significantly (p=0.000) determined level of food safety knowledge such that those with food handling training background had higher knowledge scores. Finally, the food handlers' experience (B = 0.518) also significantly (p=0.012) predicted the food safety knowledge such that the longer the experience the better the knowledge.

Table 23a: Regression model for food safety knowledge

Independent variables	B	SE	Beta	t	Sig.
(Constant)	83.428	6.878		12.130	0.000
Type of food handler	-8.101	2.644	-0.197	-3.064	0.003
Level of academic institution	-8.582	1.366	-0.396	-6.284	0.000
Category of academic institution	5.447	2.249	0.148	2.422	0.017
Level of education completed by the food handler	2.929	4.566	0.091	0.642	0.522
Professional training of the food handler	-3.572	0.702	-0.724	-5.086	0.000
Number of years completed on the job	0.518	0.203	0.151	2.550	0.012

Dependent variable: food safety knowledge

Table 23b shows a further regression outcome for food safety knowledge. The conditions of the food safety equipments appears to be a weak positive (B = 0.128) but insignificant predictor of the food safety among the food handlers.

Table 23b: Regression model for food safety knowledge

	B	SE	Beta	t	Sig.
(Constant)	50.557	5.744		8.801	0.000
food safety equipment	0.128	0.123	0.192	1.033	0.310

Dependent variable: food safety knowledge

4.6.4 Food safety practices

Table 24 shows the result of cross tabulation between the mean percentage food safety practices by the institutions' food handlers against the levels and categories of the institutions. The institutions' level was found to be significantly associated with their food handlers' food safety practices. The institutions' levels had mean percentage food safety practices score of: post-secondary, 57.6%; secondary, 42.7% and primary, 47.5%. This difference was found to be statistically significant ($p<0.05$). The category of the institutions had percentage mean food safety practices scores of public, 42.0% and private, 52.6%; however this difference was not very statistically significant ($p>0.05$).

Table 24: Cross tabulation of food safety practices with independent variables

Independent variables	Mean	SD	$\chi 2$ value	df	p-value
Level of institution					
Post-secondary	57.6	18.547	43.739	42	0.398
Secondary	42.7	7.616			
Primary	47.5	5.333			
Category of institution					
Public	42.0	6.245	19.952	21	0.524
Private	52.6	12.954			

Table 25a focuses on the study's two independent predictors of food safety practices, whether they are statistically significant and, if so, the direction of the relationship. The level of the institution (B = -7.112) is a significant (p = 0.004) predictor of the food handlers' food safety practices. This association is such that as one moves down from the post-secondary institutions through secondary schools to primary schools, the food safety practices are likely to improve. The category of institutions (B =14.545) is also a significant (p = 0.001) determinant of

food safety practices indicating that as you move from public to private institutions, the food safety practices become better.

Table 25a: Regression model for food safety practices

	B	SE	Beta	t	Sig.
(Constant)	40.386	6.836		5.908	0.000
Level of institution	-7.112	2.263	-0.493	-3.142	0.004
Category of institution	14.545	3.850	0.593	3.777	0.001

Dependent variable: food safety practices

The study looked at the two intermediate predictors of food safety practices indicate whether they are statistically significant and the direction of the relationship (Table 25b). Food safety knowledge together with food safety equipments are significant (p = 0.000) predictors of food safety practices. However, food safety knowledge on its own is not a significant (p = 0.052) predictor of their food safety practices. The association is also such that higher food safety knowledge scores are not equated to higher food safety practices scores (B = -0.274). The functional conditions of food safety equipments on its own is a positive (B = 0.296) and significant (p = 0.003) predictor of food safety practices.

Table 25b: Regression model for food safety practices

	B	SE	Beta	t	Sig.
(Constant)	51.765	7.938		6.522	0.000
Food safety knowledge	-0.274	0.135	-0.328	-2.036	0.052
Food safety equipment	0.296	0.090	0.533	3.310	0.003

Dependent variable: food safety practices

4.6.5 Conditions of food safety equipments

Table 26 shows the result of cross tabulation between the mean percentage scores on condition of food safety equipments within institutions against their levels and categories. The level of institution was found to be significantly associated with the conditions of their food safety equipments. The level of the institution had mean percentage condition of food safety equipment scores as

follows: post-secondary, 65.5%; secondary, 32.0% and primary, 33.0%. This difference was found to be statistically significant (p=0.0362). The category of institutions had mean percentage condition of food safety equipment scores of public, 32.3% and private, 46.6%, but this difference was not significant (p=0.536).

Table 26: Cross tabulation between condition of food safety equipments and independent variables

Independent variables	Mean	SD	χ2 value	df	p-value
Level of institution					
Post-secondary	65.50	26.159	40.475	38	0.362
Secondary	32.00	10.548			
Primary	33.00	11.321			
Category of institution					
Public	32.27	10.827	17.799	19	0.536
Private	46.63	24.685			

Table 27a focuses on the two predictors of conditions of food safety equipments, whether they are statistically significant and, if so, the direction of the relationship. The level of the academic institution (B = 19.763) is a significant (p = 0.000) predictor of institution's condition of food safety equipments. As you move from primary through secondary to post-secondary levels, the mean percentage condition of food safety equipment score increases. The category of institution (B = 25.233) is also a significant (p = 0.000) predictor of the institution's condition of food safety equipments. As you move from public to private categories, the condition of the mean percentage condition of the food safety equipments score increases.

Table 27a: Regression model for condition food safety equipments

	B	SE	Beta	t	Sig.
(Constant)	-36.081	12.503		-2.886	0.008
Level of institution	19.763	3.230	0.762	6.118	0.000
Category of institution	25.233	5.496	0.572	4.591	0.000

Dependent variable: mean percentage condition of food safety equipments score

Table 27b indicates the regression outcome of food safety knowledge as a predictor of the conditions of the food safety equipments within the institutions. The food safety knowledge is a weak positive (B = 0.288) and non significant (p = 0.310) predictor of the conditions of food safety equipments.

Table 27b: Regression model for food safety equipments

	B	SE	Beta	t	Sig.
(Constant)	25.300	16.047		1.577	0.126
food safety knowledge	0.288	0.279	0.192	1.033	0.310

Dependent variable: food safety equipment

CHAPTER FIVE : DISCUSSIONS

This study aimed at determining the level of food safety practices and determinants within primary, secondary and post-secondary learning institutions in Nairobi. In this chapter, the findings are discussed highlighting the key ones. At the same time a comparison of the results with the reviewed and emerging literature is done.

The food handlers' level of education was significantly associated with food safety knowledge which is a determinant of food safety practice. This study showed that 64% of the food handlers have gone through college level of education. The importance of food handlers' education is underscored by Finch and Eileen (2005), who found out that food handlers' limited level of education impacts negatively on food safety due to their inability to grasp the necessary advanced technological concepts. This study further showed that post-secondary institutions had more food handlers (78%) with college level of education compared with secondary (64%) and primary (56%) schools. The private institutions also had more food handlers (68%) with college level of education as opposed to public institutions (57%). All the food service supervisors had gone through college level of education compared to the 52% food service operators. This is not surprising considering that there are no guidelines indicating the minimum educational requirement for food handlers being placed in the learning institutions.

Professional training on food handling is important for food safety as is emphasized by Capunzo et al (2005). This study, however, showed that only 37% of the food handlers had undergone food handling training while 36% had no professional training at all. This can also be attributed to the fact that there is no specific professional requirement for the food handlers during placement. The number of trained food handlers was greater (69%) within the post-secondary

institutions than the secondary (31%) and primary (21%) schools. The figures were also higher within the private (39%) than public (31%) institutions.

It has been shown that rapid turnover of the food handlers, among other things, contribute to unsafe food practices (Worsfold et al, 2003). This study also showed that work experience is significantly (p=0.012) associated with food safety knowledge which is a determinant of food safety practice. The mean work experience in the study was 7 years; it was higher among the food service supervisors (9 years) than food service operators (7 years) and also higher in post-secondary institutions (9 years) than in secondary schools (6 years) and primary schools (7 years).

According to Mansour et al (2005) and LaGraca (1988), good work equipments form a positive workgroup climate and motivate employees to engage in good work practices. This study also showed that working condition of food safety equipments both alone and together with food safety knowledge was a significant determinant of food safety practices. The overall proportion of the food safety equipments within the institutions whose functioning conditions conformed to food safety requirements was 43.5%. This proportion varied with the level of the institution and also the category of the institution.

The level of the institution was positively and significantly associated with the conditions of the food safety equipments ($p = 0.000$). This means that as you move from the primary schools to the higher level institutions the conditions of the food safety equipments improved. This may be attributed to the variation in the students' cognitive abilities such that those in post-secondary schools may be more aware of the expected equipments than their counterparts in primary schools. They are therefore likely to demand for better food safety equipments.

The category of the institutions was also positively and significantly related to the conditions of the food safety equipments ($p = 0.000$). The private learning

institutions had better food safety equipments than the public institutions. This difference may be due to the adequacy and reliability of the institutions' financing which will affect their ability to procure and maintain food safety equipments. It can also be due to the fact that since the parents invest a lot of resources in private institutions, they are likely to demand for more accountability from the institutions' managers leading to better food safety equipments.

The food safety knowledge also had a positive influence on the working conditions of the food safety equipments but this was statistically insignificant. This implies better food safety knowledge would not necessarily translate into better working conditions of the food safety equipments. This may be due to the fact that food handlers probably are not involved in procurement of equipments.

This study assessed the level of food safety knowledge and its relationships with the independent variables: level of institutions, category of institutions, and professional training and work experience. In general, the mean percentage food safety knowledge score among the food handlers was 55.8% with a standard deviation of 17.9. This however varied depending on the type of food handler, level of academic institution, category of academic institution, food handlers' education, food handlers' profession and experience on the job.

The type of food handler (B = -8.101), that is, the food service supervisors and food service operators, is significantly (p=0.003) associated with their food safety knowledge. This negative association implies that the food service operators have more knowledge on food safety than the food service supervisors. This would appear contrary to the findings of Worsfold (2006) which showed that food handlers' level of education determines food safety knowledge since all the food service supervisors had attained college level of education compared to the 52.2% among the food service operators. However, this can be justified by the fact that more food service operators (41%) have been trained on food handling than the food service supervisors (23%). They are therefore more likely to be

endowed with better knowledge on the complex technological concepts of food safety than the food safety supervisors.

The category of the institutions is positively (B = 5.447) and significantly (0.017) associated with the food safety knowledge of the food handlers. This means therefore that the food handlers within the private institutions have better knowledge on food safety than their counterparts within the public institutions. This may be due to the earlier stated reason that more food handlers have college level of education and trained on food handling within the private institutions than the public ones. These same reason would also explain the negative (B = -8.582) but significant (p=0.000) association between the level of institutions and the food safety knowledge among the food handlers. This shows that the primary schools' food handlers have better food safety knowledge than the higher institutions since the former have a higher proportion of private institution than the latter.

Food handlers who have undergone professional training on food handling are likely to have better food safety knowledge (p=0.000) than those who have not. This could be because the training empowers them with knowledge on food safety practices. The food handlers' experience in terms of the number of years on the job is also a significant (p=0.012) determinant of their food safety knowledge. The longer the period of employment, the better the food safety knowledge.

The conditions of food safety equipments though has a positive influence on the food safety knowledge (B = 0.128), this is statistically insignificant (p=0.310). This implies better working conditions of food safety equipments would not translate into better food safety knowledge among the food handlers. Despite the availability of good food safety equipments, the food handlers still don't comprehend the concepts and principles behind the practices and applications of these food safety equipments.

It is through proper food safety practices that ultimate food safety can be ensured. The study showed that only 48.7% of the food safety practices within the schools and higher learning institutions conformed to the stipulated food safety standards. The post-secondary institutions had higher score (57.6%) than the secondary (42.7%) and primary (47.5%) institutions. This difference was statistically significant ($p = 0.004$). The association, however, showed that food handlers within the food premises of the higher learning institutions did not necessarily engage in better food safety practices than their counterparts within the primary schools. The study also showed that 52.6% of food safety practices within the private institutions conformed to the standards as opposed to 42.0% within the public institutions. This association was positive and statistically significant ($p = 0.001$). This better food safety practices by food handlers in private institutions can be attributed to the differences in the financing of the institutions. The private institutions are primarily funded by the parents which is more reliable as opposed to the public institutions which are primarily funded by the government (Eshiwani, 2002). This is likely to affect not only the ability to employ but also the caliber of food handlers engaged within the institutions. This is clearly supported by the results which indicate that the proportion of food handlers who had attained college level of education was 68% in private and 57% in public institutions while those who had attained training on food handling was 40% in private and 32% in public and all these attributes are known determinants of good food safety practices (Worsfold, 2006). The differences can also be explained by the fact that since the parents invest more in private institutions, they are likely to demand more accountability from the institutions' managers leading to better caliber of staff and quality of services. The higher proportion of private schools at the primary level (84.6%) as compared to secondary (44.4%) and post-secondary (50.0%) therefore explains why the food safety practices are poorer in post-secondary institutions.

The food safety knowledge together with food safety equipments significantly determine food safety practices ($p = 0.000$). However, food safety knowledge on its own does not significantly improve the food safety practices ($p = 0.052$). Greater food safety knowledge therefore does not necessarily translate to better food safety practices. In any case, it is associated with poorer food safety practices. This agrees with the findings of Julian (2006) which showed that there is often a difference between the food handlers' knowledge and what they actually do. The food safety practices, however, improve with the betterment of the functional conditions of food safety equipments and this is statistically significant ($p = 0.003$). This is also in agreement with LaGraca (1988) who showed that modification of the food handlers' work environment by providing the necessary work equipments promotes good food safety practices.

CHAPTER SIX : CONCLUSIONS AND RECOMMENDATIONS

This study aimed at determining the level of food safety practices and determinants within primary, secondary and post-secondary learning institutions in Nairobi. This chapter makes conclusions on the findings of this study, makes recommendations to policy and guidelines and also suggests areas that may require further research.

6.1 Conclusions

The study findings showed that on average, only 48.7% of the food safety practices within these learning institutions conform to food safety requirements. It also showed the mean score of the food safety knowledge among the food handlers in these learning institutions to be 55.8% and 41.4% of food safety equipments were in required functioning conditions.

The institutional ownership, a proxy indicator of the institutional financing, directly affects the food safety practices. Privately funded institutions have better food safety practices than the government funded institutions. The level of institution, a proxy indicator for students' cognitive ability, does not have any direct influence on the food safety practices.

The functional conditions of the food safety equipments needed for storage, food service, cleaning, personal hygiene and health positively influence the food safety practices within the institutions. The category and level of institutions also positively influence the conditions of food safety equipments hence indirectly determine food safety practices.

The food handlers' food safety knowledge is an important determinant of food safety practices such that increase in knowledge leads to better practices. The knowledge is however determined by the food handlers' level of education, food handling training and experience.

6.2 Recommendations

This study therefore recommends the following:

- Empowerment of the food handlers in schools and higher learning institutions with knowledge on food safety. This can be achieved through refresher courses, in-services training, residential training, continuous food safety education, seminars and workshops.

- Improvement of the conditions of the food safety equipments within the schools and higher learning institutions. This may be done through procurement support, preventive maintenance and routine servicing.

- The policy makers within the education sector need to develop job placement criteria and guidelines to ensure that the food handlers in the learning institutions attain at least a post-secondary level of education.

- The policy makers within the education sector also to put in place guidelines that would ensure that the food handlers in the learning institutions undergo professional training on food handling and safety before employment.

- The MoH and MoEST should institute food safety surveillance and monitoring systems in the learning institutions to ensure that the food safety equipments always conform to conditions required standards.

- The categorization of the schools and higher learning institutions did not completely control for the differences in economic status between the private and public institutions since there are low cost and high cost public and private institutions. The student population is also a likely key determinant of food safety practices as it determines the financing, quantity of food handled and type of food safety equipments needed. These may have introduced some bias in the analysis as they were not explored in the study hence need to be catered for in future studies.

- The study has shown experience to be an important determinant of food safety knowledge and ultimately the food safety practices. A further study with the aim of suggesting ways of enhancing food handlers' retention.
- Study the relationship between the food safety practices and the incidence of food borne disease outbreaks within the learning institutions.

REFERENCES

Ana K. C. C., Ângela M. S. C., Liana B. G. P., Neide R. F., Paulo R. M. A. and Tânia L. M. S. (2009); Assessment of Personal Hygiene and Practices of Food Handlers in Municipal Public Schools of Natal, Brazil; *Food Control*; **20**(9): 807-810.

Arnout R. H. F., Aarieke E. I., Rob J., Lynn J. F., Maarten J. N. (2005); Improving Food Safety in the Domestic Environment: The Need for a Transdisciplinary Approach, *Risk Analysis*; **25**(3): 503–517.

Asheena K., Duc J. V., Joelle N., Gretchen A. R., and John M. C. (2003); Is Drinking Water a Risk Factor for Endemic Cryptosporidiosis? A Case-control Study in the Immunocompetent General Population of the San Francisco Bay Area; *BMC Public Health*; **3**(11).

Australia New Zealand Food Authority (2001); National Food Handling Benchmark 2000/2001 Report; Campbell Research and Consulting Pty Ltd, Clifton Hill.

Azanza M. A. and Patricia V. (2006); Philippine Food Borne Disease Outbreaks (1995–2004); *Journal of Food Safety*; **26**(1): 92-102.

Barbara A. A., and Jeannie S. (2003); Food Safety and HACCP in Schools; *Journal of Child Nutrition and Management*; Issue 1, Spring 2003.

Barker J., Naeeni M., and Bloomfield S. F. (2003); The effects of cleaning and disinfection in reducing *Salmonella* contamination in a laboratory model kitchen; *Journal of Applied Microbiology*; **95**(6): 1351-1360.

Barnes J. (1997); Industry Guide to Good Hygiene Practice: Catering Guide; Chadwick House Group Ltd.

Betty C. H. and Roberts D. (1993); Food Poisoning and Food Hygiene; 6th Edition; Arnold, London.

Bidawid S., Farber J. M., and Sattar S. A. (2000); Contamination of Foods by Food Handlers: Experiments on Hepatitis A Virus Transfer to Food and Its Interruption; *Applied and Environmental Microbiology*, **66**(7): 2759-2763.

Binkley M., and Ghiselli R. (2005); Food Safety Issues and Training Methods for Ready-to-eat Foods in Grocery Industry; *Journal of Environmental Health*; **68**(3): 27-31.

Blanchfield J. R. (2001); Good Manufacturing Practice: Dealing with Food Allergens in Ingredients. Food Processing, Retailing and Foodservice; *Foodservice Research International*, **12**(13): 119-132.

Bolton D. J., Meally A., Blair I. S., McDowell D. A. and Cowan C. (2008); Food safety knowledge of head chefs and catering managers in Ireland; *Food Control*; **19**(3): 291-300.

Bruhn M. Christine (1997); Consumer Concerns: Motivating to Action; *Emerging Infectious Diseases*, Volume 3 Number 4.

Bryan, F.L.; Hazard Analysis Critical Control Point Evaluations: A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage; WHO, Geneva; 1992.

Capunzo M., Cavallo P., Boccia G., Brunetti L., Buonomo R. and Mazza G. (2005); Food hygiene on merchant ships: the importance of food handlers' training; *Food Control* **16**(2): 183-188

Central Bureau of Statistics, Government of Kenya; Kenya 1999 Population and Housing Census Volume VIII: Analytical Report on Education; Nairobi. 2002.

Central Bureau of Statistics, Government of Kenya; Kenya 1999 Population and Housing Census Volume I; Nairobi, 2002.

Central Bureau of Statistics, Government of Kenya; Statistical Abstract; Nairobi, 2004.

Centre for Disease Control and Prevention (2000); Surveillance for Foodborne Disease Outbreaks, 1993-1997.

Charlebois R. (2002); Foodborne Disease: A Focus for Health Education; *Canadian Veterinary Journal*, **43**(9): 717-720.

Charles R. H. G. (1983); Mass catering; *WHO Regional Publications; European Series*, Number 15.

Christie A. B. and Christie M. C. (1972); Food Hygiene and Food Hazards; Faber and Faber Ltd.

Clayton D.A., Griffith C.J. and Price P. (2003); Consumers' attitudes, knowledge, self-reported and actual hand washing behaviour: a challenge for designers of intervention materials; *International Journal of Consumer Studies*, **27**(3): 218-251.

Corry B. Struijk and D. A. A. Mossel (2002); Eventual Management of Sprout-Transmitted Salmonellosis; *Journal of Clinical Microbiology*, **40**(8).

Courtenay M., Ramirez L., Cox B., Han I., Jiang X. and Dawson P. (2005); Effects of Various Hand Hygiene Regimes on Removal and/or Destruction of *Escherichia coli* on Hands; *Food Service Technology*, **5**(2-4): 77-84.

Cretikos M., Telfer B., and McAnulty J. (2008); Enteric Disease Outbreak Reporting, New South Wales, Australia, 2000 to 2005. *NSW Public Health Bulletin*; Vol. 19, Page: 3–7.

Cuiwei Z., Beilei G., Juan V., Robert S., Emily Y., Shaohua Z., David G. W., David W. and Jianghong M. (2001); Prevalence of *Campylobacter* spp., *Escherichia coli*, and *Salmonella* Serovars in Retail Chicken, Turkey, Pork, and Beef from the Greater Washington, D.C., Area; *Applied Environmental Microbiology*, **67**(12): 5431-5436.

De Noya B. A., Ruiz R., Diaz Z., Colmenares C., Zavala R., Mauriello L., Surez J.A., Torres J.R., Naranjo L., Castro J., Marques J., Mendoza I., Ossenkopp J. and Noya O. (2008); Large Outbreak of Orally-Acquired Acute Chagas' Disease, in a Publlc School of Caracas, Venezuela; *International Journal of Infectious Diseases*; **12**(1): 44-62.

Duncan J W Kwamina (1975); Sanitary Control of Food; *Nigerian Journal of Engineering*, **1**(2)105-107.

Emily Meadows and Nicole Le Saux (2004); A systematic review of the effectiveness of antimicrobial rinse-free hand sanitizers for prevention of illness-related absenteeism in elementary school children; *BMC Public Health*, **4**(50).

Eshiwani G. (2002), Education in Kenya since Independence, EAPA, Nairobi.

FDA Retail Food Program Steering Committee. (2000). Report of the FDA retail food program database of foodborne illness risk factors. Available at: http://www.cfsan.fda.gov/~dms/retrsk.htm

Finch C. and Eileen D. (2005); Food safety knowledge and behavior of emergency food relief organization workers: Effects of food safety training intervention; *Journal of Environmental Health*, Vol. 67 Page 30-35.

Food and Agriculture Organisation; Assuring Food Safety and Quality: Guidelines for Strengthening National Food Control Systems; FAO/WHO, 2003.

Food Safety and Inspection Service, United States Department of Agriculture (2006); Cooking for Groups: A Volunteer's Guide to Food Safety; FSIS Publications; Washington, D.C.

Gaman P. M. and Sherrington K. B. (1981); The Science of Food: An Introduction to Food Science, Nutrition and Microbiology, 2nd Edition; Pergamon Press.

Giampaoli J., Sneed J., Cluskey M. and Koenig H. F. (2002); School Foodservice Directors' Attitudes and Perceived Challenges to Implementing Food Safety and HACCP Programs; *Journal of Child Nutrition and Management*; Issue 1.

Giampaoli, J., Cluskey, M., & Sneed, J. (2002). Developing a practical audit tool for assessing employee food-handling practices. *The Journal of Child Nutrition & Management, 26,* Retrieved May 11, 2010. http://docs.schoolnutrition.org/newsroom/jcnm/02spring/giampaoli2/

Gillespie I. A., O'Brien S. J, Adak G. K., Ward L. R., and Smith H. R. (2005); Foodborne General Outbreaks of Salmonella Enteritidis Phage Type 4 Infection, England and Wales, 1992–2002: Where are the Risks?; *Epidemiology of Infections*; Issue 133, Page 795–801.

Gilmore, S. A., Brown, N. E., and Dana, J. T. (1998). A food quality model for school foodservices. *The Journal of Child Nutrition & Management, 22,* 32-30.

Giraffa Giorgio (2002); Enterococci from foods; *FEMS Microbiology Reviews*, **26**(2): 163-171.

Government of Kenya (1986); Public Health Act, Chapter 242; Laws of Kenya; Government Printer, Nairobi.

Government of Kenya (1992); Food, Drugs and Chemical Substances Act, Chapter 254; Laws of Kenya; Government Printer, Nairobi.

Graham-Rack B. and Binsted R. (1973); Hygiene in Food Manufacturing and Handling: Protection of Food, 2nd Edition; Food Trade Press Limited.

Gross P., Kamara B., Hatheway L., Powers P., Libonati P., Harmon M., and Israel E. (1989); Clostridium perfringens food poisoning: Use of Serotyping in an Outbreak Setting; *Journal of Clinical Microbiology*, **27**(4): 660-663.

Günter K. and Axel K. (2004); Epidemiologic Background of Hand Hygiene and Evaluation of the Most Important Agents for Scrubs and Rubs; *Clinical Microbiology Reviews*, **17**(4): 863–893.

Hazelwood and McLean (1991); Hygiene: A Complete Course for Food Handlers; 1st Edition; Hodder and Stoughton Publishers, London.

Henroid, D. and Sneed, J. (2003); Readiness to implement hazard analysis critical control point (HACCP) systems in Iowa schools. *The Journal of the American Dietetic Association.*

Hightower J. and Moore D. (2003); Mercury Levels in High-End Consumers of Fish; *Journal of Environmental Health Perspectives*, **111**(4): 604-608.

Hislop N. and Shaw K. (2009); Food Safety Knowledge Retention; *Journal of Food Protection*; **72**(2): 431-435

Hunt, M.C., Warren K. E, Hague M. A, Kropf D. H, Waldner C. L, Stroda S. L. and Kastner C. L. (1995); Cooked Ground Beef Color is Unreliable Indicator of Maximum Internal Temperature, Presentation to American Chemical Society April 6, 1995.

Ingham C. S., Losinski A. J., Becker L. K. and Buege R. D. (2004); Growth of *Escherichia Coli* O157:H7 and *Salmonella* Serovars on Raw Beef, Pork, Chicken, Bratwurst and Cured Corned Beef: Implications for HACCP Plan Critical Limits; *Journal of Food Safety*, **24**(4): 246-256.

Ivatts John (1992); The Case of the School Meals Service; *Social Policy and Administration*, **26**(3): 226-244.

Jang C. H. and Fong U. W. (2004); A Survey of Food Hygiene Knowledge and Attitudes among Chinese Food Handlers in Fong Song Tong District; *Asia Pacific Journal of Public Health*; **16**(2): 121-125.

Jones K.E., Patel N.G., Levy M.A., Storeygard A., Balk D. and Gittleman J. L. (2008); Global trends in emerging infectious diseases; *Nature*; **451**(7181):990-993.

Julian Jensen (2006); Safe Food; *Nutrition and Dietetics*, **63**(2)128–129.

Karsten B., Birgit K., Christof E., Michaela B., Gabriele L., Jerome E. and Georg P. (2001); Enterotoxigenic Potential of *Staphylococcus intermedius*; *Applied and Environmental Microbiology*, **67**(12): 5551-5557.

Kim, T. and Shanklin, C.W. (1999); Time and temperature analysis of a school lunch meal prepared in a commissary with conventional versus cook-chill systems. *Foodservice Research International,* **11**: 237-249.

Knight A. J. and Warland, R. (2005); Determinants of Food Safety risks: A Multi-Disciplinary Approach; *Rural Sociology*; **70**(2): 253-275

Koopmans M., Bonsdorff C., Vinjé J., Medici D. and Monroe S. (2002); Foodborne viruses; *FEMS Microbiology Reviews*, **26**(2): 187-205.

LaGraca Genevieve (1988); Training Foodservice Employees: A Guide to Profitable Training Techniques; Van Nostrand Reinhold, New York.

Larson E., Aiello A., Lee L. V., Della-Latta P., Gomez-Duarte C. and Lin S. (2003); Short- and Long-term Effects of Handwashing with Antimicrobial or Plain Soap in the Community; *Journal of Community Health*, **28**(2): 139 -150.

Larson E. L., Gomez-Duarte C., Lee L. V., Della-Latta P., Kain D. J. and Keswick B. H. (2003); Microbial Flora of Hands of Homemakers; *American Journal of Infection Control*, **31**(2): 72-79.

Legros D. (2004); Shigellosis: Report of a Workshop; *Journal of Health, Population and Nutrition*; Vol. 22, Number 4.

Lin F.Y., Becke J. M., Groves C., Lim B.P., Israel E., Becker E. F., Helfrich R. M., Swetter D. S., Cramton D. and Robbins J. B. (1988); Restaurant-associated Outbreak of Typhoid Fever in Maryland: Identification of Carrier Facilitated by Measurement of Serum Vi Antibodies; *Journal of Clinical Microbiology*, **26**(6): 1194-1197.

Longree K. and Gertrude G. B. (1971); Sanitary Techniques in Food Service; John Wiley & Sons, Inc.

Lynch R. A., Phillips M. L., Elledge B. L., Hanumanthaiah S. and Boatright T. (2005); A Preliminary Evaluation of the Effect of Glove use by Food Handlers in Fast Food Restaurants; *Journal of Food Protection*; **68**(1)187-190.

Mahon D., Cowan C., Henchion M. and Fanning M. (2006); Food-Handling Practices of Irish Beef Consumers; *Journal of Food Safety*, **26**(1)72-81.

Maitai C. K. and Mungai N. N. (2005); Human Poisoning with Plants in Kenya; *The East and Central African Journal of Pharmaceutical Sciences*, **8**(1):10-13.

Makukutu C. A. and Guthrie R. K. (1986); Behavior of Vibrio cholerae in hot foods; *Journal of Applied and Environmental Microbiology*, **52**(4): 824-831.

Mansour J. B., Vriesendorp S. and Ellis A. (2005); Managers who Lead: A Handbook for Improving Health Services; Management Sciences for Health, Cambridge, Massachusetts.

Marriot G. Norman (1985); Principles of Food Sanitation; Van Nostrand Reinhold Company; New York.

Martin C.R.A. (1989); Practical Food Inspection, 9th Edition; H.K. Lewis & Co. Ltd, London.

Mary E. P., Marge H., Mary L. T., John R. A. and Jeffrey P. D. (2001); Multistate Outbreak of *Salmonella* Serovar Muenchen Infections Associated with Alfalfa Sprouts Grown from Seeds Pretreated with Calcium Hypochlorite; *Journal of Clinical Microbiology,* **39**(10): 3461-3465.

Medeiros L., Hillers V., Kendall P. and Mason A. (2001); Evaluation of Food Safety Education for Consumers; *Journal of Nutrition Education*, **33**(1)27-34.

Michaels B., Keller C., Blevins M., Paoli G., Ruthman T., Todd E. and Griffith J. C. (2004); Prevention of Food Worker Transmission of Foodborne Pathogens: Risk Assessment and Evaluation of Effective Hygiene Intervention Strategies; *Food Service Technology*, **4**(1): 31-49.

Mikkelsen E. B. and Søndergård G. K. (2006); Street-level Bureaucrats and the Implementation of Cleaning and Sanitation Practices in Foodservice: Case Findings from a Study in Danish Hospitals and Nursing Homes; *Foodservice Research International*, **17**(1): 49-59.

Ministry of Education Science and Technology (2002); Kenya Education Directory; Express Communications Group Publication; Nairobi, Kenya.

Minor J. Lewis (1989); Sanitation, Safety and Environmental Standards; *The L J Minor Foodservice Standards Series*, Vol. II; AVI Publishing Company Inc.

Montville R., Chen Y. H. and Schaffer D. W. (2001); Glove Barriers to Bacterial Cross-Contamination between Hands to Food; *Journal of Food Protection*, **64**(6): 845-849.

Mugenda M. O. and Mugenda G. A. (2003); Research Methods: Quantitative and Qualitative Approaches; African Centre for Technology Studies (ACTS), Nairobi.

Muleta D. and Ashenafi M. (2001); Salmonella, Shigella and Growth Potential of other Foodborne Pathogens in Ethiopian Street Vended Foods; *The East African Medical Journal*, **78**(11): 576-580.

Muture B.N. and Ogana G. (2005); Aflatoxin Levels in Maize and Maize Products During the 2004 Food Poisoning Outbreaks in Eastern Province of Kenya; *The East African Medical Journal*, **82**(6): 275-279.

Mwangi W. M. (1985); Low Income Food Systems and Food Safety in Kenya: A Case of Kangemi Peri-Urban Area; Discussion Paper Number 278, Institute of Development Studies, University of Nairobi; Nairobi.

Nairobi City Council (1958); The City of Nairobi (Food Shops and Stores) By-laws 1958 (LN. 384/1958); Nairobi City By-laws.

Ngare P., Muindi B. and Kamau W. (2008); Parallel Degree Programme Blamed for Declining Quality of Education; *Daily Nation*; Sunday 24th August, 2008.

Nicholas Johns (1991); Managing Food Hygiene; MacMillan Press Ltd, London.

Okojie O. H., Wagbatsoma V. A. and Ighoroge A. D. (2005); An Assessment of Food Hygiene Among Food Handlers in a Nigerian University Campus; *Nigerian Postgraduate Medical Journal*, **12**(2): 93-96.

Ombui J.N. and Nduhiu J.G. (2005); Prevalence of Enterotoxigenic *Bacillus cereus* and its Enterotoxins in Milk and Milk Products; *The East African Medical Journal*, **82**(6): 280-284.

Ombui J.N., Kagiko M.M. and Arimi S.M. (2001); Foodborne Diseases in Kenya; *The East African Medical Journal*, **78**(1)40-44.

Osornio M. M. L., Hough G., Salvador A., Chambers I. V. E., McGraw S. and Fiszman S. (2008); Beef's optimum internal cooking temperature as seen by consumers from different countries using survival analysis statistics; *Food Quality and Preference*; **19**(1): 12-20.

Owen R. Fennema (1996); Food Chemistry, 3rd Edition; Marcel Dekker Inc, New York, USA.

Özdemir H., Gücükoğlu A. and Pamuk Ş. (2006); Effects of Cetylpyridinium Chloride, Lactic Acid and Sodium Benzoate on Populations of *Listeria Monocytogenes* and *Staphylococcus Aureus* on Beef; *Journal of Food Safety*, **26**(1): 41-48.

Palese A.M., Pasquale V., Celano G., Figliuolo G., Masi S. and Xiloyannis C. (2009); Irrigation of olive groves in Southern Italy with treated municipal wastewater: Effects on microbiological quality of soil and fruits; *Agriculture, Ecosystems & Environment*; **129**(1-3)43-51.

Pemberton C., Buckmire D. and Granderson I. (2004); Assessment of Food Safety Practices of a Children's Home in Trinidad and Tobago Using HACCAP Guidelines; *Foodservice Research International*, **15**(2): 67-77.

Redmond C. E. and Griffith J. C. (2003); A comparison and evaluation of research methods used in consumer food safety studies. *International Journal of Consumer Studies*, **27**(1): 17-33.

Riordan T., Craske J., Roberts J. L. and Curry A. (1984); Food borne infection by a Norwalk like virus (small round structured virus); *Journal of Clinical Pathology*, **37**(7)817-820.

Roday S. (1999); Food Hygiene and Sanitation; Tata McGraw-Hill Publishing Company Limited, New Delhi.

Roger A. S. and Bonnie D. (1998); Food Safety and Food Poisoning; *Postgraduate Medicine*, **103**(6): 125-136.

Santos M. J., Noqueira J. R., Patarata L. and Mayan O. (2008); Knowledge Levels of Food Handlers in Portuguese School Canteens and their Self Reported Behaviour Towards Food Safety; *International Journal of Environmental Health Research*, **18**(6): 387-401.

Satoshi I., Akiko N., Yoshiteru A., Yataro K., Tsutomu M., Akinobu S., Tetsuya Y., Michinori T., Shigeki Y. and Susumu K. (2000); Prevalence and contamination levels of *Listeria monocytogenes* in retail foods in Japan; *International Journal of Food Microbiology*; **59**(1-2): 73-77.

Snyder 0. Peter Junior (1999); The Basics of Cooling Food: USDA Recommendations; Hospitality Institute of Technology and Management; United States.

Snyder 0. Peter Junior (2000); HACCP in Retail Operations Integrating FDA Fisheries, USDA, FDA Industrial, and FDA Retail HACCP into One Set of Retail Food Industry Self-Control Requirements; *Foodservice Research International*, **12**:119-140.

Steven C. I., Jill A. L., Matthew P. A., Jane E. B., Jeffry R. B., Timothy M. W. and Thomas H. W. (2004); *Escherichia coli* Contamination of Vegetables Grown in Soils Fertilized with Noncomposted Bovine Manure: Garden-Scale Studies; *Applied and Environmental Microbiology*, **70**(11): 6420-6427.

Susan Blanch (2003); Food Hygiene, 1st Edition; Hodder and Stoughton.

Teague L. J. and Anderson W. D. (1995); Consumer Preferences for Safe Handling Labels on Meat and Poultry; *The Journal of Consumer Affairs*, **29**(1): 108-127.

Terpstra P. J. (2003); Home hygiene, habits and sustainability in a theoretical framework; *International Journal of Consumer Studies*, **27**(3): 218-251.

Todd, E. C. D., Greig J. D., Bartleson C. A., and Michaels B. S. (2007); Outbreaks Where Food Workers Have Been Implicated in the Spread of Foodborne Disease; *Journal of Food Protection*, **70**:1975-1993

Trikett Jill (2002); Food Hygiene for Food Handlers; MacMillan Press Ltd.

Troller A. J. (1993); Personal Hygiene: Sanitation in Food Processing, 2nd Edition; Academic Press Inc.

Uhlich A. G., Luchansky B. J., Tamplin L. M., Molina-Corral J. F., Anandan S. and Porto-Fett C. S. A. (2006); Effect of Storage Temperature on the Growth of *Listeria Monocytogenes* on Queso Blanco Slices; *Journal Of Food Safety*, **26**(3): 202-214.

United Nations (2008); Millennium Development Goals: Recent Gains in Eradicating Hunger and Poverty Endangered by Economic and Food Crises; Geneva. Available from: http://www.un.org/millenniumgoals/

United States Department of Agriculture (1998); Premature Browning of Cooked Ground Beef; Food Safety and Inspection Service Public Meeting on Premature Browning of Ground Beef Report; USDA, Washington, D.C.

United States Department of Agriculture (2006); Food Safety Education for the Prevention of Foodborne Illness Among U.S. Residents 65 and Older; Available from: http://www.reeis.usda.gov/web/crisprojectpages/193103.html

Unnevehr L.J. and Jensen H.H. (1999); The economic implications of using HACCP as a food safety regulatory standard; *Food Policy*, **24**(6): 625-635.

Walker E., Pritchard C. and Forsythe S. (2003); Food Handlers' Hygiene Knowledge in Small Food Businesses; *Food Control Journal*, **14**(5): 339-343.

Walsh C., Duffy G., Sheridan J., Fanning S., Blair I. S. and McDowell D. A. (2005); Thermal Resistance of Antibiotic-Resistant and Antibiotic-Sensitive Salmonella Species on Chicken Meat; *Journal of Food Safety*, **25**(4)288-302.

Wang H. H., Manuzon M., Lehman M., Wan K., Luo H., Wittum T. E., Yousef A. and Bakaletz L. O. (2006); Food commensal microbes as a potentially important avenue in transmitting antibiotic resistance genes; *FEMS Microbiology Letters*, **254:** (2)226-231.

White C., Kolble R., Carlson R., Lipson N., Dolan M., Ali Y. and Cline M. (2003); The Effect of Hand Hygiene on Illness Rate Among Students in University Residence Halls; *American Journal of Infection Control*, **31**(6)364-370.

Williams T., Moon A. and Williams M. (1990); Food, Environment and Health: A Guide for Primary School Teachers; WHO, Geneva.

World Health Organisation (1992); Evaluation of Certain Food Additives and Naturally Occurring Toxicants; *WHO Technical Report Series*, Number 828.

World Health Organisation (1999); Food Safety Issues Associated with Products from Aquaculture; *WHO Technical Report Series*, Number 883.

World Health Organisation (1989); Health Surveillance and Management Procedures for Food-handling Personnel; *WHO Technical Report Series*.

World Health Organisation (2004); Kenya Country Office Annual Report.

World Health Organisation (1997); Surveillance of Foodborne Diseases: What Are the Options? *Food Safety Issues*, WHO/FSF/FOS/96.3.

World Health Organisation (1984); The Role of Food Safety in Health and Development; *WHO Technical Report Series*, Number 705.

World Health Organization (2007); Report on WHO Initiative to Estimate the Global Burden of Foodborne Diseases; Geneva. Available from: http://www.who.int/foodsafety/publications/foodborne_disease/burden_nov07/en/index.html

World Health Organization (2008); Report on Review of Toxicological Aspects of Melamine and Cyanuric Acid Contamination,; Ottawa, Canada. Available: http://www.who.int/foodsafety/fs_management/infosan_events/en/index.html

World Health Organization (2008); Report on the Global Burden of Disease; Geneva. Available from: http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf

Worsfold D. (2006); Consumer information on hygiene inspections of food premises; *Foodservice Research International*, **17**(1): 23-31.

Worsfold D. and Griffith J. C. (2003); Widening HACCP Implementation in the Catering Industry; *Food Service Technology*, **3**(3-4).

Wu C. V. and Fung Y. D. (2006); Simultaneous Recovery and Detection of Four Heat-Injured Foodborne Pathogens in Ground Beef and Milk by a Four-Compartment Thin Agar Layer Plate; *Journal of Food Safety*, **26**(2): 126-136.

APPENDICES

Appendix A

Consent Explanation for food handlers (READ BEFORE THE KAQ)

My name is ____ and with me is _____. We are from the Department of Community Health, University of Nairobi. We are carrying out a study on '**An Audit of Food Safety Practices within the Schools and Higher Learning Institutions of Nairobi**'. This study is being conducted for the partial fulfillment of the requirements of the degree of Master of Public Health programme of the University of Nairobi and your institution was randomly selected to participate in the study.

We kindly ask for some of your time (approximately 20 minutes) and need you to respond to some of our questions. Most of the questions we are going to ask concern food handling which we believe you carry out every day.

Nothing you say in the interview will affect you or your institution in any way. The interview is completely anonymous and information obtained in this study that can be identified with you will remain confidential. You do not have to give me an answer to any questions that you do not wish to respond to, however, your honest responses to these questions will give us a better understanding of food handling in academic institutions.

Regarding the language, we would like you to feel free to use either English or Kiswahili.

Respondent's consent

I _____ declare that:

I have heard and understood the consent explanation above;

I have voluntarily agreed to participate in this study;

I may withdraw my consent at any time and discontinue participation without penalty;

I have received a copy of this form;

I am not waiving any legal claims, rights or remedies.

Signature_____ Date _____

Appendix B

Food safety knowledge assessment questionnaire (KAQ)

An Audit of Food Safety Practices within the Schools and Higher Learning Institutions of Nairobi

Institution's number _____ Participants number _____ Date _____ Time ____

Researcher: _____

Research Assistant: _____

Q1. Institution's group _____ Q2. Participant's category _____

We will start by asking a few personal questions.

Q3. What is your professional background?

1. Food handling (Proceed to Q5)
2. Administration (Proceed to Q4)
3. Education (Proceed to Q4)
4. Others (specify) _____ (Proceed to Q4)
5. Don't know (Proceed to Q4)
6. No response (Proceed to Q4)

Q4. If NOT 1, have you attended any food handling training?

(DON'T READ OUT – accept ONLY ONE response)

1. Yes (Proceed to Q5)
2. No (Proceed to Q6)
3. Don't know (Proceed to Q6)
4. No response(Proceed to Q6)

Q5. What is your highest level of food handling training?

(DON'T READ OUT – accept ONLY ONE response)

1. Degree
2. Diploma
3. Certificate
4. Others (Specify) _____

5. Don't know
6. No response

Q6. For how long have you served in this position?

1. More than 5 years
2. Less than 5 years
3. Don't know
4. No response

The next few questions are on procurement of food items and staffing.

Q7. What would be your NUMBER ONE consideration when sourcing food items?

(DO NOT READ OUT – accept only ONE response)

1. If the food is inspected and certified fit for human consumption (Proceed to Q8)
2. If the source is of good reputation (Proceed to Q9)
3. If the prices are cheap (Proceed to Q9)
4. Others (specify) _____ (Proceed to Q9)
5. Don't know (Proceed to Q9)
6. No response (Proceed to Q9)

Q8. If 1, what would be your most important reason for doing so?

(DO NOT READ OUT – accept only ONE response)

1. To ensure food safety
2. To ensure authenticity of the food
3. It is a regulatory requirement
4. To ensure nutritional quality
5. It is economical
6. Others (specify) _____

Q9. Should water being used for food preparation be treated?

(DON'T READ OUT, accept ONLY ONE response)

1. Yes (Proceed to Q10)
2. No (Proceed to Q11)
3. Don't know (Proceed to Q11)

4. No response (Proceed to Q11)

Q10. What is the importance of treating water used for food preparation?

(DON'T READ OUT, accept MULITPLE responses)

1. Kill disease causing germs
2. Make the water clean
3. Improve its taste
4. Improve its appearance
5. It is a requirement
6. Others (Specify) _____
7. Don't know
8. No response

Q11. Which would be your consideration when hiring a FSO?

(DO NOT READ OUT – accept MULTIPLE responses)

1. Professional qualifications
2. Academic qualifications
3. Experiences
4. Physical fitness
5. Medical fitness
6. Age
7. Sex
8. Ethnicity
9. Personnel costs
10. Others (specify) _____
11. Don't know
12. No response

The next few questions are on general knowledge of safe food handling.

Q12. Have you heard the term safe food handling?

(DO NOT READ OUT, accept ONE response)

1. Yes (Proceed to Q13)
2. No (Proceed to Q15)
3. Don't know (Proceed to Q15)

4. No response (Proceed to Q15)

Q13. If YES, what does safe food handling involve?

(DO NOT READ OUT, accept MULITPLE responses)

1. Purchasing from licensed outlets
2. Proper storage
3. Good health of food handlers
4. Adequate preparation and cooking
5. Good food handler habits
6. Proper sanitation
7. Others (Specify) _____
8. Don't know
9. No Response

Q14. What problems are likely to be encountered if safe food handling is not adhered to?

(DO NOT READ OUT, accept MULITPLE responses)

1. Food borne disease outbreaks
2. Food spoilages
3. Bad reputation for the institution
4. Closure of the institutions
5. Student riots
6. Others (Specify) _____
7. Don't know
8. No Response

The next few questions are about food storage.

Q15. Under what conditions should dry food items such as cereals be stored?

(DO NOT READ OUT, accept MULITPLE responses)

1. In a dry and cool place
2. Screened store from pests
3. In a ventilated store
4. In a well lit store
5. In a clean and tidy place

6. Raised above the floor and away from the wall
7. Others (specify) _____
8. Don't know
9. No response

Q16. How do you tell whether stored food items have become unfit for consumption?

(DO NOT READ OUT, accept MULITPLE responses)

1. When they are passed the use by date
2. When they have signs of spoilage such as moulds
3. When they are spoilt by pests
4. Others (specify) _____
5. Don't know
6. No response

Q17. Are there food items that need to be kept chilled or frozen?

(DO NOT READ OUT, accept only ONE response)

1. Yes (Proceed to Q18)
2. No (Proceed to Q22)
3. Don't know (Proceed to Q22)
4. No response (Proceed to Q22)

Q18. Which foods items should be kept chilled or frozen?

(DON'T READ OUT, accept MULITPLE responses)

1. Meats: Beef, fish and poultry products; dairy products
2. Vegetables and fruits
3. Cereals e.g. beans, maize, rice, peas, etc
4. Pastries
5. Others (specify) _____
6. Don't know
7. No response

Q19. At what temperature should chilled food be stored at?

(DO NOT READ OUT, accept only ONE response)

1. 5^0C or less

2. Above 5^0C
3. Don't know
4. No response

Q20. At what temperature should frozen food be stored at?

(DO NOT READ OUT, accept only ONE response)

1. Below -18^0C
2. Above -18^0C
3. Don't know
4. No response

Q21. What is the MOST important reason for keeping these food items chilled or frozen?

(DO NOT READ OUT, accept only ONE response)

1. Prevent contamination due to growth of pathogens
2. Avoid altering the value (flavour, taste, colour, etc) of the foods
3. It is a regulation
4. Other (specify) _____
5. Don't know
6. No response

Q22. Where should non-food items such as sanitizers, pesticides and chemicals be kept?

(DO NOT READ OUT, accept only ONE response)

1. Separate room from the food items (Proceed to Q23)
2. Food store (Proceed to Q24)
3. Don't know (Proceed to Q24)
4. No response (Proceed to Q24)

Q23. If 1, why is it so?

(DO NOT READ OUT, accept only ONE response)

1. Protect food from possible contamination
2. Create more space for the food stuffs
3. So that the store looks neat
4. Others (specify) _____

5. Don't know
6. No response

The next few questions are about food service processes.

Q24. What method(s) do you know that can be used to thaw frozen foods?

(DO NOT READ OUT - accept MULTIPLE responses)

1. In a microwave oven, under cold running water, in the refrigerator or as part of the cooking process (Proceed to Q25)
2. On the table at room temperature (Proceed to Q26)
3. Others (specify) _____ (Proceed to Q26)
4. Don't know (Proceed to Q26)
5. No response (Proceed to Q26)

Q25. If 1, why is it necessary to thaw food items that way?

(DO NOT READ OUT - accept only ONE response)

1. Prevent contamination due to growth of pathogens
2. Avoid altering the value (flavour, taste, colour, etc) of the foods
3. It is a regulation
4. Other (specify) _____
5. Don't know
6. No response

Q26. How would you best know if food is safely cooked?

(DO NOT READ OUT - accept MULTIPLE responses)

1. Use a thermometer probe
2. When specified time has been achieved
3. Look for colour change
4. Feel for consistency
5. When all the water has evaporated
6. Others (specify) _____
7. Don't know
8. No response

Q27. Are there cooked food items that should be held in a food warmer?

(DO NOT READ OUT - accept MULTIPLE responses)

1. Yes (Proceed to Q28)
2. No (Proceed to Q31)
3. Don't know (Proceed to Q31)
4. No response (Proceed to Q31)

Q28. If YES, which of the following food item(s) should be held in a food warmer? (READ OUT, accept MULITPLE responses)

1. Cooked cereals
2. Cooked poultry products
3. Peanut butter
4. Cooked beef products

Q29. What is the MOST important reason for holding these food items in a food warmer?

(DO NOT READ OUT - accept MULTIPLE responses)

1. To keep them safe from microbial contamination
2. To keep their nutritional qualities
3. To make them more palatable (temperature, taste, colour, consistency)
4. It is a regulation
5. Other (specify) _____
6. Don't know
7. No response

Q30. What is the recommended temperature at which food should be held in a food warmer? (IF NECESSARY: "What is your best guess?")

(DO NOT READ OUT - accept only ONE response)

1. 60^0C and above
2. Below 60^0C
3. Don't know
4. No response

Q31. Are there ready-to-eat food items that should be served chilled?

(DO NOT READ OUT - accept MULTIPLE responses)

1. Yes (Proceed to Q32)
2. No (Proceed to Q34)

3. Don't know (Proceed to Q34)
4. No response (Proceed to Q34)

Q32. If YES, what is the MOST important reason for serving these food items chilled?

(DO NOT READ OUT - accept MULTIPLE responses)

1. To keep them safe from microbial contamination
2. To keep their nutritional qualities
3. To make them more palatable (temperature, taste, colour, consistency)
4. It is a regulation
5. Other (specify) _____
6. Don't know
7. No response

Q33. What is the recommended temperature at which food should be held in a food warmer? (IF NECESSARY: "What is your best guess?")

(DO NOT READ OUT - accept only ONE response)

1. 5^0C and below
2. Above 5^0C
3. Don't know
4. No response

Q34. How should ready-to-eat foods be handled?

(DON'T READ OUT, accept MULITPLE responses)

1. Using barriers (Single use gloves, serviettes, tongs, spoons) (Proceed to Q35)
2. Bare hands (Proceed to Q36)
3. Others (specify) _____ (Proceed to Q36)
4. Don't know (Proceed to Q36)
5. No response (Proceed to Q36)

Q35. If 1, what is the MOST important reason for using these barriers?

(DON'T READ OUT, accept only ONE response)

1. To keep them safe from microbial contamination
2. To keep their nutritional qualities

3. To appear more presentable to the customers
4. It is a regulation
5. Other (specify) _____
6. Don't know
7. No response

Q36. Should raw foods be separated from ready-to-eat foods?

(DON'T READ OUT, accept only ONE response)

1. Yes (Proceed to Q37)
2. No (Proceed to Q38)
3. Don't Know (Proceed to Q38)
4. No response (Proceed to Q38)

Q37. If YES, what is the MOST important reason for doing so?

(DON'T READ OUT, accept only ONE response)

1. Prevent contamination of the ready-to-eat foods
2. Avoid making ready-to-eat foods dirty
3. Avoid altering the flavour of the ready-to-eat foods
4. It is a regulation
5. Other (specify) _____
6. Don't know
7. No response

The next few questions are about cleaning.

Q38. What should be the temperature of the final rinse in a dishwasher?

(DON'T READ OUT - accept ONE response only)

1. 70°Celsius and above (Proceed to Q39)
2. Below 70° Celsius (Proceed to Q40)
3. Don't know (Proceed to Q40)
4. No response (Proceed to Q40)

Q39. If 1, what is the MOST important reason for setting this temperature of the final rinse?

(DON'T READ OUT, accept only ONE response)

1. To kill the food contaminating pathogens

2. To remove the detergents from the utensils
3. To make the utensils look cleaner
4. It is a regulation
5. Other (specify) _____
6. Don't know
7. No response

Q40. Do you know of any sanitizers for washing utensils?

(DON'T READ OUT, accept only ONE response)

1. Yes (Proceed to Q41)
2. No (Proceed to Q42)
3. Don't know (Proceed to Q42)
4. No response (Proceed to Q42)

Q41. If YES, which one(s) do you know?

(DON'T READ OUT, accept MULTIPLE responses)

1. Chlorine
2. Iodine
3. Quaternary ammonium compounds
4. Hot water
5. Others (specify) _____
6. Don't know
7. No response

Q42. Do rodents (e.g. rats, mice) and insects (e.g. cockroaches, and flies) present any problem in the food premise?

(DON'T READ OUT, accept only ONE response)

1. Yes (Proceed to Q43)
2. No (Proceed to Q44)
3. Don't know (Proceed to Q44)
4. No response (Proceed to Q44)

Q43. If YES, What are the problems caused by these rodents and insects?

(DON'T READ OUT - accept MULTIPLE responses)

1. Contamination of food

2. Spoilage of stored food
3. Are unaesthetic
4. Make the food dirty
5. Eating the food in store
6. Others (specify) _____
7. Don't know
8. No response

Q44. How should the rodents, insects and animals be controlled from the food premises?

(DON'T READ OUT - accept MULTIPLE responses)

1. Clean kitchen environment
2. Construct barriers e.g. screens
3. Good housekeeping
4. Contract professional exterminators
5. Use pesticides
6. Use rodent and insect traps
7. Keep cats and dogs
8. Kill them manually
9. Others (Specify) _____
10. Don't know
11. No response

Q45. Is kitchen environment supposed to be restricted to non food handlers?

(DON'T READ OUT, accept only ONE response)

1. Yes (Proceed to Q46)
2. No (Proceed to Q47)
3. Don't know (Proceed to Q47)
4. No response (Proceed to Q47)

Q46. Which is the MAJOR reason why non-food handlers should not be allowed into the food preparation area?

(DO NOT READ OUT – accept only ONE response)

1. Possible contamination of food

2. Prevent disappearance of food
3. Not to distract the food handlers
4. Maintain kitchen recipes secret
5. Others (specify) _____
6. Don't know
7. No response

The next few questions are about personal hygiene.

Q47. Which of the following personal habits are good for food handlers?

(READ OUT - accept MULTIPLE responses)

1. Bathing every day before and after work
2. Keeping short trimmed nails
3. Wearing jewels, make ups and nail polish at work
4. Eating, drinking, and smoking while working
5. Use perfumes
6. Properly trim beards

Q48. How should food handlers be dressed while on duty?

(DON'T READ OUT, accept only ONE response)

1. Put on clean outer protective gear (Proceed to Q49)
2. Put on clean presentable/smart personal clothing (Proceed to 50)
3. Others (specify) _____ (Proceed to 50)
4. Don't know (Proceed to 50)
5. No response (Proceed to 50)

Q49. If 1, which is the MOST important reason for this?

(DO NOT READ OUT - accept only ONE response)

1. Protect food from contamination
2. So that they look smart
3. It is a regulation from the authorities
4. So that they don't soil their personal clothes
5. Other (specify) _____
6. Don't know
7. No response

Q50. When should a person wash hands within the food premise?

(DO NOT READ OUT - accept MULTIPLE responses)

1. After visiting the sanitary conveniences
2. After smoking
3. Before handling any food
4. After handling food
5. When changing from one food to the next
6. Before changing gloves or touching utensils
7. After touching exposed body parts
8. After shaking hands
9. Others (specify) _____
10. Don't know
11. No response

Q51. What are the necessities needed for proper hand washing?

(DO NOT READ OUT - accept MULTIPLE responses)

1. Clean hot water
2. Clean cold water
3. Soap
4. Hand sanitizers
5. Single use paper tissues
6. Others (specify) _____
7. Don't know
8. No response

The next few questions are about health.

Q52. Do you know that it is necessary for food handlers to undergo medical examination before being employed in a public food premise?

(DON'T READ OUT, accept only ONE response)

1. Yes (Proceed to Q53)
2. No (Proceed to Q55)
3. Don't know (Proceed to Q55)
4. No response (Proceed to Q55)

Q53. If YES, what is the MAJOR reason for this medical examination? (DON'T READ OUT - accept ONE response only)

1. So that they don't contaminate food (Proceed to Q54)
2. To avoid missing work due to sickness (Proceed to Q55)
3. The work is physical and require healthy people (Proceed to Q55)
4. Others (specify) _____ (Proceed to Q55)
5. Don't know (Proceed to Q55)
6. No response (Proceed to Q55)

Q54. If 1, which of the following disease(s) are food handlers LIKELY to pass to clients when sick in the course of their duty? (READ OUT - accept MULTIPLE responses)

1. HIV/AIDS
2. Chest infections
3. Diarrhoeal illness
4. Skin / wound infections
5. Urinary tract infections

Q55. If a food handler developed a cough, diarrhoea or cold while on duty, what should be done? (DO NOT READ OUT – accept only ONE response)

1. Take off-duty till well
2. Relocate to areas not in contact with clients
3. Continue working while treating yourself
4. Other (specify) _____
5. Don't know
6. No response

Thank you very much for your time and responses, however, should we need more clarification on these responses, we hope you won't mind us getting back to you.

Appendix C

Food safety practices observation checklist (POC)

An Audit of Food Safety Practices within the Schools and Higher Learning Institutions of Nairobi

Institution's group _____ Institution's number _____ Date _____ Time _____

Researcher: _____

Research Assistants: _____

For each of the critical control points (CCPs) / food service procedures (FSPs), make observations of the food handling practices listed. Record your observations against the CCPs / FSPs by CLEARLY TALLYING as below:

1. "YES" where safe food handling practice is adhered to, and
2. "NO" where safe food handling practice is not adhered to.

NOTE:

- CLEARLY mark "NS" on the appropriate row where the practice is not observed and "NA where the practice does not apply to the institution.
- If you don't observed any CCPs / FSOs and it is applicable to the institution, please ask for a demonstration from the concerned staff and tally against "YES" or "NO" depending on how the demonstration is carried out. However, mark "NS" where the staff declines.

CCPs / FSPs	PRACTICES OBSERVED	TALLY		TOTAL	%
I. **Storage**					
1. Dry Storage	1. Labeling	YES			
		NO			
	2. Stock Rotation	YES			
		NO			
	3. Cleaning Spillages	YES			
		NO			
	4. Opened Packages	YES			
		NO			
	5. Separation	YES			
		NO			
2. Cold Storage	6. Labeling	YES			
		NO			
	7. Stock Rotation	YES			
		NO			
	8. Correct Temperature	YES			

	Setting Maintained	NO			
	9. Separation	YES			
		NO			
	10. Lids Usage	YES			
		NO			
3. Freeze Storage	11. Labeling	YES			
		NO			
	12. Stock Rotation	YES			
		NO			
	13. Correct Temperature Setting Maintained	YES			
		NO			
	14. Separation	YES			
		NO			
	15. Lids Usage	YES			
		NO			
4. Non-foods Storage	16. Separate Storage	YES			
		NO			
	17. Labeling	YES			
		NO			
II. Food Service					
5. Processing	18. Separation	YES			
		NO			
6. Thawing	19. Refrigerator Thawing	YES			
		NO			
	20. Hot Water Thawing	YES			
		NO			
	21. Microwave Thawing	YES			
		NO			
7. Cooking and Reheating	22. Cooking Temperatures	YES			
		NO			
	23. Cooking Duration	YES			
		NO			
	24. Tasting	YES			
		NO			
8. Hot Holding	25. Food Warmer Setting	YES			
		NO			
9. Ambient Holding	26. Holding Duration	YES			
		NO			
10. Cold Holding	27. Ice Bath Setting	YES			
		NO			
11. Cooling	28. Cooling Duration	YES			
		NO			
	29. Cooling Pans Usage	YES			
		NO			
	30. Ice-Water Bath Cooling	YES			
		NO			
12. Food Protection During Service	31. Lid Usage	YES			
		NO			
	32. Sneeze Guards	YES			
		NO			
13. Ready-to-eat Foods	33. Separation From Raw Foods	YES			
		NO			
	34. Handling Utensils	YES			

		NO			
II. Cleaning					
14. Washing Utensils	35. Pre-rinsing	YES			
		NO			
	36. Washing	YES			
		NO			
	37. Rinsing	YES			
		NO			
	38. Sanitizing	YES			
		NO			
	39. Drying	YES			
		NO			
	40. Dishwasher Settings	YES			
		NO			
15. Food Area	41. Food Surfaces	YES			
		NO			
	42. Waste Bins	YES			
		NO			
	43. Floor Cleaning	YES			
		NO			
	44. Usage of Chopping boards	YES			
		NO			
	45. Usage of Preparation Utensils	YES			
		NO			
16. Pest Control	46. Clearing Spillages	YES			
		NO			
	47. Closing Shutters	YES			
		NO			
	48. Waste Disposal	YES			
		NO			
	49. Usage of Pesticides	YES			
		NO			
IV. Personal Hygiene					
17. Personal Habits	50. Bathing	YES			
		NO			
	51. Touching the Body	YES			
		NO			
	52. Smoking, Eating	YES			
		NO			
	53. Sneezing	YES			
		NO			
	54. Shaking Hands	YES			
		NO			
18. Clothing	55. Usage of Uniforms	YES			
		NO			
	56. Head Scarves	YES			
		NO			
	57. Foot Wear	YES			
		NO			
	58. Jewels	YES			
		NO			
	59. Perfumes	YES			
		NO			

	60. Nails	YES			
		NO			
	61. Beards	YES			
		NO			
19 Hand Hygiene	62. Timings of Hand Washing	YES			
		NO			
	63. Washing Process	YES			
		NO			
	64. Drying	YES			
		NO			
	65. Sanitizing	YES			
		NO			
	66. Usage of Food Handling Utensils	YES			
		NO			
V. Health					
20 Staff Illness	67. Coughing	YES			
		NO			
	68. Wounds	YES			
		NO			
	69. Diarrhoea	YES			
		NO			
	70. Colds	YES			
		NO			
	71. Skin Rashes	YES			
		NO			

Appendix D

Food Safety equipments evaluation log (EEL)

An Audit of Food Safety Practices within the Schools and Higher Learning Institutions in Nairobi

Researcher: _____ Date: _____ Time: ____ Institution: _____ Group: __

For each of the critical control points (CCPs) / food service procedures (FSPs), evaluate their facilities' conditions in relation to the specified requirements for safe food handling. Make notes by CLEARLY CIRCLING as below:

1. "Y" where the facility's condition meets the specified requirements,
2. "N" where the facility's condition does not meet the specified requirements,
3. "NS" where the facility is present but evaluation is not done,
4. "A" Where the facility is applicable but not available in the institution, and
5. "NA" where the facility does not apply to the institution.

Note: If for one reason or the other you are unable to evaluate a facility such as lack of access, yet it exists in the institution, please ask for assistance from the food handlers and tally against "YES" or "NO" depending on the facility condition and "NS" where the assistance is not offered.

CCPs / FSPs	FACILITIES	EVALUATION				
I. Storage						
1. Dry Storage	1. Shelves / Racks	Y	N	NS	A	NA
	2. Ventilation	Y	N	NS	A	NA
	3. Lighting	Y	N	NS	A	NA
	4. Screens	Y	N	NS	A	NA
	5. Roof	Y	N	NS	A	NA
	6. Cleanliness	Y	N	NS	A	NA
2. Cold Storage	7. Temperature Gauge	Y	N	NS	A	NA
	8. Separators	Y	N	NS	A	NA
	9. Doors	Y	N	NS	A	NA
3. Freeze Storage	10. Temperature Gauge	Y	N	NS	A	NA
	11. Separators	Y	N	NS	A	NA
	12. Doors	Y	N	NS	A	NA
4. Non-Food Items Storage	13. Separate Store	Y	N	NS	A	NA
	14. Labels	Y	N	NS	A	NA
II. Food Service						

5. Thawing	15. Refrigerator	Y	N	NS	A	NA
	16. Running Potable Water	Y	N	NS	A	NA
	17. Microwave	Y	N	NS	A	NA
6. Cooking and Reheating	18. Food Thermometers	Y	N	NS	A	NA
	19. Cooking Timers	Y	N	NS	A	NA
7. Holding	20. Food Warmers	Y	N	NS	A	NA
	21. Ice Baths	Y	N	NS	A	NA
8. Cooling	22. Cooling Pans	Y	N	NS	A	NA
	23. Water Baths	Y	N	NS	A	NA
9. Ready-To-Eat Foods	24. Single Use Gloves	Y	N	NS	A	NA
	25. Serving Utensils	Y	N	NS	A	NA
	26. Serviettes	Y	N	NS	A	NA
III. Cleaning						
10. Washing Utensils	27. Hot Water	Y	N	NS	A	NA
	28. Soap	Y	N	NS	A	NA
	29. Running Cold Water	Y	N	NS	A	NA
	30. Dishwasher Manual	Y	N	NS	A	NA
	31. Sink	Y	N	NS	A	NA
11. Drying	32. Drain Board	Y	N	NS	A	NA
12. Sanitizing	33. Hot Water	Y	N	NS	A	NA
	34. Chemical Sanitizers	Y	N	NS	A	NA
	35. Chemical Test Strips	Y	N	NS	A	NA
13. Food Area	36. Food Surfaces	Y	N	NS	A	NA
	37. Ventilation Hoods and Filters	Y	N	NS	A	NA
	38. Hand Washing Sinks	Y	N	NS	A	NA
	39. Waste Containers	Y	N	NS	A	NA
	40. Floor	Y	N	NS	A	NA
	41. Chopping boards	Y	N	NS	A	NA
	42. Processing Utensils	Y	N	NS	A	NA
14 Pest Control	43. Screens	Y	N	NS	A	NA
	44. Pesticide	Y	N	NS	A	NA
	45. External Waste Containers	Y	N	NS	A	NA
IV. Personal Hygiene						
15. Personal Habits	46. Bathrooms	Y	N	NS	A	NA
	47. Restrooms	Y	N	NS	A	NA
	48. Lavatories	Y	N	NS	A	NA
	49. Work Schedules	Y	N	NS	A	NA
16. Clothing	50. Dust Coats / Work Uniforms	Y	N	NS	A	NA
	51. Shoes	Y	N	NS	A	NA
	52. Chef Caps	Y	N	NS	A	NA
	53. Neck Scarf	Y	N	NS	A	NA
17. Hand Washing	54. Instruction Posters	Y	N	NS	A	NA
	55. Sinks	Y	N	NS	A	NA
	56. Soaps	Y	N	NS	A	NA
	57. Single Use Towels / Serviettes	Y	N	NS	A	NA
V. Health						
18. Health	58. First Aid Box	Y	N	NS	A	NA
	59. Medical Examination Records	Y	N	NS	A	NA

Appendix E

Criteria for evaluating the food safety equipments

CCPs / FSPs	FACILITIES	CRITERIA FOR EVALUATION
I. Storage		
19. Dry Storage	• Shelves / Racks	Should be 15 centimetres off the floor and 45 centimetres away from the walls
	• Ventilation	Ventilated, dry and cool
	• Labels	Use-by and receipt date labels
	• Lighting	Well lit
	• Screens	Able to keep off targeted pests/animals
	• Roof	Not leaking
20. Cold Storage	• Temperature Gauge	Fridge gauge
	• Labels	Use-by and receipt date labels
	• Separators	Three fridges or one fridge with three shelves.
	• Doors	Airtight seals
21. Freeze Storage	• Temperature Gauge	Freezer gauge
	• Labels	Use-by and receipt date labels
	• Separators	Moisture-proof and airtight materials
	• Doors	Doors with airtight seals
22. Non-Food Items Storage	• Store	Separate store
	• Labels	Content, instructions and warning labels
II. Food Service		
23. Thawing	• Refrigerator	Working condition
	• Water	Potable, running and at 24^{0}C
	• Microwave	Working condition
24. Cooking and Reheating	• Food Thermometers	Working food thermometers
	• Cooking Timers	Working timers
25. Holding	• Food Warmers	Working gauge
	• Ice Baths, cold displays	Sufficient
26. Cooling	• Cooling Pans	Sufficient
	• Water Baths	Sufficient
27. Ready-To-Eat Foods	• Single Use Gloves	Sufficient
	• Serving Utensils	Sufficient
	• Serviettes	Sufficient
III. Cleaning		
28. Washing Utensils	• Hot Water	Sufficient
	• Soap	Sufficient
	• Running Cold Water	Sufficient
	• Dishwasher Manual	Available
	• Sink	Three compartment sink
29. Drying	• Drain Board	Accommodates all utensils
30. Sanitizing	• Hot Water	At least 82^{0}C
	• Chemical Sanitizers	Available with instructions
	• Chemical Test Strips	Available
31. Food Area	• Food Surfaces	Impervious and smooth
	• Ventilation and Hoods	Installed
	• Hand Washing Sinks	Present and convenient

	• Waste Containers	Present
	• Floor	Impervious and smooth
32. Pest Control	• Screens	Present
	• Pesticide	Present
	• Waste Bins	Present
IV. Personal Hygiene		
33. Personal Habits	• Bathrooms	Present and has water, soap and towels
	• Restrooms	Clean and provided with sinks, single-use towels, waste containers, and soap dispensers
	• Lavatories	Convenient with sinks
	• Work Schedules	Present
34. Clothing	• Work Uniforms	Available and provided for
	• Shoes	Available and provided for
	• Chef Caps	Available and provided for
	• Neck Scarf	Available and provided for
35. Hand Washing	• Instruction Posters	Present
	• Sinks	Present with running potable water
	• Soaps	Sufficient
	• Single Use Towels	Sufficient
V. Health		
36. Health	• First Aid Box	Present and equipped
	• Medical Examination	Certificates and records

Appendix F

The criteria for evaluating the food safety practices

CCPs / FSPs	PRACTICES	"YES" CRITERIA
I. Storage		
21. Dry Storage	• Labeling	Label stock with use-by and receipt dates
	• Stock Rotation	Adoption of First-In-First-Out stock rotation
	• Cleanliness	The store is free from spillages, dust, litter etc
	• Packages	Opened food packages should be stored in labelled containers with tight-fitting lids
	• Separation	Raw foods separated from ready-to-eat foods
22. Cold Storage	• Labeling	Label stock with use-by and receipt dates
	• Stock Rotation	Adoption of First-In-First-Out stock rotation
	• Temperature	Set between 1°C - 5°C
	• Separation	Keep the raw meats and fish; cooked foods; and dairy products in different fridges or in case of only one fridge, raw meat and fish at the bottom shelves, cooked foods on the centre shelves, and dairy products on the top shelves
	• Lids Usage	Properly covered food to avoid any drip contamination
23. Freeze Storage	• Labeling	Label stock with use-by and receipt dates
	• Stock Rotation	Adoption of First-In-First-Out stock rotation
	• Temperature	Set at -18°C or less
	• Separation	Food items should be wrapped in moisture-proof and airtight materials
24. Non-foods Storage	• Storage	Stored separate from food and utensils
	• Labeling	Properly-labelled with contents, instructions and warnings
II. Food Service		
25. Processing	• Separation	Raw foods should be processed separately from ready-to-eat foods
26. Thawing	• Method	Thawing in the refrigerator; under running potable water at a temperature of 24°C; in a microwave oven; or as a cooking process
27. Cooking and Reheating	• Temperatures	Observation of recommended internal cooking temperatures
	• Duration	Observation of recommended durations
28. Hot Holding	• Food Warmer	Keeping food above 65°C
29. Ambient Holding	• Duration	Should be held for not more than 2 hours
30. Cold Holding	• Method	Keeping food below 5°C
31. Cooling	• Duration	Cool hot foods from 65°C to 20°C within 2 hours and from 20°C to 5°C within 4 hours
32. Food Protection during service	• Method	Cover food with lids or sneeze guards
33. Ready-to-eat Foods	• Handling	Handle using food handling barriers
III. Cleaning		
34. Washing Utensils	• Pre-rinsing	Using plain water
	• Washing	Use soap and hot water

	• Rinsing	Using plain water
	• Sanitizing	Complete immersion of the utensils into water at least 82°C for at least 30 seconds or into a sanitising solution
	• Drying	Drip or air drying
	• Dishwasher Settings	Temperature, detergent and sanitizer settings conform to the manual
35. Food Area	• Food Surfaces	Cleaning and sanitising
	• Waste Bins	Keeping exterior garbage containers tightly closed, removing food wastes and spills promptly, and disposing food wastes in tightly sealed bags
	• Floor Cleaning	Kept clean
36. Pest Control	• Clearing Spillages	Removing all piles of rubbish and spillages from the premises
	• Closing Shutters	Closing external doors and screening all windows and openings
	• Usage of Pesticides	Use of an approved pesticides, baits and traps away from any food or food contact surface.
IV. Personal Hygiene		
37. Personal Habits	• Bathing	Bathing daily
	• Smoking, Eating	Avoid eating, drinking or smoking in the food preparation area
	• Sneezing	Sneezing away from food and onto a handkerchief
38. Clothing	• Usage of Uniforms	Putting on clean, washable and white work uniforms
	• Head Scarves	Wearing cap/net/scarf
	• Foot Wear	Putting on clean, washable shoes
	• Jewels	Prohibited
	• Perfumes	Prohibited
	• Nails	Should be trimmed
	• Beards	Should be shaven or guarded
39. Hand Hygiene	• Hand contacts	Avoid shaking hands and keep hands away from mouth, nose, arms, body
	• Timings of Hand Washing	Hand washing should be done before handling or clean utensils, between working with raw and ready-to-eat foods, after touching bare human body parts, after using the toilet and bathing rooms, after each break, after handling soiled utensils or equipment, and after coughing, sneezing, using tobacco, eating or drinking.
	• Washing Process	Use soap and warm water, rub for at least 20 seconds then rinse with liberal amount of water
	• Drying	Drying of hands with single-use towels
	• Sanitizing	Using hand sanitizers only after washing and drying
	• Usage of Food Handling Utensils	Use food handling barriers such as single-use gloves, tongs, serving spoons, single-use serviettes, spatulas and other dispensing utensils
V. Health		
40. Staff Illness	• Coughing	Should not work in a food premise
	• Wounds	Use impermeable bandages and gloves
	• Diarrhoea	Should not work in a food premise
	• Colds	Should not work in a food premise
	• Skin Rashes	Should not work in a food premise

ppendix G

ampling Frame

ublic Primary Schools	Private Primary Schools
ɛwala Academy, Nairobi Primary, G.S.U. mary, Nairobi River, Kilimani Junior, Starehe ys, Moi Forces Academy	St. Charles Lwanga, Kinyanjui Road, St. Elizabeth Academy, Mercury Academy, The Kings School, Josnah, St. Hannah's, Twin Birds Academy, Epren Academy, Le Pic, Marion Preparatory, Malezi, Wanja and Kim, Sunrise School, Young Heroes, Palace Academy, Emma, St. Paulines Junior Academy, Victory Alfa, Mountain View, Blue Sky Academy, St. Lucia Academy, Heshima Road, Compassionate Academy, Gatoto, Pelida, Sibiah's Star, Glad Toto, Lavington United Church Academy, Karura Church, Our Lady of Nazareth, Roysambu Junior Academy, Pinockio Junior, Eureka,St. Ann's Junior, St. Charles, Jema, St. Charles Academy, Nairobi Calvary
Public Secondary Schools	**Private Secondary Schools**
Aquinas, Buru Buru Girls, Dagoreti High, Embakasi Girls, Hospital Hill, Jamhuri High, Kenya High, Lenana School, Moi Girls, Muhuri Muchiri, Moi Forces, Ngara Girls, Nembu Girls, Nairobi School, Pumwani Secondary, Pangani Girls, Precious Blood, Statehouse Girls, St. Georges Girls, Starehe Boys, Upper Hill	Balkan High, Brookshine Secondary, Compuera Academy, Forest View, Karengata Academy, Kenya Muslim, Kitisuru Boys, Kyuna Academy, Riara Springs, Queen Of Apostles, St. Catherine's Mt. View, St. Elizabeth's Karen, St. Martin's Kibagare, Sunshine School, Stephjoy secondary
Public Post-Secondary Academic Institutions	**Private Post-Secondary Academic Institutions**
• University of Nairobi • Kenyatta University • Kenya Polytechnic • Nairobi technical • Kabete Technical Training Institute • Railway Training Institute • Karen Technical Training Institute • Kenya College of Communications Tech. • Utalii College • Highridge Teachers Training College • Kenya Science College • Paramount Chief TTI • Kenya Medical Training College • Kenya Institute of Special Education • Animal Health and Industry Training Institute	• Daystar University • Catholic University of Eastern Africa • United States International University • African Nazarene University • Kiriri Women's University • Aga Khan University • Strathmore University • East African School of Theology • Nairobi Evangelical School of Theology • Scott Theological College • Pan African Christian College • Nairobi Institute of Technology • Teskin College of Technology • Maragua Muslim Teachers Training College

Source: Ministry of Education Science and Technology, 2006.

Appendix H

Certificate of Medical Examination

ORM D

HE FOOD, DRUGS AND CHEMICAL

UBSTANCES ACT

Cap 254)

ERTIFICATE OF MEDICAL EXAMINATION

	Microscopy	Culture
Throat swab		
Urine		
Stool		
Sputum		
Chest X-Ray if sputum is TB positive		

I hereby certify that I have this day examined

Mr/Mrs/Miss..... and that in my opinion he/she is fit under the Food, Drug and Chemical Substances (Food Hygiene) Regulations to work at .....

(Name of food plant), Plot No .....

Town / Market .....

This certificate is valid for six months with effect from .....

....., 19..... to .....

.....

.....

.....

.....

(Signature and name of Medical Officer)

Date ..... (Official Stamp of the Medical Institution)

(Adapted from the Food, Drugs and Chemical Substances Act Chapter 254 (GoK, 1992)