# FOOD SAFETY AND HYGIENE PRACTICES: A COMPARATIVE STUDY OF SELECTED TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING AND UNIVERSITY HOSPITALITY SCHOOLS IN KENYA

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## DECLARATION

This is my original work and has not been presented for a degree in any other university or any other award.

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## DEDICATION

To my children Edith, Iddah, Christine and Edward, to my lovely grandchildren Zoe, Laquisha, Caren, Daniel, Nicci and Monique, and to my late parents Michael Okonjo Ochieng and Christabel Magero Nyong'ore.

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TO GOD BE THE GLORY

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## ABSTRACT

Food is a basic human need that plays a vital role in the sustenance of life. Its safety, however, has become a major concern to the food industry given that the consumption of contaminated food and water contributes to a myriad of health problems the world over. Although food prepared and served at the restaurants may look clean and taste delicious, it may have been contaminated by biological, chemical or physical hazards during the preparation procedures from the source through to service. Food workshops (kitchens) are viewed as the major sources of contaminations from poor sourcing and handling practices which include undercooking, poor personal hygiene, and use of unclean equipment, inappropriate storage and incorrect holding temperatures. Despite extensive investment in training of food handling personnel, food-borne diseases remain a contentious problem to both developed and developing nations. The general objective of this study was to compare food safety and hygiene practices in training colleges to ascertain their capacity in training food safety and hygiene practices. The specific objectives included to compare the level of hygiene awareness in Technical Industrial Vocational and Entrepreneurship Training (TVET) and University hospitality Schools, to compare food-handling practices between TVET and University hospitality schools, to establish their capacity in offering food safety and hygiene practices, to assess the applicability of HACCP pre-requisites, to determine barriers to food safety and hygiene practices in these institutions and more importantly, to determine the microbial load of vegetables served from these institutions. Hospitality training encompasses appropriate food handling procedures, careful selection of food source and use of correct equipment, proper storage, proper cleaning procedures and proper management of food waste. All University hospitality schools and food and beverage departments in TVET colleges were considered as reliable sources of information. Accordingly, the target population included both students and heads of these departments. The instruments used to collect data included questionnaires, interviews, observation checklists, photographs and focus group discussions. An observation checklist was used to assess good hygiene practices (GHP) particularly in the training workshops. Both descriptive and inferential procedures were used in data analysis and hypotheses. Chi-square was also used to test the independence of various samples. Both paired t-test and one sample t-tests were used to test for equality of various study variables in the two institution categories. All tests were performed at 95% confidence level. For microbial tests, Samples of spinach, coleslaw and macẽdione of vegetables (n=36) from these institutions were analysed in the laboratory to determine the microbial load, *aerobic plate* count and *coliform*. Finally, to determine the barriers to food safety, a multiple regression analysis was undertaken. The study established that the levels of awareness varied across the institutions. Out of the total number of students, 17% were not aware of HACCP principles. Institutions had no safety guidelines therefore no operational standards were followed. The study revealed that institutions were not adequately equipped, and the HACCP prerequisites were not used in most of the institutions. Multiple regression analysis revealed that lack of resources posed a serious threat to food safety and hygienic practices. The isolation of *E.coli, salmonella and pseudomonas* confirmed that food safety in the institutions was compromised. This study therefore recommended that HACCP food safety system be introduced in all hospitality training institutions as a measure against food contamination.

## LIST OF ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| AU | - | African Union |
| AMC | - | Active Managerial Control |
| CDC | - | Centre for Disease Control |
| CCF | - | Codex Committee of Food |
| DSLB | - | Double Strength Lactose Broth |
| EHEC | - | Enter haemorrhagic Escherichia coli |
| EMB | - | Eosin Methylene Blue |
| FBD | - | Food -borne Diseases |
| FKE | - | Federation of Kenya Employers |
| FAO | - | Food and Agricultural Organization |
| FBD | - | Food Borne Diseases |
| GHP | - | Good Hygiene Practices |
| GFN | - | Good Food Network |
| ILO | - | International Labour Organization |
| KAP | - | Knowledge, Attitudes and Practices |
| LMIC | - | Low and Middle Income Countries |
| NITC | - | National Industrial Training Council |
| TIVET | - | Technical, Industrial, Vocational and Entrepreneurship Training |
| WHO | - | World Health Organization |
| HACCP | - | Hazard Analysis and Critical Control Point |
| FSA | - | Food Standard Agency |
| INFOSAN | - | International Food Safety Authority |

| | | |
|---|---|---|
| RPM | - | Rotation per minute |
| HPC | - | Heterotrophic Plate Count |
| MPN | - | Most Probable Number |
| SSLB | - | Single Strength Lactose Broth |
| TDZ | - | Temperature Danger Zone |

## DEFINITION OF OPERATIONAL TERMS

**Food:** A combination of natural ingredients from proteins, carbohydrates, mineral and vitamins needed by man as energy that supports the daily activities of the body. The composition of food may be determined by three components:

**Appearance:** Size, shape, wholesomeness, glossiness, colour and consistency.

**Texture:** Mouth feel or firmness, softness, juiciness, , grittiness and easy chew as detected by the the sensory organs.

**Palatability**: Flavour (sensation perceived by the tongue, i.e. sweet, salty, sour, bitter, and aroma perceived by the nose.

**Food safety**: A discipline describing handling, preparation and storage of food in a manner that prevents transmission of foodborne illnesses.

**Hazard Analysis and Critical Control Point (HACCP):** A systematic way of analysing potential hazards in food operation, identifying the points in the operation when the hazards may occur, which are also called critical control points (CCPs). The CCPs are then monitored and remedial actions implemented if conditions are not within the safe limits.

**Disinfectant:** A chemical that reduces bacteria to a safe level – normally used after cleaning with detergent.

**Food handling:** The act of taking, holding or managing food with the hands.

**Food handling personnel**: A worker in the food industry whose hand comes in direct contact with food.

**Food hygiene:** Study of methods of production, preparation and presentation of high quality food that is safe and suitable for human consumption.

**Food poisoning**: A condition caused by the consumption of contaminated food.

**Food safety practices**: Application of good hygiene while preparing food.

**Infestation:** The process of inhabitation by pests or presence of pests in food preparation areas.

**Insectocutors:** Electrified flying insect killers that attract flying insects by emitting ultraviolet (U.V.) light.

**Microbial contamination**: The presence of unwanted microorganisms in food.

**Macẽdione:** A mixture of vegetables cooked together (peas, carrots, French- beans, turnips).

**Personal hygiene:** Maintenance of personal cleanliness from head to toe by food handling personnel.

**Pests:** Animals, rodents, birds or insects whose presence in food or food premises is unwanted.

**Vehicle of infection**: Course, way or media by which disease causing agents are transmitted.

**Hazard identification**: Entails identification of biological, chemical and physical agents capable of causing adverse health effects, which may be present in a particular food or group of foods.

**Quality assurance**: All the planned and systematic activities implanted within the quality system and demonstrated as needed to provide adequate confidence that an entity will fulfil requirements for quality**.**

**Safety policy**: The overall intentions and direction of an organization with regards to safety as formally expressed by top management.

**Cleaning:** Involves physical removal of any foreign matter present in an item which should not be part of it. The matter may contain microbes that can result to food poisoning or spoilage.

**Sanitizer:** A term for disinfectants used in food industry

**Schools**: Refers to departments in the Universities offering hospitality training.

**Sterilization**: Describes the total elimination of all microbes (whether harmful or not).

**Disinfection**: Elimination of sufficient diseases producing microbes to ensure safety. The purpose of disinfection, cleaning and sterilization in food hygiene is to prevent food poisoning and spoilage.

**Food Hygiene:** The exclusion and elimination of microorganisms from food.

**Aesthetics:** The outward appearance of food or its surrounding and acceptability in relation to the senses.

# CHAPTER 1 - INTRODUCTION

## 1.1 Background to the Study

According to a report by World Health Organization (2003), the magnitude of Food-Borne Diseases (FBDs) caused by contaminated food and water significantly contributed to a myriad of health problems. FBDs were said to be on the increase despite adoption of vast measures to curb food-related illnesses. The Centre for Disease Control and Prevention (CDC, 2005) attributed this upward trend to increased multiplication rate of disease-causing microorganisms and exposure to 00 levels of toxins from industrial effluents. CDC (2005) further added that poor hygiene practices, inadequate cooking, improper holding temperatures, use of contaminated equipment and poor personal hygiene contributed significantly to the spread of FBDs. Though symptoms of FBDs varied from one individual to another or from place to place, common symptoms ranged from mild gastroenteritis to life-threatening neurologic, hepatic, and renal syndromes (Hughes, 2000).

Further reports by CDC (2005) indicated that more than 250 different food-borne diseases have been identified and most of the illnesses are caused by microbial contaminants. Some of the most common disease-causing microbes included Escherichia *Coli 0157:H7*, *Salmonella*, *Campylobacter* and *Staphylococcus* among others (CDC, 2004). Among these groups of microorganisms, some were capable of mutating and re-emerging as new organisms. This feature, frequently observed in *Salmonella enteritidis* and *Escherichia-coli 0157:H7*, interfered with the process of reducing FBDs. In the US, for example, a nation-wide survey conducted between 1998 and 1999 by the CDC found that microbiological contamination was the number one cause of FBDs followed closely

by chemical contamination. Food-related infections were said to constitute a critical health problem in both developed and developing countries (Dugassa, 2007). Further reports indicated that food- borne illness was a major cause of personal stress, preventable death and avoidable economic burden in USA (Mead, Dunne, Graves, Weidman, Patrick, & Hunter, 1999). It had also been estimated that food-borne diseases causes 76 million illnesses, 325,000 hospitalizations and 5000 deaths each year (Anding, 2001). Additionally, the annual cost of FBDs in terms of pain and suffering, reduced productivity and medical cost is estimated to be between $10-83billion (Anding, 2001).

Apart from the USA, other developed countries also experienced the burden of FBDs. In Turkey, for instance, a total of 23,010 cases of dysentery were reported in 1997 (Aycikel, 2007). In Emilia-Romagna, a single region in Italy, 1564 episodes of food-borne diseases were reported between 1988 and 2000 (Legnani, 2004). A national survey done by the British government in 2009 revealed that outbreaks of food poisoning had serious financial and social implications (Christopher, 2010). The survey further added that Salmonella alone caused 1939 food-related illnesses (Acheson, 2011). On the same vein, indicated that about one million people suffer from food poisoning every year at an estimated cost of $ 1.5 million annually (Acheson, 2011). Another observation by Rona Ambrose, Minister of Health in Canada (2014), also reported that although Canada boasted of the safest and healthiest food safety systems in the world, the Government was still committed to strengthening food safety by giving tough penalties and cracking down those that did not comply with food safety measures.

In developing countries, particularly in most African countries, a change in socio-economic setting had resulted in multiple food safety challenges (Green, 2003). Green

pointed out that between 70% and 90% of employees in Africa were in the food trade. These traders were said to significantly influence the prevalence of FBDs in their respective countries. Green (2003) added that availability, distribution and maintenance of adequate supply of portable water and nutritious food were the major challenges to most of these countries. Moreover, inadequate sanitation and physical facilities were said to contribute to lower aesthetic standards, resulting to contaminated food and water (Green, 2003).

According to Dugassa (2007), the burden of food-borne illness in developing countries was significant, and was said to be in a worse condition than developed countries due to inadequate and poorly developed food safety structures and policies. A report by FAO and WHO (2005) indicated that the challenges of food safety in Africa were precipitated by poor food safety systems, lack of systematic surveillance and structural organizations which were viewed as weak and could not protect human health. Besides, there was underdeveloped human resource and insufficient capacity to determine the prevalence and magnitude of the problem. According to Adams (2003), developing countries experienced the challenges of widespread poverty, rapidly growing population and large-scale migration to already overcrowded cities leading to poor sanitary conditions. He further indicated that about 2.6 billion people in developing countries lacked even a simple pit latrine, and about 1.1 billion had no access to portable water. Adams (2003) therefore concluded that food safety was a big challenge due to lack of facilities for hygienic preparation and storage of food.

Kenya, like other countries was not exempted from the burden of FBDs. According to Abegaz (2007), up to 70% of all diarrhoeal episodes were attributed to ingestion of

contaminated food and water. This study viewed training intervention of food handling personnel as a solution not only in Kenya but also in Africa and other developing countries struggling with food safety challenges. It was upon this backdrop that this study aimed at comparing food safety and hygiene practices in training colleges to ascertain their capacity in training food safety and hygienic practices.

### 1.2 Training in Relation to Food Safety and Hygiene

Training plays an important role in any career and is expected to result in a change of behaviour, attitude and skill of the participants. A report on quantitative survey carried out in Australia on training trends on food safety management indicated that effective education and training programmes provide the best way of improving safety awareness among food handlers (Linda, Roberts & Deery, 2004). The report further indicated that there was need to train, especially food managers, on safety and hygiene in order to improve their capacity to deal with issues related to food safety. A similar study in Thailand also pointed out that governments needed to formulate food safety policies that would include educating senior managers on the benefits of safe food.

While exploring the importance of education as a measure towards curbing FBDs, Raymond (2006) reported that education intervention for consumers was an important step in minimizing food-related illnesses. This claim was important since inadequate implementation of food safety practices in the homes was also viewed as a contributing factor to food-borne diseases. Raymond (2006) further proposed simple hygiene measures such as hand washing as a way of reducing contamination by at least 87% and reducing cross contamination by 85%, as well as proper cooking which reduced contamination by 77%. Based on reports from these surveys, education and training were

considered key in ensuring that appropriate food safety measures were employed. Douglas (2011) however, noted that many institutions were not adequately managing food safety despite basic training of employees. He recommended that to overcome this challenge, institutions could organize mandatory training for all persons in food service outlets and ensure strict implementation of food safety management systems.

In Kenya today, an increase in population and thirst for training opportunities has significantly contributed to the growth of training institutions offering food production related courses at degree, diploma, craft and artisan levels. The Universities and tertiary institutions offer these courses at different levels. The tertiary institutions that offer these courses fall under Technical and Vocational Education and Training (TVET) colleges. The increase of TVET colleges have been occasioned by the need to alleviate high unemployment rate among the youths by producing graduates who are tailor made for self-employment. As a result, between 2009 and 2012, the government upgraded 11 TVET institutions to centres of excellence by rehabilitating the workshops and improving their facilities. At the same time, upon realization that there was still need for more specialised managerial skills, the universities introduced hospitality courses to offer degree and diploma programmes. This gap may have been aggravated by high demands for higher skills for particular disciplines, including hospitality. The rapid increase of University hospitality schools and TVET colleges has raised a lot of concerns as to whether these institutions have met the threshold standards for hospitality training.

According to the Sessional Paper No. 1 (2005), the objective of TVET and University hospitality schools was to train professionals who could apply scientific knowledge in solving any environmental problems in the industry. This study therefore sought to assess

the strengths and weaknesses of both institutions with the view of improving their weak areas. The study also sought to establish whether university hospitality schools have put up better food safety training measures than TVET Colleges or otherwise. The study intended to come up with ideas and strategies, which would improve food safety training. In addition to improving the existing situation, the comparative study also intended to find means of reinforcing and integrating theory with practice on food safety and hygiene, by recommending policies that would safeguard their operations.

Upon completion of their training, graduates from TVET and Hospitality Schools work in the hospitality industry as managers, assistant managers, chefs, waiters, supervisors and food production assistants. An effective training therefore would have an impact in the entire hospitality industry across the country.

### 1.3 Problem Statement

Food poisoning is on the increase as a result of consumption of unwholesome food. Food handling personnel are assumed to be responsible for most illnesses as a result of poor handling behaviour. Angelilo, Vigiani, Rizzo, and Bianco (2000) argued that although food handling personnel played an important role in producing food for consumption, they were likely to contaminate the food by introducing pathogens in the process of preparation, production, processing, distribution and service. Studies by Akonor and Akonor (2013) indicated food safety was a public health problem associated with consumption of food and water, mainly triggered by improper food handling practices. Studies conducted by Mulan and Wong (2006) reported that an estimated 5.4 million Australians got sick annually from eating contaminated food and that up to 20% of the

illnesses were suspected to originate from inappropriate handling behaviour. In fact, the WHO (2007) also recorded that up to 30% of individuals in developed countries suffered illnesses related to consumption of food and water hence pointing out that food safety was a major global catastrophe (WHO, 2007).

Kenya is not an exception. A number of FBDs triggered by improper food handling practices have affected the Kenyan population over the years. Abegaz (2007) noted that the most prevalent diseases in Kenya in the year 2004 alone were *typhoid*, which affected 643,151 people, *dysentery*, which affected 600,660, and *gastroenteritis*, which affected 722,275 people. Abegaz also added that *aflatoxin* poisoning affected 323 and *brucellosis* 198, while 68 persons were victims of cholera. Based on the frequency and location of the diseases, the report further indicated that some of the FBDs were seasonal and subsequently, required urgent intervention. Other reports indicated that *E.coli* alone caused an estimated 73,480 illnesses, leading to 2,168 hospitalizations and 61 deaths annually (Rangel, Sparling, Crowe, Griffin and Swerdlow, 2005).

Globalisation, rapid urbanisation, increase in population and change of eating habits has led to a significant increase in the growth of the food service outlets in Kenya. Despite the economic benefits of these sectors, they are viewed as potential hazards especially when food is not hygienically prepared. There is therefore a critical need to provide adequate training for food handling personnel, to ensure that FBDs caused by improper food handling practices are eradicated. This study identified that in Kenya, food handling practices are taught, but when it comes to practice, the ballgame changes. Accordingly, Mortlock, Peters & Griffith, (2009) observed that efficacy of training in terms of changing behaviour and attitudes to food safety was questionable. However, Clayton and

Griffith, (2004) observed that only knowledgeable trained and skilled employees followed proper procedures when handling food. In essence, if food handling personnel are trained on proper food handling practices, there is a likelihood that FBDs will take a decline trend.

It is upon this background that this study aimed at comparing TVET and University's hospitality school undertaking training on food production and service in Kenya, to ascertain if there were any significant differences, and, to what extent.

### 1.4 Justification\Significance of the study

This study was important in articulating food safety and hygiene practices as observed in hospitality training departments, with the hope that the study would encourage TVET and University hospitality Schools to compare their operations and take necessary corrective measures to lift themselves from under-performance, as well as set strategy for improvement. The comparative study may help both institutions to focus on specific known challenges and be able to better their performance instead of generalizing behaviour. Besides, the comparison generated data and knowledge that could be used as reference material by the institutions, general readers and researchers. In essence, this study was vital in enhancing the body of knowledge in food safety and hygiene practices. In addition, the recommendations gathered from this study will help future development of policies and curriculum that will give comprehensive training programmes on food safety and hygiene practices. Furthermore, this study has contributed to the pool of existing knowledge in this area of study and may be used as a yardstick by future researchers interested in further studies. The study also provides an important basis for formulating well-targeted policy support for food handling personnel. By this, it is

expected that food safety code of ethics particularly HACCP will be introduced in all hospitality training institutions. It is further expected that the results of this study will find significance among stakeholders in training of hospitality not only in Kenya but also in other institutions developing their capacity in hospitality training in Africa. Lastly it is envisaged that Kenyatta University will be used as a model hospitality School in the introduction and implementation of HACCP food safety system in Kenya.

### 1.5 General Objective

The general objective of the study was to carry out a comparative study of training on food safety and hygiene in TVET and University Hospitality schools and their impact on hygiene practices in the hospitality industry in Kenya.

#### 1.5.1 Specific Objectives

Specific objectives of the study were;

i. To establish the level of awareness of HACCP practices in TVET and University hospitality schools.
ii. To compare food-handling practices between TVET and University hospitality schools.
iii. To establish the capacity for the TVET and university hospitality schools in offering food safety and hygiene training.
iv. To assess and establish the level of implementation of HACCP system in TVET and university hospitality institutions.
v. To determine barriers to food safety and hygiene Principles (HACCP) in TVET and University hospitality schools.
vi. To establish the microbial load of foods prepared and served in TVET and

university hospitality schools.

### 1.6 Research Hypotheses

$H_{01}$ There are no significant difference in the level of awareness and knowledge in TVET and university hospitality schools.

$H_{02}$ There are no significant differences in food handling practices in TVET and university hospitality institutions.

$H_{03}$ There are no significant differences in the capacity for the TVET and university hospitality schools in offering food safety and hygiene training in the country.

$H_{04}$ There are no significant differences in the applicability of HACCP system in TVET institutions and university hospitality schools.

$H_5$ There are no significant differences in barriers to safe and hygiene practice in TVET and university hospitality schools.

$H_{06}$ There is no significant difference in microbial load in foods served in TVET and hospitality schools.

### 1.7 Limitations of the Study

Data limitation was a major obstacle especially from Kenya since no study has been done on the same. Lack of available data from other African countries was also a setback as there were no records on training and the monitoring of food-borne related diseases. This made it difficult to accurately espouse on the details. However, the study used literature from other countries. Besides, the target group carried out practical lessons at different times of the year and this affected the data collection schedule. As a result, the study had to spread out the data collection period. In addition, the information needed were captured during observation. To alleviate the impact of these limitations, the researcher

used journals for information on Africa, and relied on the little available literature that was available. In order to cover all third year students targeted in the study, the researcher used two assistants to visit the institutions whenever the students had practical lessons. Although it affected the time-plan of the research, all targeted students were covered.

### 1.8 Conceptual Framework

The conceptual framework below presented the relationship between the variables of the study. The dependent variable for the study was appropriate food safety and hygiene practices. Independent variables included food-handling practices in the institutions, suitability and capacity of the studied institutions, level of implementation of HACCP, barriers to proper food safety and microbial load in foods prepared in the institutions.

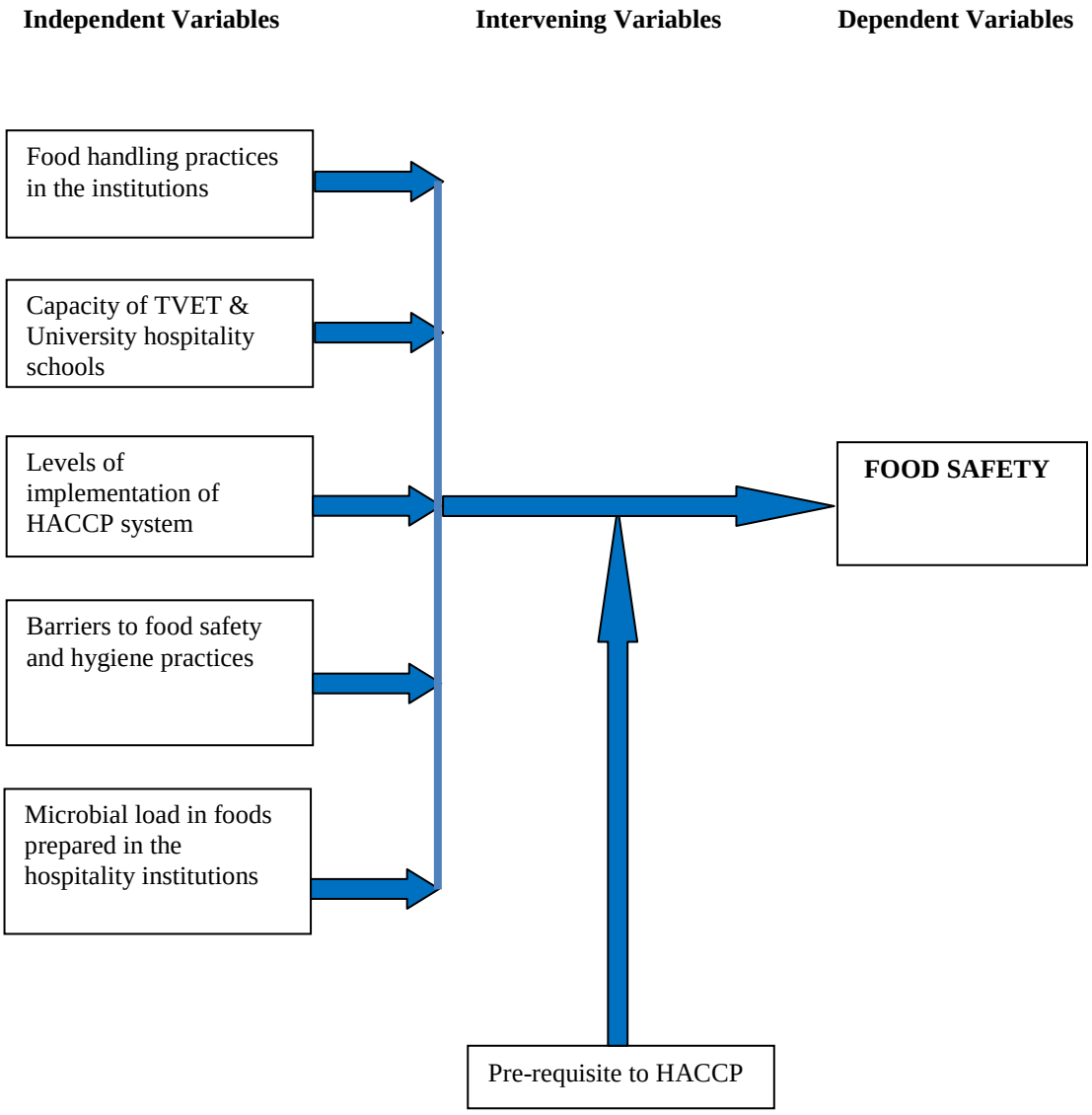



**Figure 1.1:- Conceptual Framework on Food Safety**

The conceptual framework was based and summarized along the challenges, interventions and solutions to food safety variables. The independent variables included the capacity of institutions such as availability of equipment and facilities and food handling practices in regard to food safety.

Intervening variables of the study comprised of the major barriers to implementation of food safety systems. Such barriers included external factors caused by lack of technical skills; expertise and inadequate finances allocated for the implementation of food safety systems by the institutions. Internal factors on the other hand included challenges such as lack of resources, capacity, operational complexity and operational variability such as the size of the workshop, equipment and tools available for training in addition to the number of students using the production work shop. The framework also viewed psychological barriers as intervening variables, including lack of motivation, out-come of expectancy, lack of self-efficacy and lack of positive attitude to implementation.

# CHAPTER 2 - LITERATURE REVIEW

## 2.0 Introduction

This chapter reviewed literature related to studies on food safety and hygienic practices. The review focused on the aspects of personal, environmental and food hygiene as discussed in sections below.

## 2.1 Background of Hospitality and Food-Service Industry

According to Dittmer (2000), the term hospitality was derived from the Latin word *Hospice*, meaning *to receive a guest*. O'Gorman (2007) argued that hospitality principally focused on a host who received, welcomed and catered for the needs of the guest who was temporarily away from home. Such needs included food and shelter, among others. Development of hospitality depended on increase of population, economic growth of cities and good transport systems. Development of transport systems for instance, allowed movement of people from one place to another and consequently enhanced interactions, which led to the development of motels, inns and hotels. The hotels later developed into more spacious chains with cuisines designed to meet the customers' needs (O'Gorman, 2007). The trend prompted the construction of hotels near airports to provide hotels and conference facilities. The inventions of the modern technology in the 1990s made an impact on the hospitality industry leading to expansion of hotels to cater for more enlightened customers. This created need for trained personnel and soon new techniques and methods of service delivery were devised (Levy, 2009).

Kenya is known to have experienced remarkable advancements in the hotel industry. Today, hospitality industry is one of the largest foreign exchange earners, with the

industry having contributed to approximately 10% of the gross domestic product (GDP). Despite this significant contribution, the industry was recorded as having faced many challenges in satisfying the diverse nature of the hospitality and tourism industry. To overcome this challenge, the hospitality industry in Kenya was required to engage professionals with the required competence to address the problem, and this could only be achieved through appropriate context - based, need-driven training and education. It is upon this backdrop that TVET and hospitality-training colleges were established.

## 2.2 Technical and Vocational Education and Training (TVET) and University Hospitality Institutions

The term TVET as used in this study, referred to "those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupation in various sectors of the economy (ILO, 2011). In this description, the International Labour Organization (2011) implied that the institutions incorporated technical education, industrial education, vocational education, apprenticeship and on-job training.

ILO (2012) further reported that one billion young people, the majority from low- and middle-income countries (LMICs) were predicted to reach employment age within the next decade. This prediction posed a threat to the severely limited opportunities for integrating youth into the labour market. This worsening youth unemployment crisis led to the development of Technical, Industrial and Vocational Education and Training (TIVET) institutions. However, as reported by the African Union (2007), the institutions had previously been established but collapsed since their importance had not been clearly

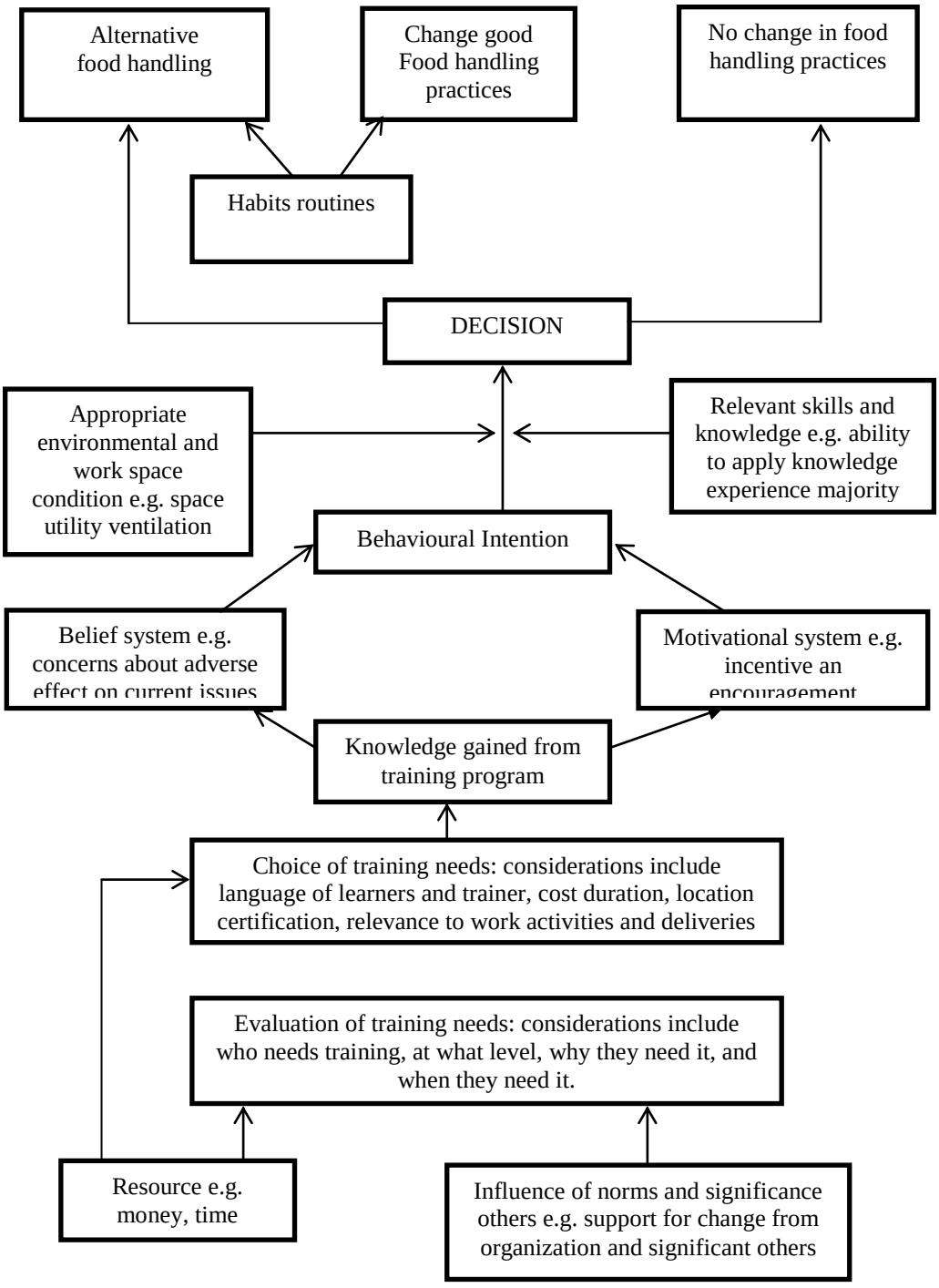
understood in several regions globally. The collapse was also attributed to the neglect by the World Bank and donor agencies. Nevertheless, with increasing demand for better skills in the global knowledge-based economy, TVET institutions came back on the development agenda after years of neglect. This renewed focus on the potential of TIVET to equip the youth with abilities to seize available work opportunities aimed at reducing global poverty level and to improve social stability. Consequently, there was growing investment in TIVET institutions since 2000 (African Union, 2007). The same trend was observed in Kenya. The past decade saw TIVET institutions being included in the development agenda and as a result; several TIVET institutions were established in several parts of the country. More recently, the Ministry of Education, Science and Technology renamed TIVET to TVET (Technical and Vocational Education and Training).

### 2.3 Training on Food Safety and Hygiene Practices

WHO (2007) identified the training of food handlers as one of the most indispensable interventions in the prevention of food-borne diseases. McLauchlin and Little (2007) defined food hygiene education as the 'process of acquiring knowledge and training for the prevention and control of food-borne disease**.**' Education and training was believed to get the trainee informed to be able to perform given tasks effectively and with understanding. In Kenya this responsibility was given to the Ministry of Higher Education, Science and Technology (MOEST). The Ministry of Education, Science and Technology (2012) articulated the primary task of higher education as being to cultivate high level innovative talent and standards that embraced proper food safety and hygienic practices. It added that in hospitality training, food safety was a priority foundation unit

that was important in imparting knowledge and skills in food handling behaviour. As Knowles (2002) explained, the recipients of training were expected to have a higher level of understanding at the end of the training.

Food and beverage production service and food hygiene were considered as public health professional basic course. In fact, appropriate food hygiene training and enactment of safe food handling practices learnt during training were critical elements in the control of food-borne illnesses. Toh and Birchenough (2000) observed that there was a strong correlation between knowledge and positive food handling practices. This report reinforced the importance of conducting a preliminary assessment of training needs and evaluating the effectiveness of the training as suggested by Rennie (1999). Rennie (1999) further reiterated that knowledge gained was intended to bring about behaviour change and as such, the learners had to be motivated. Besides, the correct environment had to be created so that the trainees could apply the relevant skills to the work experience that had to be rewarded with certificates which was relevant of the training. Rennie (1999) came up with an illustration as shown below.




Source: Rennie (1999)

**Figure 2.1:- Food Safety Model (Rennie, 1999)**

The model was viewed as a way of improving food businesses, which would, in effect, reduce food-borne illnesses. There was an implied assumption that such training would

lead to changes in behaviour based on the Knowledge, Attitudes and Practices (KAP) model (Seaman and Eves, 2006). This model was criticized by Griffith (2001) for its limitations. Griffith argued that knowledge alone was insufficient to trigger preventive practices and that other mechanisms were needed to motivate action and generate positive attitudes. In an evaluation of food hygiene training, Egan, Raats, Grubb, Eves, Lumbers, Dean and Adams (2007) observed that although there was positive response towards knowledge of good hygiene, knowledge alone did not result in changes in food handling practices, and as a result change of behaviour also played an important role. Tripney (2007), on the same vein, postulated that effective and relevant food hygiene training delivered with the support of the government re-enforcement could have some effect on food handlers' behaviour that would ensure that safe working practices were sustained. Another study by Yiannas (2007) observed that hands-on training on good hygienic practices (GHP) would contribute to retention of important food safety issues as articulated by the Chinese proverb: *I hear and I forget, I see and I remember, I do and I understand* (Yiannas, 2007*).*

Studies carried out by (Valerie, Laura, Brannon, Shanklin, Kevin, Roberts, Betsy, Barret & Howels, 2008) and Griffith (2011) linked the behaviour of food handlers to organizational culture and food safety management systems adopted by particular organizations. Benjamin (2011) noted that despite extensive investment in food handlers' training, the programmes used were inconsistent and were rarely evaluated for efficacy by the stakeholders.

As a result, Global Food-borne Network (GFN), a building capacity for control and prevention of FBD infections resolved to develop international training courses to build

technical capacity and quality systems. These systems were crucial in the laboratory to test FBD and identify pathogens. GFN has since established 17 training sites around the world and has conducted over 65 training courses in Chinese, English, French, Portuguese, Spanish and Russian languages for microbiologists. This has resulted in more than 80 countries being able to provide data of over 1.5 million human-related microorganisms, especially *salmonella*.

**2.4 Knowledge and Practice of the Food Handlers**

A study by Rodríguez and Gregory (2005) revealed that an effective training programme assessed whether participants acquired new skills during the training, and whether the newly acquired skills were transferred to the job setting. The report further indicated that food safety training was recommended for all cadres of staff including junior food-service staff, supervisors and managers who needed to know the dangers of food-borne illnesses and their prevention. Another study by (Egan et al., 2006) also observed that effective training depended on both attitude of the management and their willingness to provide resources needed for implementation of food safety systems. According to Birchenough (2000), there was a strong correlation between knowledge and food handling practices. Earlier studies on performance of individuals indicated that food safety knowledge increased with age and practice. Nurul (2008) suggested that training and motivation needed to be provided to encourage food handlers to practice appropriate attitude and procedures when working in the food arena.

By the same token, another study conducted by Coleman and Roberts (2005) observed that for food safety delivery systems to be effective, the prevailing food safety beliefs, knowledge and practices of food handlers had to be assessed, to determine what was

needed to change their attitude. More importantly, Howells, Roberts, Shankling, Pilling, Branson and Berret (2008) postulated that there was a correlation between positive behaviours (attitudes) and continued education of food handlers towards sustenance of safe food handling practices. Howells et al. (1996; 2008) indicated that approximately 97.0% of foodborne outbreaks were as a result of improper food handling practices in food service outlets. On the other hand, Ehiri and Moris (2001) pointed out that knowledge alone was not sufficient to promote positive attitudes and safe behaviour among food handling personnel. Ehiri and Moris (2001) also observed that attitude was an important factor that could not be ignored if FBDs were to be minimized.

### 2.5 Food Safety and Personal Hygiene of the Handlers

A microbiological study of open, ready-to-eat, prepared salad vegetables from retail catering premises by Sagoo, Little and Mitchell (2003) identified a direct relationship between food hygiene training and practice of food safety procedures. Another study of ready-to-eat food from retail premises in North Eastern England by Richardson and Stevens (2003) also indicated that members of staff who practiced poor personal hygiene could contaminate food items with infected excreta, pus, respiratory drippings or other infectious discharges. This claim implied that food handlers were the major sources of contamination either as carriers of pathogens or through poor hygienic practices (Kaferstein, 2003). The study further suggested that food handlers could carry microbial pathogens on their skin, hair, hands, digestive systems or respiratory tracts. As a result, the report asserted that it was imperative for the staff to understand and follow basic food hygiene principles to avoid unintentional contamination of foods, water supplies and/or equipment used during the processing of food (Richardson and Steven, 2007).

Sneed, Strohbehn and Gilmore (2004) conducted another study on food safety practices and implementation of HACCP programme in facilities in Iowa and identified a number of food safety practice concerns. They observed that hand washing was inappropriately done and food handlers had no effective hair restraints. The study also noted that food temperature monitoring and recording were infrequent and sanitizer concentration used was not checked regularly. The study concluded that employees in foodservice operations had sufficient food safety knowledge and positive attitudes toward food safety but were not following the correct procedures, an indication that there was need to improve food safety practice (Sneed et al., 2004).

### 2.6 Food Safety and Employee-Related Characteristics

Apart from personality related behaviours, Bertin (2009) also observed that certain employee-related characteristics such as poor educational level, low socio-economic level, rapid staff turnover, literacy barriers and poor motivation due to low pay also contributed to poor professional performance at work. Bertin found that food handlers had a very important role in preventing contamination during food preparation and distribution and this responsibility became even greater in hospitals.

Other studies used for testing effectiveness of hygiene education pointed out that hygiene knowledge alone was not sufficient in improving hygienic attitude and practices of food handling personnel. The studies further indicated that discrepancies still existed between hygiene, knowledge and practices (Park, Kwak and Chang, 2010). One explanation for the discrepancy between food safety knowledge and practice was the barriers experienced in the food-service establishment that could prevent food handlers from implementing practices such as good hand washing in the restaurants (Green and Selman, 2005). The

duo observed that availability and accessibility of hand washbasins was a major concern followed by peak time pressure during operations. Moreover, high volume of business, stress, lack of accountability, lack of equipment, type of restaurant and inadequate food handler training were considered as critical barriers mentioned by participants in other studies (Pragle, Harding, and Mack, 2007). Another significant contribution by Clayton, Griffith, Price and Peters (2002) recorded that time was a major factor that barred correct practices of food safety.

### 2.7 Barriers to Food Safety Practices

Pragl et al., 2007 asserted that food-service establishments were expected to address emerging issues of barriers to food safety practices to narrow the gap between food safety knowledge and practice. Consequently, they argued, food safety training could incorporate strategies that eliminated barriers to proper handling practice in order to improve compliance and reduce the incidence of food-borne related disease outbreak. The report further asserted that training was only valuable if its importance was translated into performance. Transfer of training was viewed as the core issue that linked individual change to an organization's requirements. To realize the difference on food handlers in the organizational performance, Yamnill and McLean (2001) recorded that the transfer of knowledge must be clear to ensure it is translated into practice. Seaman and Eves (2009) gave strength to that argument by adding that the managers had to be on the frontline in training and the management had to support food safety training and reinforce the adoption of safe food handing behaviours. Education and training were expected to enable trainees to perform the given tasks effectively and with understanding. It is on

these premises that this study saw the need to cover the three types, which included personal, environmental and food hygiene.

### 2.7.1 Personal Hygiene

*Regulation (EC) No 853/2004 stated that "Every person working in a food handling area shall – maintain a high degree of personal cleanliness and wear suitable clean and appropriate protective clothing."* Personal hygiene was defined as the maintenance of personal health, particularly by cleanliness (McLauchlin and Little, 2007). Rippington (2008) recorded that personal hygiene was achieved through daily bathing or showering, wearing clean underwear, caring for the hair, mouth, teeth, hands and nails. Green and Selman (2005) reiterated that good hygiene was the foundation for preventing the spread of food-borne illnesses, as human beings were said to be the major source of food contamination. On the same breath, McSwane, Rue and Linton (2005) postulated that if a food handler was not clean, any food handled by dirty hands could contaminate the food with organisms from their gastrointestinal tract. In another observation, Collins (2001) shared the same sentiments and asserted that lack of personal hygiene amongst food handlers were likely to contribute to food-borne illnesses. Sneed et al. (2004), in addition, argued that good personal hygiene prevented incidences of cross-contamination to a reasonable level. The same was noted by Angellilo, Viggiani, Rizzo, and Bianco (2000) who observed that personal hygiene could be a source of cross contamination. Elson (2006) cited personal hygiene of food handlers as the most important aspect in the prevention of food poisoning.

According to (FAO/WHO, 2006), components of personal hygiene included the cleanliness of the hands and body and maintaining good personal cleanliness, wearing clean and appropriate uniforms, and by following hygienic sanitary habits in addition to maintaining good health and reporting any ill health to medical personnel. On the same note, Clayton et al., (2002) reiterated that inappropriate food handling practices alone led to 97.0% of food-borne diseases. Pragle, et al., 2007) recorded that food handling played an important role in the safety of the clients and therefore, the managers were expected to take an active "coaching-style" approach to promote hand washing. In a similar study on food handlers' perspectives of barriers to hand washing, participants stated that they wanted "hands-on" hand washing training to be included in pre and post- training as an element of motivation to food handlers in sustaining safe handling practices learnt during training (Seaman and Eves, 2009).

**Hand Washing**

Hand washing was said to be the most critical aspect of personal hygiene. Proper hand washing was very important in the prevention of transfer of *staphylococcus* from one surface area to another. Green (2006) noted that food worker hand washing practice was critical because pathogens from the hands to food were a major contributing factor to food-borne illnesses. Many food handlers failed to wash their hands as required especially where hand washbasins were not provided. Though hand washing took only twenty seconds, staff rarely practiced it. There was need to train in the five steps of washing hands: wetting, applying soap, scrubbing hands and arms for 10 to 15 seconds, rinsing thoroughly, then drying hands using disposable towels or hot air dryers. The Food

Standard Agency (2006) stipulated six steps of hand washing procedure that took the following sequence:

Step 1: Wet hands thoroughly under warm running water and squirt liquid soap onto the palm of one hand.

Step 2: Rub hands together to make a good lather.

Step 3: Rub the palm of one hand along the back of the other and along the fingers. Repeat with the other hand.

Step 4: Rub in between each finger on both hands and around the thumbs, fingertips and nails.

Step 5: Rinse off soap thoroughly with clean running water.

Step 6: Dry hands thoroughly using a paper towel or a hand dryer. Turn off tap with the towel and dispose of the towel or turn off the tap using an elbow.

Another premise in support of proper hand washing came from The National Restaurant Association Education Foundation (NRAEF, 2004), which reiterated that hands were to be washed under running water of at least $100^0$F and be scrubbed for at least 20 seconds then dried under single use paper towels. Elson (2006) recorded that food handlers were to be trained to wash their hands before they started work, during preparation processes particularly after every procedure in operation. He added that nails were to be kept short, nail polish was not be worn and artificial nails were not be used. Elson (2006) continued to say that all cuts and wounds on the hands were to be covered and in case one had burns, boils, sore skin infection or infected wounds, one was not to work.

According to Angellilo et al., (2000), hands had to be washed before wearing gloves and more importantly, gloves were not be used before hand washing. The gloves were to be

made from safe, durable and easy to clean materials. Disposable gloves and finger cots had to be worn on bandaged wounds and hands. Angellilo et al. (2000) also observed that food-handling personnel had to report health problems to the manager of the establishment before working.

**Other Important Personal Hygiene Practices**

Other personal hygiene practices, according to Richard (2006) included wearing a hat or other hair restraints, wearing clean clothing daily, removing aprons when leaving food preparation areas, removing jewellery from hands and arms and wearing appropriate shoes. In addition, policies regarding eating, drinking, smoking and chewing gums and tobacco, sneezing, coughing, using a tissue, taking out garbage or touching anything that could contaminate hands such as un-sanitized equipment or work surfaces had to be observed (Richard, 2006). Richard further argued that in case food was to be tasted during preparation; it had to be placed in a separate dish and tasted using a spoon and a saucer.

In other words, as Richard so ardently put it, good personal hygiene was a critical protective measure against contamination and food-borne illnesses (Richard, 2006). The NRAEF (2004) synopsized the whole matter when they recorded that the success of personal hygiene depended on a well-trained food handler who had acquired knowledge, skills and attitude necessary for keeping food safe (NRAEF, 2004).

### 2.7.2 Environmental Hygiene

According to European Union Food Safety Standards EC No.178/2002 regulation, food establishment had to comply with legal requirements covering constructions. The

premises had to be designed and constructed in ways that prevented contamination and access to pests.

It considered the layout of the kitchen, equipment and other facilities in relation to hygiene in and around the food production premises. Becker (2003) defined a food premise as the building, structure, caravan, vehicle, or stand used for storage, preparation and service of food. It also included areas where equipment were washed and stored, lockers, washrooms and garbage disposal areas. Fosket and Ceserani (2007) defined the term food premises to comprise the kitchen (where ingredients were brought, prepared and cooked according to the menu of the day), the restaurant (where food was served and consumed), and the storage area (where food materials were ordered, stored and issued for production) The FAO, HACCP board of experts (2002), the Kenya Public Health Act, Cap 242 of 1986; and FSA, (2006) advised that food premises had to be designed properly to ease cleaning.

**Cleanliness of Premises**

The FSA (2000) particularly recommended that all sections of the premises where food-related activities were carried out had to be kept clean, in good repair and well maintained. Specifically, kitchens and restaurants as the major areas of operations where food was prepared, had to be designed to separate “low risk” (uncooked product) from “high risk” (cooked product) areas. The premises were required to have adequate space, hygiene, design and construction, appropriate location and provision of adequate facilities to control the hazards. Food premises design as explained by Birchfield (2008), referred to the entire facility while the layout involved a consideration of each small unit or workspace in the facility. Knowles (2002) and Mohini (2004) recorded that the size of the

facility was supposed to be determined by the menu to be served and the workload expected, as well as the type of establishment and the purpose for its intended use. Besides, the facility was required to be large enough to accommodate all materials and equipment required, as well as to allow free movement during operation.

**Location of Workshops**

Workshops had to be ideally located for the proper practice of food hygiene. Basics such as adequate lighting, ventilation and portable water supply were essential (Paster, 2007). Hoffman (2007) argued that the surrounding area was not supposed to be potential breeding ground for mice, flies or harmful insects. Sanitary facilities such as hand wash basins, and rest rooms used by staff had to be conveniently located and the number adequate enough to serve the anticipated number of staff. Moreover, shower and changing rooms were to be made available if hygiene was to be taken into consideration. Hoffman further argued that facilities of handling, transporting and carrying foodstuff on the way to establishments had to be properly cleaned, and the route used for waste disposal (refuse point) had to be well maintained. He added that refuse was not to be carried through the kitchen or dining rooms (Hoffman, 2007).

**Size, Nature and Layout of Premises**

According to the FAO/WHO (2007), food storage premises needed to be cool and dry. Walls needed to be built with damp proof material. Working premises needed to be large enough to allow employees to carry out their work comfortably without congestion on traffic lines. Working tables were not to be crowded and the queuing for the use of sinks was to be avoided. They further recorded that large gangs allowed free movement and

good working environment and sufficient tables and shelf space needed to be available to allow used and unused utensils to be kept apart from each other and from food preparation areas (FAO/WHO, 2007). Paster (2007) corroborated that a good design was needed to ensure that equipment and facilities were constructed in a way that contamination was minimized, by ensuring that premises were located away from environmental pollution, flooding or pest infestations. Proper sanitation and maintenance of premises were recorded as important to permit continuous and effective control of food hazards, pests and other agents likely to contaminate food (FAO/WHO, 2007).

The objective of good premises design also required that surfaces and materials, particularly those that came into contact with food were non-toxic, durable, and easy to maintain and clean. Walls and floors were to be made of impervious non-toxic materials and suitable materials for design to ensure an effective protection against pest, adequate supply of portable water, and other sanitary facilities. Also, monitored parts of the premises had to be sanitized and pest control procedures undertaken to prevent access or infestation (FSA, 2006). The area surrounding the location of the workshop was considered important in view of airborne contaminants that could have posed a risk to the food business. Besides, odors emanating from the surrounding areas and infestation with pests were reported as likely to lower the standards of operation (CDC, 2008) if the facility was located in a poor environment.

Layout of kitchen was required to consider storage areas with goods' entrance clearly separated from customers' entrance. Stores arrangements were required to allow cool, well-ventilated and large enough vegetable storage rooms to allow for orderly storage. Stores were required to have a good drainage system to exit water. In addition, FAO

(2005) recommended that store walls and partitions had to be made with smooth surfaces that would ease cleaning and be treated with residual insecticides to prevent pest infestations. Besides, the storerooms were to be well lit, ventilated and where possible the doors had to be fitted with glass panel. Cabinets were to comply with the standard specification and allow the rotation of stock.

When planning for a kitchen, according to Griffin (2007), chief factors to be considered included the flow of work, the nature of various operations and the position of windows, doors and drainage. Kitchens were not to be used as thoroughfare to other parts of the building. The floors were to be constructed in such a way as to allow adequate drainage and cleaning. The windows were required to be easy to clean, constructed to minimize built-up dirt, while at the same time fitted with cleanable insect proof screens. The kitchen was required to have adequate natural and artificial lighting (Griffin, 2007).

Ceilings and overhead fixtures such as extraction hoods needed to be constructed to minimize the built-up of dirt, condensation of steam and the shedding of food particles. Built-in cupboards and other fixed kitchen units needed to be arranged to allow enough spacing. Free standing equipment were to be used as they were much more hygienic. Paster (2007) further recorded the several forms of kitchen organizations that existed, with the most common ones being the U- shape, L-shape and island arrangements. Paster (2007) asserted that an island layout made it easy to maintain and clean the equipment. Equipment may be fixed, wall mounted or mobile. McLauchlin and Little (2007) recommended that for ease of cleaning, equipment had to be accessible or mobile. If fixed, the equipment may have a space of at least 300mm behind them, as moveable equipment and worktops facilitated cleaning. Island grouping of cooking appliances

referred to an arrangement whereby all the cooking equipment were arranged in the middle of the kitchen, sometimes back-to-back and fitted with splash backs. McLauchlin and Little (2007) cited this system as convenient for the extraction of steam and odours.

Griffin (2007) argued that ideally, a good plan needed to have working tables against the walls between the sinks and the ovens, stores, mixing machines and ranges in the centre of the room. Working tables needed to be movable for easy cleaning. He added that cooking stoves and ranges required a canopy and exhaust fan system of ventilation (hoods) to draw off the fumes, and recommended small extract fans to draw steam and odours from small cooking ranges over a filter pad (Griffin, 2007). Griffin further added that working surfaces coming into direct contact with food needed to be made of smooth non - absorbent durable materials that were easy to maintain and sterilize. Alli (2004) reiterated that design and layout of a food premise had to be constructed in such a way that it permitted good hygienic practices. These hygienic practices needed to be extended beyond the food itself to the environment in which the food was prepared to prevent contamination. The accumulation of dirt on surfaces, floors, walls and ceilings of food storage, preparation, production and service areas undermined food hygiene, hence the requirement for the cleaning and disinfection of floors**,** walls, ceilings and other surfaces.

Sanitary facilities near work areas provided good personal hygiene, reduced loss of productivity and allowed proper supervision of food handler, asserted (Mc Swane, Rue & Linton, 2000). According to the Kenya Food, Drugs and Chemical Substances Act, cap254 of 1992 Regulation 11(K), adequate suitable and conveniently located change rooms, toilets and ablution facilities needed to be provided in all food establishments. (Regulation 8(2) of the Kenya building code section 150-166 and section 190 also stated

that facilities needed to be well ventilated, well lit and were not to be opened directly onto food preparation areas.

### 2.7.3 Waste Disposal

Waste if not properly removed would potentially result into contamination of food, equipment and water and also attract breeding of pests. According to the Kenya Food, Drugs and Chemical Substances Act, cap254 of 1992, Regulation 7 (11), waste needed to be disposed in designated containers with covers for temporary collection of waste and garbage. The containers were to be properly identified and were to be made of durable impervious materials. Besides, the containers needed to be kept in sanitary condition. Cap 242 of 1972 sections 127 and 128 of Kenyan regulation further stated that no leakage from the waste containers was to be allowed, and that the containers needed to be well maintained so that they would not become sources of contamination or pest infestations.

During the course of preparation, waste products were recorded to be generated in the store, kitchen and restaurant. These waste products were either organic (waste food, used cooking oils) or inorganic (papers, plastics, cans). These waste products became breeding grounds for microbes and served as potential sources of contamination when allowed to accumulate, or became centres of attraction for rodents, pests and flies if not disposed of properly. McLauchlin and Little, (2007) recommended immediate waste disposal by sorting and destroying according to type. According to Blanch (2003), the method of waste disposal needed to be in line with the recommendation of the public health officers. Fosket and Ceserani (2007) also maintained that accidents, contamination, pest infestation, unpleasant odours, fire hazard and pollution needed to be prevented with correct clearing and handling of wastes.

According to Fosket and Ceserani (2007) and McLauchlin and Little (2007), food and other waste containers needed to be closed, cleaned and disinfected, and all storage and waste disposal facilities needed to be designed and built with pest proof materials to allow easy cleaning. Pest infestations were recorded to occur as a result of inadequate cleaning, poor building maintenance, as well as suppliers' deliveries. Food pests included rodents (such as rats, mice, squirrels), birds and insects (such as cockroaches, flies, ants and wasps). Pests in food production areas were not only unsightly and repugnant, they also caused damage to food and building. According to Blanch (2003) and McLauchlin and Little (2007), pests contaminated food products by their bodies or body parts, fur, eggs and droppings and were a potential source of infection. Infestation of pests as suggested by McLauchlin and Little (2007); Blanch (2003); Fosket and Ceserani (2007) was controlled by denying the pests access, harbor, warmth, sources of food and water in the premises. This was achieved through regular inspection of the premises, cleaning of the workshop, immediate cleaning of spillage and food particles from the kitchen surfaces.

### 2.7.4 Wash – Up Areas

Where possible, crockery, cutlery, and all dirt articles were to be taken to the washing-up room, sorted into various categories and sizes and stacked (FSS, 2007). Wash- up areas in any operation was a very important section although it was regarded as a menial task. During wash-up, Paster (2005) asserted that food residues needed to be scraped or tipped off into refuse containers. The aim of scraping was to keep the washing water as free as possible from food particles and germs. A three-sink method of washing –up was appropriate where the first sink with hot soapy water was used for washing, the second

for rinsing with plain warm water and the third with water heated to a temperature of about $60^0$C ($140^0$F). The utensils were suitably arranged in wire baskets for immersion in the sterilizing rinse. No detergents or chemicals were to be added to the sterilizing sink but the water was to be maintained at a temperature of not less than $77^0$C ($170^0$F). The utensils were to be left in the hot water for at least two minutes. The hot temperature would also air – dry the utensils almost instantaneously. No further drying by clothe was recommended especially for crockery but could have been useful for cutlery (Paster, 2005).

Paster (2007) argued that thorough cleaning and effective sterilization of the utensils used in preparation and service was the manager's obligation to his/her customers. Sometimes dirty utensils were piled and allowed to accumulate until the end of the day, which created a possibility of a guest being served with dirty crockery or cutlery and particularly with cups stained with lipstick or over-running from previous fillings (Paster, 2007). To ensure wash – up was efficiently done, the staff were supposed to keep their hands meticulously clean, with no open wounds or sores on their hands and arms so as to avoid contaminating the utensils. Though most institutions washed their utensils manually by hands, some few institutions had washing machines. Whichever the methods applied, washing up should to be done promptly to prevent the accumulation of dirty utensils, which posed a risk of dangerous germs multiplying in the food residues. Efficient wash-up required suitable equipment to be followed by proper storage in a clean store. Indeed the rush hour practice of rinsing and washing in a basin of tepid water and washing a plate by holding it under cold water jet and then wiping with a tea towel before

placing it before a customer should not be tolerated in any establishment as practised in most of the TVET and hospitality restaurants.

Paster (2007) went on to argue that where chemical sterilizers were used, the usability, cost and availability were to be considered. The manufacturers' instructions needed to be carefully followed. The basin wash practised by many institutions was usually a greasy job and required ample supplies of clean and very hot water. Pan washing was done by hand and therefore, the use of special detergent and where possible scouring powder was recommended (Paster, 2007).

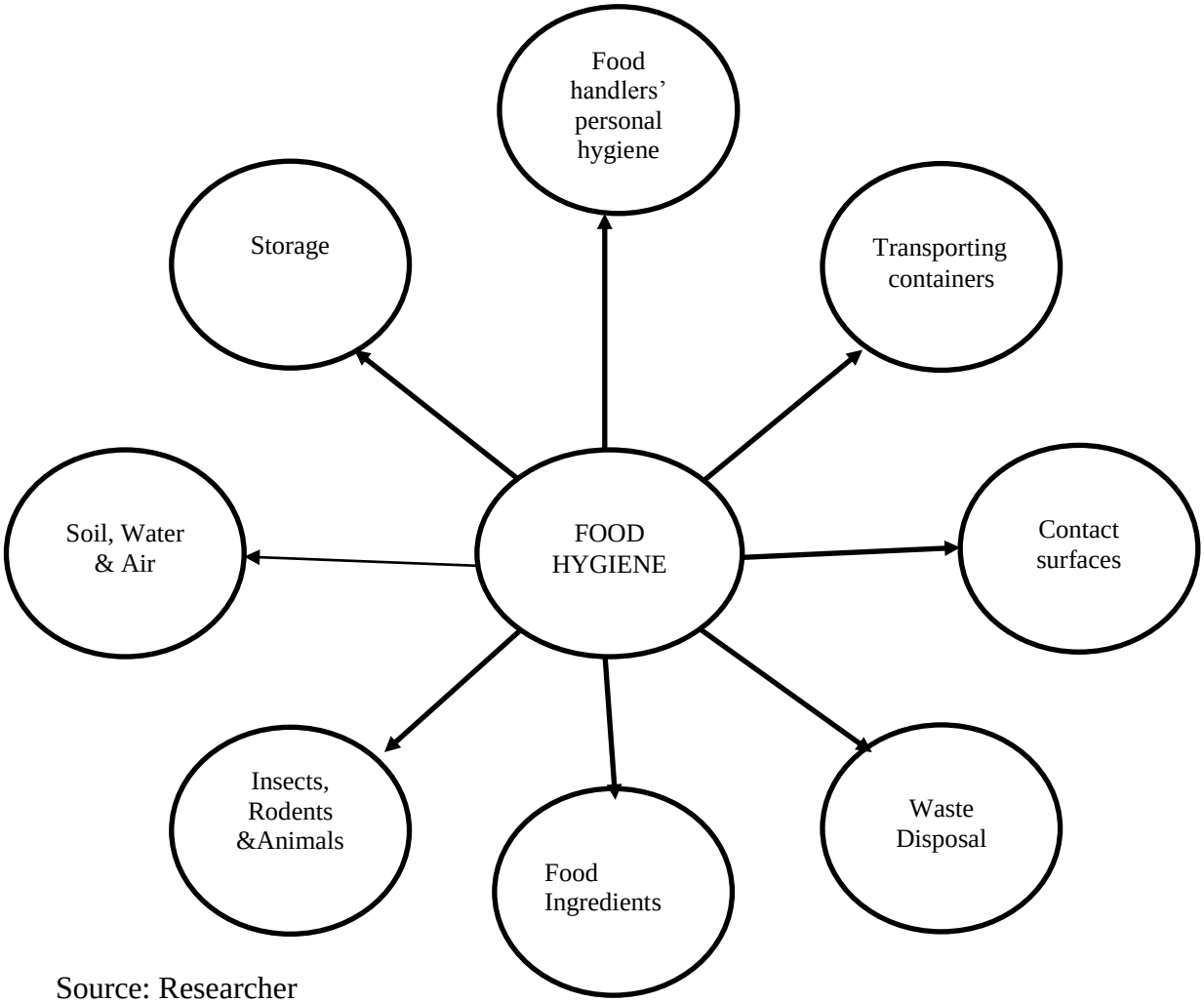
### 2.7.5 Water supply

Water being an essential commodity in the food industry used extensively for drinking, cleaning and preparing food, washing up, washing hands, equipment, utensils, containers, clothes, among others, it was imperative that the food premises got adequate supply of portable water for all the operations in the kitchens. There was also need for adequate supply of drinking water, and all ice consumed in food premises was supposed to be made from drinking water. Like food, water was a major source of contamination and infection leading to water-related diseases such as *diarrhoea, typhoid, cholera* and *salmonella typhimurium* Water used for washing food eventually became part of the food; therefore, it was necessary to ensure that contaminated water was not used in the kitchen. The sources of water used in food preparation determined the quality and safety of food prepared. According to Knowles (2002), water acted as a vehicle for a number of micro-organisms other than those which caused typical food poisoning. Water contamination needed to be controlled through boiling for small scale use and chlorination for large scale use. It was expected that all food establishments would source

their water from government regulated main water pipes but where a food premises could not access the main drinking water supply, private water supply needed to be arranged. The sources of private water supply ranged from deep boreholes to springs, wells and harvesting of the rain water (McLauchlin & Little, 2007). It was advised that all sources of water, whether private or from the mains needed to be protected from being contaminated by sewage caused by poor drainage system.

## 2.8 Food Hygiene

Food hygiene was defined as a sanitary science which aimed at producing food that had good keeping quality, was safe to consumer, and free from micro-organisms (Hobbs and Robert, 1993; Becker, 2003). Food hygiene entailed the provision of food for consumption with minimal risk of contracting food poisoning. This was to be achieved by exercising good hygiene practices during production, preparation, storage and service. It also included sanitary washing of dishes, work surfaces, proper waste disposal methods and maintaining an environment that was free from pest infestation. Mc Swane (2000) added that food hygiene was also concerned with cleanliness of the premise, vehicles used for transporting food, and proper separation of raw from cooked foods. Food safety encompassed all conditions and measures necessary for the safety of food and the prevention of potential causes of food poisoning. The cardinal aim of cooking food was to make it easy to eat and digestible, to kill microorganisms and to make it palatable. Besides, food that was well cooked was inclined towards setting standards for the establishment and ensuring a repeat of business.




Source: Researcher

**Figure 2.2:- Food Hygiene**

As indicated in Figure 2.2, food was mainly likely to be contaminated by flies, cockroaches and other insects, animals such as dogs, cats and human beings through cross contamination especially if environmental hygiene was compromised. Poor transportation of fruits and vegetables in inappropriate containers which were not kept clean were also recorded to lead to contamination. Additionally, storage of proteins in temperature danger zone was also considered as a major risk to contamination. Food contact surfaces such as work tables including equipment and tools used in food

preparation played an important role in food contamination (Clayton and Griffith, 2004). Apart from personal and environmental hygiene, food hygiene played an important role in the reduction of contamination and subsequently mitigating infection. It was therefore advised that food had to be kept clean at all times from the farm where the fertilizers used were expected to be free from pollution. Water used for irrigation was to be obtained from reliable sources.

WHO (2001) recommended that food be kept safe by preparing it just before eating time, and by serving hot food piping hot and cold food chilled. WHO (2001) further recommended that vegetables and fruits had to be washed thoroughly before eating and cooking especially for the salads. In addition, covering foods would prevent it from flies and other insects. It was further advised that surfaces, equipment and utensils needed to be maintained clean and sanitized to reduce the microorganisms.

### 2.9 Food-Borne Diseases and Microorganisms

Micro-organisms were defined as microscopic living organisms which occurred ubiquitously in the environment. Although some were harmless, some were virulent and could cause infections (CDC, 2008). The infections were due to several factors including violation of certain basic food hygienic practices. For example, FBDs were caused by micro-organisms or toxins transmitted through person to person, animal-human or human-animal contacts and through contact with the environment such as through human to surface or equipment. Transmissions of infections were recorded to either be directly or indirectly from food and/or water which, in most cases, acted as vehicles for infection. Contamination by food poisoning agents were said to occur at various stages during the

food chain in raw products, prior to harvesting, during slaughter or processing or as cross contamination in the kitchen by the food handlers.

CDC (2008) further recorded that eating food containing pathogens or their toxins (poisons) was the leading cause of food-borne illness. CDC (2008) further stated that there were four types of micro-organisms that could contaminate food and cause FBDs. These included bacteria, viruses, parasites and fungi. The National Restaurant Association (2006) recorded the nutrients that supported these microorganisms to grow included food, acidity, temperature, time, oxygen and moisture (FATTOM). It was also noted that almost all these are derived from foods that humans consume. According to WHO (2000), food-borne illness were reported daily the world over, in both developed and developing countries. Further reports indicated that diseases caused by contaminated food constituted one of the most widespread problems and was the main cause of reduced economic productivity. The prevalence rate of FBDs raised a lot of concern since the magnitude of the problem was unknown due to lack of reliable data. According to (WHO, Fact Sheet No. 124, Jan 2012), FBDs have been on the increase and even more challenging is the re-emergence of drug resistant microorganisms, which was viewed as a big threat to the hospitality industry.

According to CDC (2012) *Ecoli 0157: H.Listeria Monocytogenes and Salmonella Enterica* were three of the eight known pathogens that accounted for the vast majority of reported food-borne illnesses, hospitalizations and deaths each year (Montgomery and David, 2013). For example, outbreaks of *Salmonellosis* had been reported for decades, but within the past 25 years, the disease had increased in many continents. As a result, the food-borne illnesses were said to be on the increase due to micro-organisms. In 2006, for

example, there were 1270 reported food-borne disease outbreaks in USA resulting in 27,634 illnesses and eleven deaths (CDC, 2010). Another study done by Schaff in 2009 estimated that food-borne illnesses cost the United States $152 billion per year in healthcare, workplace, and in other economic losses. In addition, the Americans also experienced nationwide shock as outbreaks of toxic *E. coli 0157:H7* was discovered in spinach. Other reports indicated that in 2006, 250 individuals were infected in twenty-six states and three people died in the outbreak (US/FDA, 2007).

*Salmonellosis* was recorded to be the most commonly reported bacterial food-borne illness resulting to many hospitalizations and even death, followed by *Listeria monocytogene* then *Ecoli*. (EHEC) *Enterohemorrhagic. E. Coli* is a group recognized as the primary cause of hemorrhagic colitis (bloody diarrhoea). According to (WHO 2002), the outbreak of food-borne diseases in industrialized countries is attributed to relatively new pathogens such as *Campylobacter jejune, Listeria monocytogen* and *Escherichia coli 0125:H7* (US FDA 2007).

### *2.9.1 Salmonella*

In Europe and other Western countries, *Salmonella serotype entiritidis* (SE) had become the predominant strain (Boyce et al., 1995). Investigations of SE outbreaks indicated that its emergence was largely related to consumption of poultry, meat and their products. In Australia, Canada, United States, European countries and South Africa, infections with *E. coli serotype 0157:H7* was reported to be a major cause of bloody diarrhoea and acute renal failure (Mortajemi et al, 2002). Outbreaks of these infections were associated with beef consumption and were said to be fatal particularly in children. In Japan for example it is recorded that in 1996, an outbreak of *E. coli 0157:H7* affected over 6300 school

children and resulted in two deaths (WHO fact sheet No. 124, 2002). This was considered as the largest outbreak ever recorded for this pathogen. In Canada, in the town of Walkerton, Ontario, an outbreak of *E. coli 0157* claimed 5 lives and left 27 hospitalized (WHO, 2002). Laboratory tests confirmed that *E. coli* contamination was predominantly in the water supply system. As a result, the public health unit issued a "Boil Water Order" to the residents of Walkerton, which was still in effect by the time the information was published by WHO (2000).

Many developed countries had experienced outbreaks of diseases due to newly recognized types of food-borne pathogens such as *Campylobacter jejuni, Listeria monocytogenes and E. coli 0157:H7. Campylobacter* and *Vibrio parahaemolyticus which* were the most common pathogens in fish, were most probably transmitted in the market or while cooking, according to Adam and Motarjemi (2001). Other contaminants like pesticide residues or environmental chemicals were also reported in fruits and vegetables. Examples included *Bacillus, Clostridium*, and *Listeria monocytogens,* which were said to be introduced from the soil, as well as viruses such as rotavirus and bacteria including *Shingella, Salmonella, and E-coli*.

It was also reported that governments all over the world were intensifying their efforts to improve food safety (Breuer et al., 2001). The efforts were in response to an increasing number of food safety problems and the rising cases of consumer concerns. Though global incidences of food-borne diseases were difficult to estimate, it was reported that in the year 2000 alone, 2.1 million people died from diarrheal diseases. These cases were attributed to contamination of food and drinking water (Fact Sheet, Jan, 2002). In the

United States of America for example, around 76 million cases of food-borne diseases were reported. Out of this number, 325,000 people were hospitalized.

In Rome, it was reported that millions of people still suffered from communicable and non-communicable diseases, despite awareness and measures taken to protect them against the vice (FAO, 2001). The report further revealed that other challenges which included lack of access to clean water, proper disposal of sewage and irregular refuse disposal could be associated with the many food related problems. The problem was not limited to developing countries alone. Studies in industrialized countries estimated that each year, between 5-10% of the population suffered from food-borne diseases. In many countries, *Salmonella enteritidis* was cited as the predominant pathogen and poultry, eggs and egg products were identified as the major source. Globally, about 60-80% of poultry were reported to be contaminated with *Salmonella enteridis* which was mostly associated with poultry and eggs, dairy products and beef. In USA, it was reported that in 2008, an outbreak of *salmonella* led to the infection of 1442 persons. Out of this number, 286 persons were hospitalized in 43 States in the District of Columbia and Canada. This was said to be the largest food-borne outbreak in the US in ten years (Warnock, 2008).

In developing countries in Latin America, Asia and Africa, the rate of infection had been less documented yet these countries had borne the brunt of the problem due to the presence of a wide range of food-borne diseases. *Salmonella* and *shigella* were considered as main pathogens responsible for most of the food-borne diseases and had been largely associated with diarrhoea, abdominal pains, nausea and vomiting (Mortajemi et al., 2002). Although viruses did not grow on food, raw fruits and vegetables had been cited to provide avenues for infection. For example, many outbreaks of Hepatitis A were

associated with consumption of lettuce and diced tomatoes (Kaferstein et al., 1999; Yanamala, 2011).

In African countries, particularly in Kenya, reported cases of food-borne diseases were considered insignificant although health facilities indicated that prevalence level of FBD symptoms were many (Fact sheet No. 124, 2002). *Vibrocholera* was a major public health problem in developing countries. It was found in contaminated water and food that included rice, vegetables, millet, gruel, and various types of fish. Its symptoms included abdominal pain, vomiting and profuse diarrhea which led to severe dehydration and eventually death (Fact Sheet No. 124, 2002). Recently, according to a UN report, an outbreak of cholera was confirmed in two Sudan cities where it claimed 27 lives after use of unclean water. In less than two weeks, 1433 causes had been reported. The disease was known to spread fast especially in closely-knit populations.

Food-borne illnesses were classified as infections, intoxications and toxin-mediated infections. Different types of bacteria were cited to cause major food-borne illnesses. These included *campylobacteriosis, salmoneliosis, shingellosis, listeriosis, vibrio parahaemolyticus* and *vibrio vulnificus*. In particular, bacteria that caused intoxication included, among others, *Bacillus cereus*, which was a spore forming bacteria found in the soil. Foods commonly associated with the bacteria included rice, cooked corn, cooked potatoes, vegetables and their processed products.

The factors contributing to food-borne illnesses were listed as time, temperature abuse, unsafe hygienic practices and cross contamination. All the three were said to be related to food service employees who did not conform to food safety guidelines (Food and Drugs Administration, 2000 & 2004). A publication by the National Restaurant Association in 2008 recorded that over 13 million people were employed in the restaurant industry. Research showed that food service establishments were more concerned with the task of serving guests than following the laid down rules and regulations on food safety. The argument was that food service employees did not comply with food safety guidelines because they received inadequate training (Green and Selman, 2005) and (Lynch et al., 2003). Green, Selman and Lynch also argued that food safety training was also associated with increased knowledge among food service operators.

### *2.9.2 Brucellosis and Other Pathogens*

Brucellosis was another food-borne disease that was raising concern. It occurred worldwide but in North America and Western Europe, the incidents were reported to have decreased due to strict surveillance and the application of HACCP system. However, the disease still remained an important health problem in the Mediterranean countries (Egypt, Greece, Italy, Morocco and Tunisia), the Middle East (Iraq, Iran, Saudi Arabia) Mexico, Peru and some regions of China and India. *Vibrio-parahaemolyticus* was listed as another pathogen that caused acute gastroenteritis. In developing countries, especially in Africa, the microorganism constituted a group of pathogens that caused persistent diarrhoea. This group included *Giadialamblia*, *Cryptosporidium ssp* and *Entramoebahistolytica*. These pathogens mainly affected children and people with impaired immunity. Raw and uncooked meat and vegetables were major routes for their

transmission. Other parasites transmitted through raw meat included *Trichinella spiralis*, *Taechiasolium* and *Taechia Saginatyaawhich* (Mensah, 2002).

According to Francois (2006), 75% of emerging and re-emerging food-borne diseases were caused by animals. For example, *bovine Spongiform Encephalopathy* BSF, a fatal transmissible neuro degenerative disease of the cattle, was first discovered in the United Kingdom in 1985. This epidemic attacked over 180,000 animals in the UK alone (CDC, 2005). The disease affected brain and spinal cord of the animals. The disease is reported to have since spread to 19 other countries including Japan. In human populations, exposure to the BSF agent was linked to the appearance of a new transmissible Spongiform Encephalopathy of humans called Variant Creutzfeld- Jacob Disease (VCJD) in 1996 from France. As of January 2002, 119 people had developed human VCJD, most of them from the UK and 5 from France.

The most recent food-borne disease was the Avian Influenza. According to WHO (2005), the virus, which attacked birds, was highly pathogenic. The flu started in Asia, moved to Europe and more recently moved to Africa. It was reported that the virus infected human beings through contact with infected live or dead poultry. Exposure may have also occurred when the virus was inhaled through dust and possibly through contact with contaminated surfaces. Strain of Avian Influenza virus was found only in the respiratory and gastrointestinal tracts of infected birds and not in the meat. However, available data showed that highly pathogenic viruses such as *H5N1* strain may have been spread through marketing and distribution channels, since low temperature was conducive for the viruses. Available data further indicated that the virus survived in poultry droppings

for at least 35 days at low temperature of $4^0$C while at $37^0$ C, it could survive for six days (WHO, 2005). It was also noted that *H5N1* was not killed by refrigeration.

Further reports indicated that the eggs could contain *H5N1* virus both on the shell and on the inside (white and yolk). As a result, it was recommended that eggs from areas with *H5N1* outbreak were not supposed to be consumed raw or partially cooked (runny yolk for breakfast). Furthermore, uncooked eggs were not supposed to be used in foods that were not to be cooked, baked or heat-treated. In line with this, cooked poultry was supposed to be served "piping hot." Although there was no evidence indicating that people had been infected with *H5N1* virus after consumption of properly cooked poultry or eggs, previous studies showed that the greatest risk of exposure to the virus was through handling or slaughtering of live infected poultry. Good hygienic practices were, therefore, essential during and post-slaughter handling to prevent cross contamination from poultry to other food and from food preparation surfaces and equipment.

UN declared a regional crisis in West Africa, warning that the entire region was at risk of *H5N1* infection. The virus had spread to many countries in Europe, Africa and Middle East within a very short time. Out of the 175 people who were infected with the bird flu, over 96 resulted in deaths. Iran, Egypt, Ethiopia and Sudan were reported to be the countries that had so far been affected. Kenya set aside $1.2 million as a preventive measure. The World Health Organization also expressed fear that bird flu could have been spreading in developing countries undetected due to lack of laboratories and capacity to detect it. On the same vein, UN experts warned that the Avian Influenza was moving across the world at a threatening speed. The UN further cautioned that the virus

could mutate into a strain that could spark a human pandemic with disastrous effects if the international community did not set up measures to curb the outbreak of the bird flu.

### *2.9.3 Ecoli*

According to FAO/WHO (2005), *Enterrohemorrhagic E.coli* was another serious pathogen in regard to food safety. This concern led to formation of Codex Committee of Food Hygiene (CCFH). *Enterohemorrhagic E. coli* (EHEC) *0157:H7 serotype* was first identified as a human pathogen in 1892 in the USA. This was after two main outbreaks of hemorrhagic colitis (bloody diarrhoea). Since then, it is reported that outbreaks of this pathogen have become a serious public health problem throughout many regions of the world (Schlundt, 2001; Clarke et al., 2002). Further studies on the thermal sensitivity of *E. coli 0157:H7* in ground beef revealed that heating killed *E. coli* strains as well as *Salmonella spp*. The optimum temperature for growth of *E. coli 0157:H7* was approximately $37^0$C and the organisms would not grow at a temperature below $8^0$C to $10^0$C (Yanamala, Miller, Loneragan, Brashears and Cragg, 2011). On the other hand, *E. coli 0157:H7* survived freezing. The study also reported that *E. coli 0157:H7* was more acid resistant than other *E. coli* strains. McCarthy (2009) observed that monitoring of *Salmonella typhimurium* was of great importance because of its high survivability.

Food vehicles implicated most frequently were raw or inadequately cooked foods of bovine origin, especially undercooked, ground or minced beef and unpasteurized milk. Similarly, a number of outbreaks were also associated with the consumption of raw or minimally processed fruits and green leafy vegetables. It was reported that between 1993-1999, beef was the main source of 46% of food-borne outbreaks in the US. Other products included improperly pasteurized cow's milk. It was also realized that

pasteurization eliminated pathogens from milk including *E. coli 0157:H7*. Further research also confirmed that the fruits and vegetables contaminated with *E. coli 0157:H7* resulted in a number of outbreaks (Ackers et al., 2002).

Green leafy vegetables were cited as the source of 26% of food-borne diseases in the US between 1998 and 1999. Although contamination of vegetables could have occurred in several ways, the use of fertilizer or water contaminated with faecal matter was suspected to be the most possible route of infection (Solomon et al., 2002). In addition, suspected fertilizer from nearby cattle and poor sewage treatment was considered as another source of *E. coli 0157:H7* strains detected in cabbage plants. Ingestion of *E. coli 0157:H7* infection ranged from asymptomatic infection to death. Incubation period from the time of ingestion to the first symptom ranged from one to eight days. Illness begun with abdominal cramps and non-bloody diarrhoea, which further progressed to bloody diarrhoea within 2 to 3 days (Mead, 1998). More severe manifestation of *E. coli 0157:H7* infections included haemorrhagic colitis (bloody diarrhoea), where most vulnerable groups were children and the elderly. However, people from all ages were reported to have possibly suffered from infections of *E. coli 0157:H7*.

During 1994-2000, the number of cases of *E. coli* increased from 1,420 (0.8/100,000 people) in 1994 to 4410 (approximately 1.6/100,000 people) in 2000 (CDC, 2001). In Belgium, 97% of the food-borne diseases in the year 2000 were associated to *E. coli 0157:H7* infection (Gilbert, 2001). Many other developed nations including Japan, Britain, Australia, North America and Europe also realized the burden of the food-borne diseases. Green leafy vegetables were said to grow low to the ground and were, therefore,

recognized as another source of *E. coli 0157:H7* infection. Vegetables were, therefore, considered as potential vehicles for transmission of pathogenic micro-organisms.

Meat became contaminated with *E. coli 0157:H7* when beef carcasses came into contact with faeces and contaminated hide during the slaughter process (Elder et al., 2000). Food-borne *trematodes* were also emerging as a serious health problem, especially in South East Asia and Latin America due to increased aqua culture productions under unsanitary conditions. Hilborn et al., (1999) reported that consumption of raw and lightly processed fish and fishery products contributed to rising cases of FBDs. This affected an estimated 40 million people worldwide, especially among those living along the Coast. In humans, it was said to have caused acute liver disease and may have lead to cancer of the liver.

### *2.9.4 Pseudomonas*

*Pseudomonas* were described as rod-shaped gram-negative aerobic, non-spore forming type of bacteria commonly found in water, or some type of plant seeds. They were widely found in the environment such as soil and water plants. They thrived in moist areas and were found in hospital setups. The infection acquired in hospitals was referred to as nosocomial infection. Free bacteria found in wet areas such as sinks, antiseptic solutions and urine receptacles caused pseudo infections. It was noted that healthy persons were usually not at risk of infection. Pseudomonas infections were considered opportunistic infections, that is, they only caused disease when a person's immune system was already impaired. These included patients in burns units, cancer patients undergoing chemotherapy, HIV patients and cystic fibrosis or presence of a foreign body such as catheter.

Infection in the blood was called *bacteremia*. Symptoms included fever, chills, fatigue, muscle and joint pains. Infection of the lungs, pneumonia was indicated by symptoms, which included chills, fever, productive cough and difficulty in breathing. Others included skin infection called *folliculitis* – itchy rash, bleeding ulcers and headache. The isolation of pseudomonas could be attributed to wet surfaces in the kitchen.

Food-Borne Disease Causing Organisms are summarized below:

**Table 2.1:- Food Borne Disease Causing Organisms**

| Organisms | Common name of illness | Onset time after ingesting | Signs and symptoms | Duration | Food sources |
|---|---|---|---|---|---|
| *Bacillus cereus* | *B. cereus* food poisoning | 10-16 hrs | Abdominal cramps, watery diarrhea, nausea | 24-48 hours | Meats, stews, gravies, vanilla sauce |
| *Campylobacter jejuni* | Campylobacteriosis | 2-5 days | Diarrhea, cramps, fever, and vomiting; diarrhea may be bloody | 2-10 days | Raw and undercooked poultry, unpasteurized milk, contaminated water |
| *Clostridium botulinum* | Botulism | 12-72 hours | Vomiting, diarrhea, blurred vision, double vision, difficulty in swallowing, muscle weakness. Can result in respiratory failure and death | Variable | Improperly canned foods, especially home-canned vegetables, fermented fish, baked potatoes in aluminum foil |
| *Clostridium perfringens* | Perfringens food poisoning | 8–16 hours | Intense abdominal cramps, watery diarrhea | Usually 24 hours | Meats, poultry, gravy, dried or precooked foods, time and/or temperature-abused foods |
| *E. coli (Escherichia coli)* producing toxin | *E. coli* infection (common cause of "travelers' diarrhea") | 1-3 days | Watery diarrhea, abdominal cramps, some vomiting | 3-7 or more days | Water or food contaminated with human feces |
| *E. coli* | Hemorrhagic colitis or *E. coli* O157:H7 infection | 1-8 days | Severe (often bloody) diarrhea, abdominal pain and vomiting. Usually, little or no fever is present. More common in children 4 years or younger. Can lead to kidney failure | 5-10 days | Undercooked beef (especially hamburger), unpasteurized milk and juice, raw fruits and vegetables (e.g. sprouts), and contaminated water |
| *Listeria monocytogenes* | Listeriosis | 9-48 hrs for gastro-intestinal symptoms, 2-6 weeks for invasive disease | Fever, muscle aches, and nausea or diarrhea. Pregnant women may have mild flu-like illness, and infection can lead to premature delivery or stillbirth. The elderly or immune compromised patients may develop bacteremia or meningitis | Variable | Unpasteurized milk, soft cheeses made with unpasteurized milk, ready-to-eat deli meats |
| Noroviruses | Variously called viral gastroenteritis, winter diarrhea, acute non-bacterial gastroenteritis, food poisoning, and | 12-48 hrs | Nausea, vomiting, abdominal cramping, diarrhea, fever, headache. Diarrhea is more prevalent in adults, vomiting more common in children | 12-60 hrs | Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler; shellfish from |

| **Organisms** | **Common name of illness** | **Onset time after ingesting** | **Signs and symptoms** | **Duration** | **Food sources** |
|---|---|---|---|---|---|
| | food infection | | | | contaminated waters |
| *Salmonella* | Salmonellosis | 6-48 hours | Diarrhea, fever, abdominal cramps, vomiting | 4-7 days | Eggs, poultry, meat, unpasteurized milk or juice, cheese, contaminated raw fruits and vegetables |
| *Shigella* | Shigellosis or Bacillary dysentery | 4-7 days | Abdominal cramps, fever, and diarrhea. Stools may contain blood and mucus | 24-48 hrs | Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler |
| *Staphylococcus aureus* | Staphylococcal food poisoning | 1-6 hours | Sudden onset of severe nausea and vomiting. Abdominal cramps. Diarrhea and fever may be present | 24-48 hours | Unrefrigerated or improperly refrigerated meats, potato and egg salads, cream pastries |
| *Vibrio parahaemolyticus* | *V. parahaemolyticus* infection | 4-96 hours | Watery (occasionally bloody) diarrhea, abdominal cramps, nausea, vomiting, fever | 2-5 days | Undercooked or raw seafood, such as shellfish |
| *Vibrio vuAlnificus* | *V. vulnificus*infection | 1-7 days | Vomiting, diarrhea, abdominal pain, blood borne infection. Fever, bleeding within the skin, ulcers requiring surgical removal. Can be fatal to persons with liver disease or weakened immune systems | days | Undercooked or raw seafood, such as shellfish (especially oysters) |

Source: The U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition (www.fda.gov).

## 2.10 Prevalence of Food-borne Diseases

According to Centers for Disease Control and Prevention (CDC), in the United States of America, an estimated 76 million people contracted a food-borne disease each year. CDC further recorded that globally, 1,500 million episodes of diarrhoea occurred annually in children under the age of 5. Out of this number, over 3 million died every year. Even though about 70% of diarrheal disease episodes may have been food-borne and transmitted through food contamination, diarrheal diseases were also a major underlying factor in malnutrition in Africa (Mukhola, 2000).

The Kenya Food, Drugs and Chemical Substances Act, 1992 (Cap 254) and the Kenya Public Health Act, 1986 (Cap 242), recognized the severity of food poisoning though the magnitude was not known, due to underreporting and lack of proper documentation caused by little investigation (Kaferstein et al., 2000; Mengech, 2003). According to a report in the January 2003 issue of the *East Africa Medical Journal*, Kenya reported 37 outbreaks of diseases that included dysentery, typhoid, cholera and *salmonellosis*, with symptoms of vomiting, diarrhoea, headache, and abdominal cramps. In July 2003, twenty- two cases of *salmonellosis* were reported at Eldoret Referral Hospital. The cases were attributed to food and the implicated food was confirmed to be salad (Mengech, 2003).

In Nairobi, Kenya, a research was conducted in a tertiary institution to measure the proportion of nosocomial diarrhoea cases associated with *salmonella* and *shigella* species in 667 patients. The patients were screened on admission. The results indicated that the two microorganisms were isolated and of more concern, *salmonella* strains were isolated

in children under 13 years of age (Paton, Nicole, Mwongera, Kabiru, Mirza, Plummer and Wamola, 2012). Moreover, another research conducted by Kenya Medical Research Institute (KEMRI, 2014) established that most of the chicken sold in butcheries in Nairobi, supermarkets and retail outlets posed a serious health threat to consumers.

The survey further revealed that the meat was highly contaminated with hard to kill germs. The team leader of the research funded by WHO and Food Agricultural Organization called upon the health officials to ensure that hygienic principles were maintained in the handling and processing of chicken. Coliform bacteria was isolated in 97% of the samples while *E.coli* strain, which was found to be resistant to 12 common antibiotics was found in more than half of the samples collected. *E.coli* was associated with bloody diarrhoea. A member of the team advised Kenyans to cook chicken well. The cause of infection was associated with cross contamination during transportation, packaging and environment.

### 2.11 Factors Contributing to Food-borne Diseases

Food-borne diseases occurred for a number of reasons including, among others, increase in international travel and trade, microbial adoption, changes in the food production and globalization of food supply. In North America, for example, in 1996-1997, an outbreak of *Cyclosporiosis* was linked to contaminated raspberries imported from South America (Fact Sheet No. 124, 2002). According to WHO, introduction of pathogens into new geographical areas was also viewed as a contributing factor to the emergence of food-borne diseases (Fact Sheet No. 124, 2005). For example, *Vibrio cholera* was introduced in waters off the Coast of Southern United States when a cargo sheep discharged

contaminated ballast into the water in 1991. It is assumed that a similar mechanism led to the introduction of cholera in South America the same year (Fact Sheet No. 124, 2002).

Further reports indicated that there were many risks associated with food safety due to industrialization and mass food production. Other factors such as the emergence of longer complex food chains, fast food consumption, street vended foods, and growing eating out habits were cited as the major causes of food safety problems (Penisello and Quantic, 2001). In addition, travellers, refugees and immigrants exposed to unfamiliar food-borne hazards while abroad were also contributing factors to FBDs. In Sweden, for example, it was estimated that about 90% of all cases of s*almoneliosis* were imported (Fact Sheet No 124, 2002). Other factors experienced by many countries included changes in microbial population which led to evolution of new pathogens and development of new variant strains in old pathogens. This transformation resulted to antibiotic resistant organisms making a disease more difficult to treat (Fact Sheet no 124, 2002). This was observed where microorganism isolated in one country exhibited different characteristics in another country making it difficult to be identified and controlled.

Increases in the global population of highly susceptible persons were a warning trend to various nations with respect to FBDs. The upward trend was attributed to aging, malnutrition, HIV/AIDS pandemic and other underlying medical conditions. Elderly individuals were likely to be infected more because they had low immunity to infection. In fact, people with weak immune system were even infected with pathogens at lower doses. For example, persons suffering from cancer or HIV and AIDS were more likely to succumb to infections with *Salmonella, Campylobacter, Listeria, Toxoplasma,*

*Cryptosporidium* and other food-borne pathogens. In addition, in developing countries, poor nutritional status led to reduced immunity particularly in children and the old people, who consequently became more susceptible to food-borne infections (Fact Sheet 124, 2002).

A change in lifestyle was said to contribute significantly to the spread of food-related infections. Behaviours and practices such as eating in restaurants, canteens, fast food joints and informal outlets increased chances of consumption of contaminated foods. In many countries, effective food safety education and control did not match the boom in food service establishments. As a result, unhygienic preparation of food provided good opportunities for contamination, growth and survival of food-borne pathogens (Fact Sheet, No 124, 2002). Processing factors that contributed significantly to food-borne diseases were related to how food handlers managed various stages of food purchase and preparation, up to the point of service.

Major documented factors associated with food-borne diseases in homes and institutional settings especially in the restaurants included improper holding temperature, inadequate cooking, contaminated equipment and poor personal hygiene. According to Cody and Keith (1991) and WHO (2005), these factors had to be controlled to keep the foods safe. Boyce et al., (1995) reported that under-cooking contributed to outbreaks due to *Clostridium botulinum* (91%), *Vibro parahaemolyticus* (92%), *clostrdium perfrigens* (65%), *salmonella species* (67%) and *Trichinella spiralis* (100%). Raw seafoods were sources of *Vibro parahaemolyticus* and *enteric* viruses. Raw uncooked pork and game meat were potentially infected with *Trichinella* larvae. It was suggested that all foods had

to be heated to the time, temperature and values required to kill pathogens (Cody & Keith, 1991; WHO, 2005).

While food-borne diseases were a burden to both developed and developing countries, the challenges in developing countries were aggravated by socio-economic factors such as widespread poverty, large- scale migration to already crowded cities and rapid growth of population among others (Martin, 2005).

Moreover, climatic factors exacerbated food hygiene problems since high ambient temperatures were conducive to the growth of mesospheric bacterial pathogens. The high levels of humidity were also cited as favourable for the growth of other microorganisms (Martin, 2005). Sanitary conditions were also considered as a big challenge. WHO (2006) reported that about 2.6 billion people in the developing world lacked toilets and about 1.1 billion had no access to portable water. Poverty at the individual level was also cited to increase food safety problems due to lack of facilities, for the hygienic preparation and storage of food.

### 2.12 Food Flow from Farm to Fork

Food-borne infections occurred due to breakdown in basic hygienic practices in the entire food flow from farm to table. Food safety in any establishment depended on food flow, which referred to how food was handled from purchasing and receiving through storing, preparation, cooking, holding, cooling, reheating and finally serving (National Restaurant Association Education Foundation, 2006). NRAEF (2006) added that most food service experts considered cross contamination as the main challenge in the food flow. Cross contamination was defined as the transfer of microorganisms from one food surface to

another. Microorganisms were said to be transferred from food or unwashed hands to preparation tables, equipment, utensils, cutting boards or from one food substance to another. Physical or procedural barriers were created between food products to prevent cross contamination. These physical barriers included assigning specific equipment to each type of food product then cleaning and sanitizing all work surfaces, equipment and utensils after each task (NRAEF, 2006).

Procedural barriers referred to purchasing ingredients that minimized preparation time for various foods such as raw meat, fish and poultry. To keep food safe, NRAEF (2006) argued that food was not to be left in the danger zone of between 41°F and 135°F for long. Todd and Farber (2006) asserted that to prevent time temperature abuse in any establishment, time and temperature controls had to be incorporated in the standard operating procedures by introducing thermometers to employees for regular checking of temperatures and the corresponding time of the readings. NRAEF (2006) added that thermometers were the most important tools to manage and prevent temperature abuse, and that they were supposed to be washed, rinsed, sanitized and air-dried before and after each use to prevent cross contamination. Additionally, they were supposed to be calibrated using either boiling point adjusted to 212°F or by the use of ice water and adjusted to 32°F (NRAEF, 2006).

Abuse of temperature and/or time also occurred when food was not cooked to the required minimum temperature, cooled properly, reheated properly or held at a proper temperature. The standard temperature control in operating procedures included removing from the refrigerator only what was needed at a time.

## 2.13 Food Safety Management Systems

Food Safety Management System was defined as a group of programmes, procedures and measures for preventing food-borne illness by actively controlling risks and hazards throughout the flow of food (NRAEF, 2006). Food safety systems addressed issues related to basic sanitation and operation conditions, which included personal hygiene programme, supplier selection and food specification programme. This was in relation to the Codex Alimenterius Commission, an International body which was set by World Health Organization with the aim of ensuring the safety of the consumer and fair practices in the food trade were implemented. The EU was among the organizations using the programme. Codex Alimenterius Commission and Food Hygiene Committees made efforts to clarify the principles of food hygiene, by elucidating the rationale behind these principles and providing examples as to how the principles were to be applied (Mitchan, 2007).

Food safety management systems also entailed Active Managerial Control (AMC), which managed food safety risk and focused on the five most common risk factors responsible for food-borne illnesses as identified by the Centre for Disease Control and Prevention (CDC). The points included purchasing food from unsafe sources, failing to cook food adequately, holding food at improper temperatures, using contaminated equipment and generally practising poor personal hygiene (Mitchan, 2007).

Several systems addressing food safety were put in place in different countries. Such systems included HACCP that ensured quality service and product delivery in the entire food flow, and International Organization for Standardization (ISO), the world's largest

developer of voluntary international standards. The ISO standards are related to different fields as follows:

ISO 9000: Quality Management Standard

ISO 14000: Environmental Management Standard

ISO 22000: Food Safety Management Standard

ISO 17025: Laboratory Management Standard

The most relevant standard to this study was ISO 22000, related to Food Safety Management Standard.

The food hygiene standards, which had been in operation in many institutions included: The General Food Safety Hygiene regulations of 1990, 1995, 2002 and FAO/WHO Codex Alimentarius Commission Standards. Although HACCP had been introduced as one of the best food safety measures, the system was viewed as expensive and difficult to implement due to lack of capacity and long processes, which many institutions felt was tedious and out of reach for them due to financial constraints. Recently, the ISO certification came up with certification of institutions, which complied with the set standards for management of various activities in an organization. A brief look at ISO 22000 (2005) and ISO (2007) gave a clearer understanding of the management systems:

ISO 22000 (2005), an international standardization also known as generic food safety management system, was specifically designed to be used for certification or registry purposes, mainly because an accredited auditor formally registered an institution if it was compliant with the requirements of the system.

The system comprehensively described a set of general food safety requirements that applied to all organizations in the food chain. In this context, food chain was explained as a complete outline involved in the creation to consumption of food products. This included every step from initial production to final consumption, and involved production, processing, distribution, storage and handling of all food ingredients. However, since the food chain also included the organizations that did not directly handle raw materials used in food production, a number of categories of organizations were included in the food flow:

- Primary producers: Farms, fisheries, ranches, dairies;
- Processors: Fish, meat, poultry and feeds;
- Manufacturer: Bread, soup, snack, cereal, canned food;
- Food service providers: Restaurants, cafeteria, hospitals, airlines, cruise ships, nursing homes, senior lodges, grocery stores;
- Other service providers included storage service provider, catering service provider, transportation, sanitation service provider and cleaning service provider among others.

ISO 22000 (2007) used policies and structures defined by HACCP. The system, therefore, was involved in identification, prevention and control of food safety hazards. This implied that ISO comprehensively dealt with how to conduct a food safety hazard, identified critical control points (CCPs), established limits for each CCPs, developed procedures to monitor CCPs, designed a corrective action to handle critical limit violations, created a food safety record keeping, and validated and verified the system (CDC, 2007).

Critical control limits defined a set of values that separated acceptability from unacceptability. These parameters, according to CDC (2007), if maintained within permissible limits confirmed safety of food products. In other words, critical control points provided a tolerance level in the food flow (CDC, 2007). For instance, critical control point analyses checked on optimal temperature for each step in a food flow and the duration required for any step in food production procedures. Questions asked in such analyses included how, where, when and who. 'How' defined the methodology used to monitor the critical limit, 'where' defined the location for undertaking the activity, 'when' defined the time or frequency of the activity, and 'who' defined the responsibility for undertaking the monitor (Mitchan, 2007).

### 2.14 Overview of Food Safety Systems in Kenya

The national food safety system in Kenya is managed by various agencies under different ministries and laws. These laws, contained in the Public Health Act Cap 424, the Meat Control Act Cap 356 of the laws of Kenya, the Food, Drugs and Chemical Substances Act Cap 254 of 1992 and Public Health Act Cap 242 of 1986 of the Laws of Kenya, were designed to protect the consumers from potential biological, chemical and physical hazards. Existing laws on food safety also appeared in different institutions notably the Kenya Bureau of Standards (KBS), Department of Veterinary Services (DVS) and Ministry of Health (MoH). Other bodies included Kenya Plant Health Inspectorate Service (KEPHIS), a regulatory agency for quality control of agricultural input and produce. DVS on the other hand had the mandate to regulate the health of livestock and control the importation of livestock and livestock products. KBS had the mandate to

prepare standards relating to products and certification of industrial products and quality inspection at ports of entry among others. The food safety system aimed at promoting public health, protecting consumers against health hazards and enhancing economic development. To achieve the stated aims, the government enforced suitable food safety laws to reduce the number of FBDs and the social burdens of healthcare (caregivers' time, expenditure), so as to enhance per capita revenues, productivity and to promote food security (WHO/FAO, 2005).

Although KBS had some guidelines on food safety, the implementations of policies that guided activities in the food service implementation of the said regulations were not monitored. Besides, no surveillance was carried out to ensure that the policies were followed. As a result, impacts of food-borne diseases in Kenya could be broadly categorized into economic, health and social effects.

Economically, disease outbreaks affected general productivity of the citizens, which in turn led to low-income generation. Apart from reduction in the proportion of a healthy population in the country, failure to meet international food safety attracted threats of banning the horticultural produce and fish exports (WHO/FAO, 2005). This action, too, had serious effects on the Kenyan economy. Health impacts of FBDs were viewed in terms of prevalence or occurrence trend of food-related illnesses. The WHO/FAO Conference held in Zimbabwe in 2005 reported that in 2004, Kenya had experienced significant prevalence of food-related illnesses. Specifically, there were 722,275 cases of gastroenteritis, which would have been more if all cases would have been reported and documented. Socially, much time and other resources are spent on prevention and control

of food-related diseases. Income earned was lost in terms of man hours leading to depletion of savings, increased poverty, inadequate food, malnutrition and perpetuation of poverty (WHO/FAO, 2005).

## 2.15 HACCP System

According to Egan et al. (2007), HACCP, an internationally recognized food safety assurance system that concentrated on prevention strategies on known hazards, was defined as an effective system based on good manufacturing practice. Effective because it was designed to provide the information flow for preventive and corrective actions and could easily be established on the production lines of all kinds of foods (Ergonul, 2003). HACCP became a regulatory tool in food manufacturing industries and larger companies in hospitality and catering sectors in many countries. The Codex Alimentarius Commission advanced the tool through its adoption in the early 1990s.

It was defined as a method for ensuring food safety since the late 1960s and became recognized and widely endorsed in the 1980s and in the 1990s through its adoption by the US Department of Commerce for seafood, United States Department of Agriculture for meat and poultry and United States Food and Drug Administration for other foods, including juices (Adams, 2002). It was based on the foundation that if biological, chemical or physical hazards were identified as specific points within a product's flow through an operation, they could be prevented, eliminated or reduced to safe levels (Adams, 2002). The HACCP plan was based on the seven basic principles which included conducting a hazard analysis, determining critical control points (CCP), establishing critical limits, monitoring the procedures, identifying corrective actions,

verifying that a system works and establishing procedures for record keeping and documentation. HACCP system could also be used to control risks and hazards throughout the flow of food, which as seen earlier, entailed food-handling practices from farm to fork.

### 2.15.1 Standard Operating Procedures

In all HACCP plans, there were acceptable procedures and practices that food service organizations were expected to follow. These were called Standards Operating Procedures (SOPs) and were meant to ensure that food produced was not only safe but its consistency was maintained according to the set standard. The first principle was to identify and assess the potential hazards in the food served, which was done by looking at the menu and identifying where food hazards were likely to occur. Hazard included contamination by bacteria, viruses or parasites.

The second principle of HACCP application was to determine critical control points, as lack of hazard control at critical points could lead to unacceptable health risk. This procedure helped to identify the points in the process where biological, physical or chemical hazards could be prevented, eliminated or reduced to safe levels. The process entailed reviewing the menu items and the steps in the food flow (purchasing, receiving, storing, preparing, cooking, holding and serving). Critical control points varied from one operation to another, since, as seen, there were many steps in food preparation, The basics however included cooking, cooling, hot /cold holding, maintaining specific procedures, preventing cross contamination and ensuring that food handlers practiced

safe food handling. Time and temperature control were said to be critical due to the vegetative, spore and toxic forming bacteria.

The third principle involved establishing critical limits. Tara (2007) defined a critical limit as the specific scientific measurement that clearly indicated what needed to be done at each critical point (Tara, 2007). Critical limits were to be attainable, realistic and needed to be met for each preventive measure. Sensory tools were used in evaluating critical limits. These included the nose for detecting odours, eyes for visual confirmation of quality and hands for touch (Tara 2007). For example, the freshness of fish would be determined by pressing the body of the fish. If it sprung back instantly without creating a dent, that confirmed that it was fresh. The visual appearance of red gills or intact eyes would also imply good quality.

Tara (2007) argued that time and temperature control were the most common critical limit that were used in schools and other operations. The tools needed for time temperature control included a clock with second hand timer and a calibrated cleaned and sanitized thermometer to measure time and temperature. A thermometer was used to measure the minimum internal cooking temperature of potentially hazardous foods. Baked items were to be “cooked until done” or “cooked until juices ran clear” by cooking at an internal temperature of $165^0$C F ($73.9^0$C) for 15 seconds.

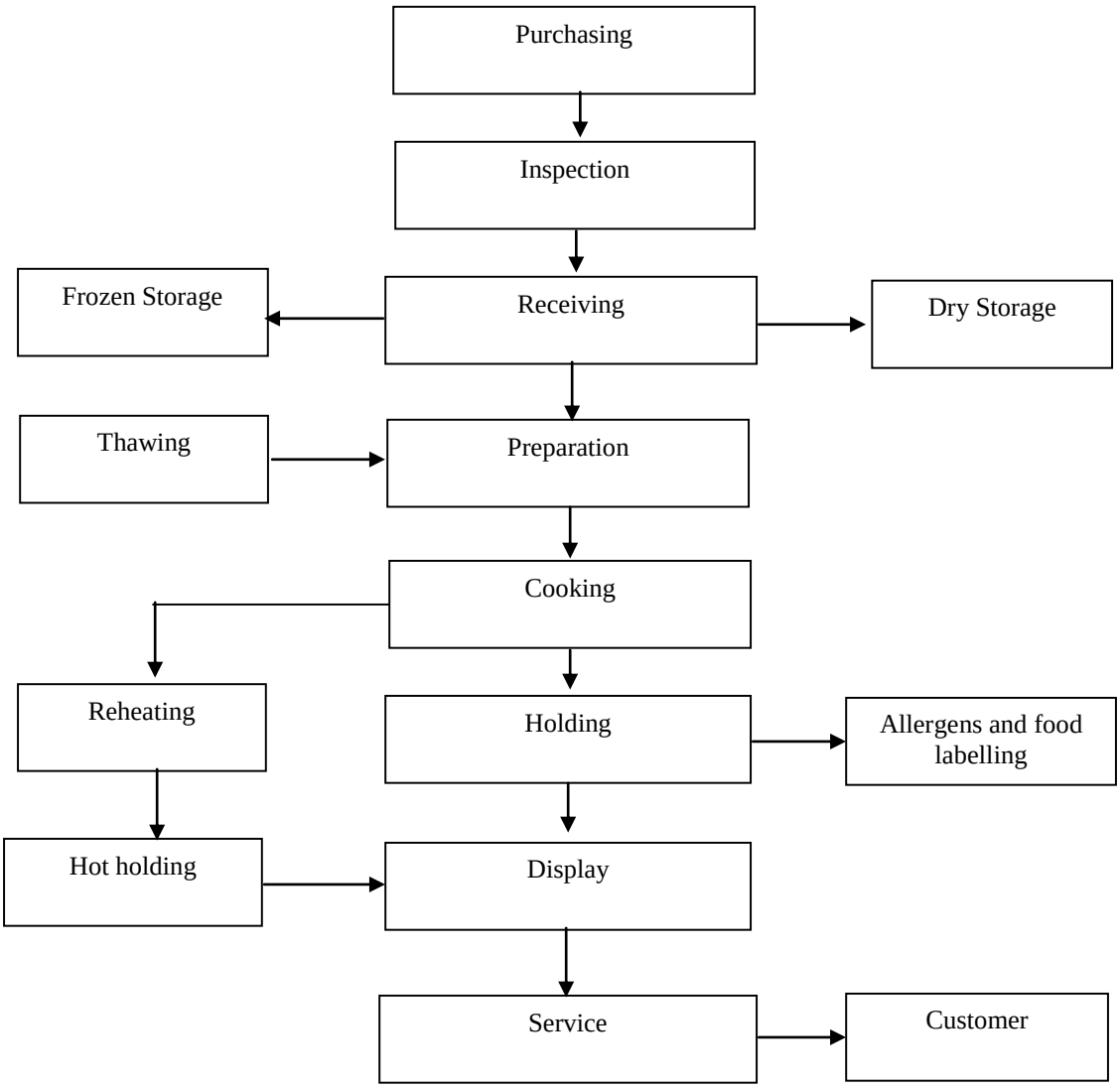
The fourth principle entailed establishing monitory procedures, which were the foundation for HACCP. The actions involved putting in suitable place time and temperature control systems in the food operation. A correct monitoring procedure ensured that food served was safe. It also provided tracking for the food safety

management system throughout the operation. The areas of concern included fault rectification, especially in equipment and/or personnel. Monitoring was done by identifying staff, training them to use equipment designated to measure the critical limits and in the standard operating procedure. Other monitoring tools included documentation and record keeping.

The fifth principle involved identifying corrective action. These were the pre- determined steps to be taken if the critical limits were not met. Corrective actions involved tasks, which included rejecting a product that did not meet the standards in terms of size, quality, quantity, brand or other purchase specification. It also included rejecting a product that did not come from reputable source. The risks included poor quality food, undercooking and cross contamination. Contamination introduced a number of unknown risks to the consumer. It was recommended that cooking food until it reached the correct internal temperature and subsequently reheating it to 165°C F (73.9°C) and monitoring would alert the worker of the temperature danger zone (TDZ).

Principle six was verification to check or confirm that the plans were working. It ensured that the operation was an effective food safety management system. Validation was a component of verification, which focused on collecting, purchasing, receiving, storing, preparing, cooking, holding (hot), cooling (cold), reheating and serving.

The last principle, seven, was to establish a procedure for record keeping and documentation. It entailed keeping all the documents created when developing the programme, as well as keeping the records to monitor how activities were performed.




Source: Adopted from Hause and Martel (2011)

**Table 2.2:- Summary of a Food Flow Audit**

### 2.15.2 Purchasing

This was the first step in the food flow where the ingredients to be used were bought. The key issue in this step was the choice of a supplier. There was need to choose a supplier who could safely deliver safe food (Lewis, 2005). To ensure that selected suppliers got products from safe, approved sources, they were required to possess a well-documented good manufacturing practices (GMP) program. The program prescribed methods,

equipment, facilities and controls used to process food according to the Food and Drug Administration (FDA) and Lewis, Michael and Heppell (2005). In addition, a supplier was required to have a good reputation in relation to packaging and/or delivery of food substances (Han Jung, 2005). Where possible, a food handler needed to inspect a supplier's warehouse to check whether the firm was HACCP compliant and whether his/her members of staff were trained (Lewis et al., 2005).

Farm produce suppliers had to have Good Agricultural Practices (GAP), which included audit measures on water supply and sources, employees' personal hygiene, facility and equipment sanitation, training and documentation inspection, proper labelling and pest control, and good storage and warehouse – practices (Lewis et al., 2005). The critical points in purchasing would be packaging, storage and transport facilities. The controls to be implemented during purchasing included getting an approved supplier, who was able to transport goods in refrigerated vehicles where temperatures would be checked in case the supplies were out of date.

### 2.15.3 Receipt and Inspection

Food products delivered to any establishment needed to be carefully checked for damage, potential contamination and proper temperature (Keith and Weenen, 2006). In addition, all foods received had to be checked for proper texture, appearance, smell, and where possible, taste (Keith & Weenen, 2006). For example, poultry had to be checked to ensure firm texture, freshness and no discolouration. For meaty foods, the substance was to have no odour and the packaging was to be surrounded by crushed self-draining ice. In case of discoloration to purple or green around the neck or dark wing tips, the product

was to be rejected. In case of stickiness under the wings and around joints and unpleasant and abnormal odour, the meat needed to be rejected. Other products such as dairy products had to be checked for freshness, abnormal colour, odour, and taste among others to determine product quality. Dry foods were to be inspected for pest infestation and moisture. Baked goods were not to have moulds or show signs of pest damage. Controls at this point would be checked on the rotation of the stock and different food items separated and stored according to minimum required temperature.

### 2.15.4 Storage

Poor storage practices caused food to spoil quickly with potentially serious results (Keith and Weenen, 2006). Improper food storage deteriorated food quality and safety. Food was to be stored in designated areas and rotated to ensure the oldest product was used first (FIFO) (Lewis et al., 2005). Dry storage areas were to be kept at appropriate temperatures and humidity levels. Stores were to be well ventilated to maintain food quality. Food in dry storage was to be stored away from walls and off the floor. Fresh meats, poultry, fish and dairy products were to be stored at 41°F or lower, and seafoods stored in their original containers at an airtight temperature of 45°F. Since microorganisms did not die when frozen, storage facilities were to be controlled, and the temperatures for the wide range of products to be stored noted. A few general rules were to be followed, such as labelling of food, rotation of produce to ensure that the oldest inventory was used first, and checking temperature of food as stored and in storage areas.

### 2.15.5 Preparation

Good personal hygiene was a critical protective measure against food-borne illness. Todd and Farber (2002) and Daryl (2000) observed that food handlers contaminated food and caused customers to fall ill by transferring microorganisms to food they touched. This was likely to happen especially if they had a food-borne illness, showed signs of gastrointestinal illness, had infected lesions through wounds or cuts, or even when they lived with a person who was ill. Control in the production would ensure that food was not kept in the temperature danger zone for more than 30 minutes, good personal hygiene was maintained and both equipment and premises were clean.

CDC (2010) developed a voluntary food safety strategic plan (2010) which was implemented on food safety management based on HACCP, to evaluate and control the risks in food and water. Food safety strategic plan (2010) indicated that rather than responding to food-borne illnesses when they prevailed, prevention would be taken by adapting a proactive approach. This approach involved using a manual that provided a roadmap for writing and voluntarily implementing food safety management. This was to ensure that food served in any establishment was safely managed.

### 2.15.6 Application of HACCP Pre-Requisites

HACCP was not a substitute for the codex general principles of food hygiene. It was the code of safety requirement put in place before beginning the HACCP process. The prerequisite food safety programs included personal hygiene programme, supplier selection and specification, sanitation and pest control programmes, facility design and equipment maintenance programmes on food safety training programs. The first principle

in application of HACCP was, therefore, to check on the prerequisite food safety programmes. Some aspects of the principle are discussed below.

### 2.15.7 Prerequisite to Food Safety Programmes

Personal Hygiene: The main objective of personal hygiene was to ensure that those who came directly or indirectly into contact with food were not likely to contaminate it. Paster (2007) asserted that maintaining an appropriate degree of personal cleanliness and behaving in an appropriate manner achieved this. Some of the principles of personal hygiene for food handlers included not handling food or entering food preparation areas if one was suspected to be suffering from diseases or illness likely to be transmitted through food, reporting any illness to management, wearing suitable protective clothing and washing hands before handling foods, both after using the toilet and between handling of raw and cooked food.

On the other hand, a sanitary facility was considered a prerequisite programme to manage cross-contamination and prevent microbial growth (Paster, 2007). Facility designers were expected to consider the flow of the product through the operation from the source to the customer. Among the considerations included the interior materials of walls, floors and ceilings, equipment locations and flow the spacing of shelves off the floor and away from the walls. Also to be considered was the ease of cleaning. Besides, workshops were required to have adequate lighting and ventilation, correct humidity, portable water and water controls on the floor with properly fitted drainages with effective plumbing, well fitted with a back flow prevention device, air gaps and vacuum breakers (Paster, 2007).

Product (ingredients used in production): The raw materials were considered in terms of source, lifespan and storage conditions. Knowledge of their chemical, physical and microbiological composition was equally important (Mitchel, Fraser & Bearon 2007). The products had to be safe in terms of microbiological, chemical and physical hazards. Preservation methods used on products such as cheese, yoghurt, meat, fish (dried), vegetables and fruit including packed foods and jams were designed to prevent the growth of *clostridium botulinum,* a deadly pathogen given the dangerous effect of *clostridium botulinium* toxin.

According to (Mitchel et al., 2007), the factors that controlled the growth and survival of microorganism included time, temperature water activity, acidity, atmosphere and preservatives. There was need to control and monitor the activities of the operations in food service areas and in particular the causes of food contamination and determine the control measures, to be applied at each stage of operation.

Pests Management: According to the European Food and Drug Administration code, Regulation (EC) NO. 852/2002, food premises had to be designed sited and constructed to permit good hygiene practices including protection against, contamination and in particular, pest control. The purpose of these clauses was to control infestations of pests. McLauchlin and Little (2007) noted that pest infestations were caused by inadequate cleaning, poor building maintenance as well as suppliers' deliveries. Common food area pests included rodents (such as rats, mice, squirrels), birds and insects (such as cockroaches, flies, ants and wasps). Pests in food production areas were repugnant, as they caused food spoilage and destroyed fabrics in the building surfaces. In addition, they

introduced pathogens to food hence cross contamination through their body parts, fur, eggs and droppings, leading to infection (Blanch, 2003 and McLauchlin & Little, 2007).

Rodents: There were over 400 types of rodents and rats found in East Africa (Jonathan, 2005). Their presence in premises not only posed a risk to food safety but also led to material loss and potential danger to health (Elson, 2006). Two species of rats were commonly encountered at food premises; the brown rat (*Rattusnorvegicus*) and black rat (*Rattusrattus*). These rats were omnivorous and had a preference for cereals. Both rat species were xenophobic. They colonized sewer systems and took advantage of defective pipe work and open drainage systems, as well as tunnel systems beneath and around the buildings. Mice (muscular/domestic) were on the other hand smaller and less habitual, and were less consistent in travel routes. Both rats and mice were nocturnal and were rarely seen during the day. A large number of droppings that differed in size and shape identified their presence in the premises. Their fur was greasy and sometimes left smear marks on walls and other surfaces over a period of time (Elson, 2006).

Rodents required food, water and shelter to survive (Bassett, 2004). Prevention of their infestation included proper storage of cereals, starchy vegetables and fatty compounds (including soap) in rodent-proof metal/plastic bines or containers. Refuse of the same type were collected in property covered metal/plastic dustbins. Food stored in sealed containers off the ground and away from walls was safe if the storage area was cleaned regularly, and, in addition, spillages cleaned immediately to prevent build – up of food. Accessibility of water was curtailed by mending dripping taps and having grids on gulley taps.

Good housekeeping was important especially when food preparation equipment and other items such as storage boxes were not used for some time; they provided harbourage for the rodents and were not allowed to remain undisturbed for a few weeks. Anything that afforded cover for the rats and mice was to be removed from the buildings. Access routes for rodents such as service pipes entering and leaving the building were to be filled (Elson, 2005). All the drains were to be maintained in good repair, other inlets such as manholes and rotting door edges were to be properly sealed and covered.

Cockroaches: A large number of cockroaches were found in diverse environments worldwide. Cockroaches sought warm moist environments and they readily infested premises. They mostly fed at night and readily infested food with their faeces and by regurgitating the contents of their stomach on to the food. They fed on food, refuse and any food with organic content (Elson, 2005). They lived in and around drains and sewers. Two species of cockroaches commonly found included the German cockroach (*Blattagermanica*) and the orientate cockroach (*Blattaorientalis*). Good design construction and maintenance of premises was essential to control and prevent infestation. Besides, routine baiting and the application of a residual insecticide on the walls and floors hindered the progress on their lifecycle. While in food preparation areas, gel and paste baits were to be used to prevent contamination of foodstuff (Elson, 2005).

Flies: Flies spread disease and carried eggs of parasitic morons. They fed on refuse or dung/sewage and then settled on sugar, jam, cheese, meat, bread, milk or any food. In turn, they infected the human food with microorganisms that led to infection. There were several species of flies in and around food premises which included houseflies,

bluebottle, blowflies, vinegar flies, fruit flies (Elson, 2005). They readily moved between faeces, refuse and fresh food while feeding and were known to carry pathogen in their bodies. During feeding, flies regurgitated their gut content onto food and defecated randomly. The danger of fly- borne contamination of food cannot be underestimated and all steps must be taken to deny flies access to food.

Prevention included covering both raw and cooked food, installing fly screens to windows that were open, and providing ultraviolet insectculators at strategic points in the food production areas. Furthermore, there was need to clean and remove food particles and refuse that accumulated in the worktops and on the floor. Regular spraying of the premise with natural or synthetic pyrethrins also removed other insects such as Pharaoh's ants, wasps, and other beetles, which infected foods. These included larder beetles, flour beetles, flat grain beetles, spider beetles, grain weevils, mites and moulds in food processing premises (Elson, 2005).

**Control of Pests:** Pest infestations were prevented or controlled by fumigation or spraying by an insecticide. Also, good stock rotation was essential in preventing recurring problems. Most of these pests lived on or in food during storage. Food deteriorated in appearance and taste whenever pests contaminated it. Thorough cleaning and maintenance of high hygiene standards went a long way in reducing pest infestations.

### 2.15.8 Waste Disposal

Kitchen waste was unique and was mainly organic which required special care from the on-set pending the final disposal. Catering waste included all waste produced in the process of food preparation and it included used cooking oils, ingredient waste from

peelings and trimmings and water waste, among others. Internationally, these types of waste were only disposed of under certain regulations such as By-Product Regulations 2005. According to Robs (2005), disposal by disintegration and flashing to the drainage system was the most convenient method of waste management. Robbs, further recommended disposal systems fixed under metal sinks for food service out-lets and asserted that an electrically driven macerating unit which broke down the waste food to a fine suspension that would wash away waste through trapped pipes were the best (Robbs , 2005). However, these kinds of fitting were only to be done with permission from the relevant authority, for example, if the waste was destined for use in a biogas plant or animal consumption or was intended for composting with approval (Robbs, 2005). Other reports indicated machines for waste disposal, which were able to reduce bulky refuse to a smaller size, were also available. Moreover, catering waste, which was disposed of through landfill or incineration, had to be handled in such a way that livestock and birds would not access it (Robbs, 2005).

Paper and plastic sacks, on the other hand, were placed inside the bins to prevent attacks from vermin, domestic animals and birds. Waste containers were required to conform to the relevant British Standard specification. Dust-bins were supposed to be of a normal capacity of 90L and the lids would fit in closely with an overlapping lid. The bins would be wheeled to ease the movement of waste from the premises.

In developing countries where waste management was and still is a major challenge, the waste was disposed of either in pits dug by institutions or disposed of at strategic places to be collected by county councils in lorries. In significant institutions, properly

constructed storage areas for refuse with concrete floor were put in place. The refuse storage areas consisted of a concrete platform and included a bund wall to prevent spillage and washing. The wall surfaces had to be smooth, impervious and able to withstand water.

### 2.15.9 Barriers to HACCP Implementation

Panisello and Quantick (2001) and Codex (2003) reported that during the last three decades, HACCP, an internationally recognized system of managing food safety, had been progressively introduced and applied comprehensively in the food industry. According to CDC (2005), HACCP was considered an important system because it had saved lives. The system was considered as an efficient tool by both the industry and health authorities in the prevention of food-borne diseases (Motarjemi and Kâferstein, 1999).

Despite the positive attributes that came with the introduction and adoption of HACCP, the system faced a lot of challenges in the hospitality training colleges and practical and psychological barriers hampered its full implementation (Codex, 2003). The HACCP system required the management team to provide commitment, strong leadership and adequate resources for the programme to succeed (CDC, 2005). However, the system was compounded by a number of challenges, which included lack of financial resources, lack of time, caterers handling a wide range of different foods on the menu, lack of technical expertise and trained personnel, in addition to other internal and external barriers such as staff turnover. Given the complexities in the operation of the food business, HACCP system was seen as a burden in itself since the industry had challenges

in adapting to different operational working patterns in addition to unexpected variations in demand and workload on the menu.

Furthermore, lack of financial resources, technical expertise and small staff base impeded HACCP system implementation, both in small and large food outlets. The HACCP philosophy simply stated that biological, chemical or physical hazards be prevented, removed or reduced to safe levels at certain times in the flow of food (CDC, 2005). Taylor (2008) argued that the classical implementation in hospitality of HACCP was exaggerated and that HACCP understanding by institution was very poor. Besides, the bureaucratic process was confusing the stakeholders in the food industry. Taylor (2008) further observed that confusion existed between prerequisite programmes and HACCP layout and how they should be managed. The confusion was attributed to negative guideline factors and lack of understanding attributed to barriers (Vela and Fernandez, 2003).

Walker, Pritchard and Forsythe (2003), reported that prerequisite activities scored satisfactory with the exception of cleaning and disinfection in UK food businesses. According to this survey, the main barrier to implementing a HACCP- based food safety management system was lack of prerequisite programmes, lack of knowledge, inadequate sources and cost related to HACCP. Problems of implementing HACCP in food businesses were named as inadequate equipment and physical conditions of the facility (Bas, Ersun and Kivanc, 2006). Well- designed premises with modern and reliable equipment were perceived as a way of protecting ingredients and food products,

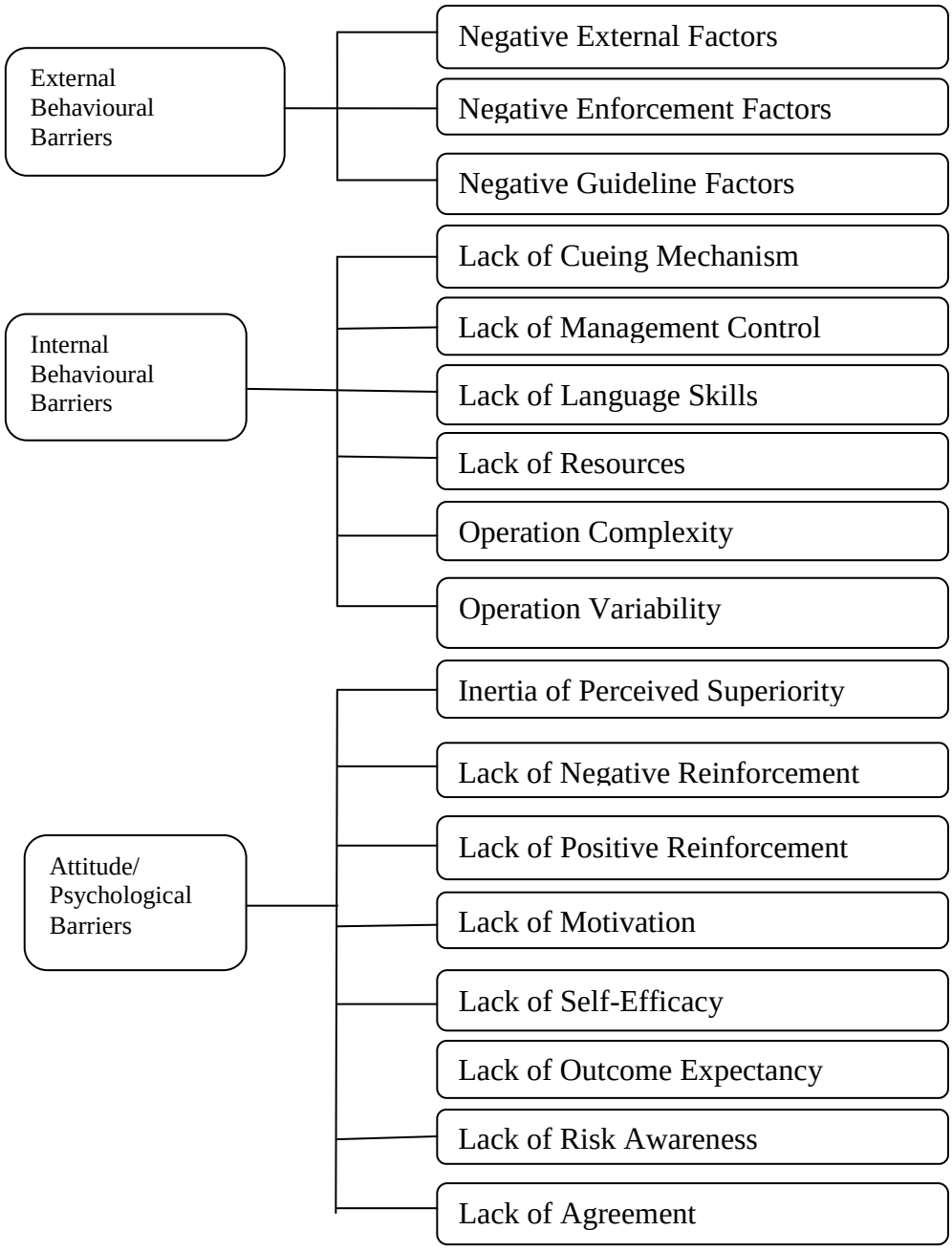
maintaining hygienic conditions, improving cleanliness besides controlling pest infestations.

Time and money were identified as obstacles in implementing HACCP, according to Giampaoli (2002). Giampaoli also found that food service directors positively agreed on the benefits of certification and continuing education related to food safety. Panisello and Quantick (2001) and Ward (2001) observed that managers seemed to find it difficult to make their employees understand the importance of hazard analysis as well as why particular operations had to be monitored and controlled when time and money were inadequate. While examining barriers to HACCP implementation in food businesses, Hwang, Almanza, and Nelson (2001) found that Indiana School foodservice managers identified time to establish a HACCP programme, time to run the programme, and labour costs as being the three biggest obstacles. In addition, lack of funds for training, time to get used to running the HACCP programme, and union problems were also cited as major obstacles.

The researchers identified three types of barriers: resource management, employee motivation and confidence. The study also found that employees were nervous about taking food safety certification examinations and were not comfortable with the change needed for implementation of a programme like HACCP. Young and Sneed (2002) identified employee and resource barriers in a national study of school foodservice directors. Lack of employee training was the biggest employee barrier and lack of financial resources to devote to food safety was the biggest resource barrier.

A study carried out in Ontario, Canada identified four key areas which included low priority given to enhancement of food safety controls, financial constraints, and the perception that HACCP was of questionable appropriateness (Deeponada & Spencer, 2010). The study concluded that HACCP implementation was impeded by barriers related to financial constraints, and that the most important drive to promote implementation of HACCP was customer requirement for HACCP to be implemented in supplier facilities.

Lee and Lee (2005) cited lack of teachers' support on students' education and limited availability of equipment and facilities as the biggest challenges in implementing HACCP. The study suggested that more investment on facilities and equipment were needed for food safety improvement and successful implementation of the system. Furthermore, the study also recommended that proper training of employees and improvement of facilities would help the employees monitor the critical control points (Lee and Lee, 2005). On the same vein, research carried out in Sankara, Turkey, indicated that HACCP was to be clearly defined, its importance assessed and its implications evaluated (Panisello & Quantic, 2001). Figure 2.17 below presents the barriers to proper food safety and hygienic procedures.




Source: British Food journal (2005)

**Figure 2.3:- Barriers to Proper Food Safety and Hygiene Practices**

## 2.16 Summary of Literature Review

This chapter covered the six objective study areas in relation to the three aspects of hygiene: personal, environmental and food hygiene. In addition, it highlighted the background of the institutions responsible for training hospitality personnel. The chapter explored various aspects of hygiene that affected TVET and University hospitality schools. The empirical literature review also espoused on the new trends and challenges facing the food industry in all the training institutions in Kenya.

# CHAPTER 3 - RESEARCH METHODOLOGY

## 3.0 Introduction

This chapter has given a detailed outline on how the study was executed. It has also explored the research design employed in the study, highlighted data collection instruments, explained data analysis and hypotheses testing, as well as experimental designs used in the isolation of microorganisms. The chapter has also discussed the validity and reliability of the entire study as well as ethical issues involved. It has outlined the overall methodological framework of the study.

## 3.1 Research Design

To achieve the objectives of this study, the researcher used descriptive cross sectional survey design, which combined both qualitative and quantitative data collection and analysis techniques. Quantitative data was derived from questionnaires while qualitative data was generated from interview schedules. As observed by Gall and Borg (2010) descriptive survey involved collection of data from members of a group, students, teachers or other persons associated with educational process. Survey design allowed the researcher to observe the status quo as well as facts rather than manipulate variables (Creswell and Plano, 2006). The design was therefore appropriate for the study since this study was interested in establishing the facts as they are in relation to food and hygiene practices in training institutions.

The design also allowed the researcher to describe, explain and examine facts, trends and patterns that emerged from the study, based on the argument that descriptive survey

focuses on people, opinions, attitudes, beliefs behaviour and motivations (Kerlinger, 2002).

This study also used both descriptive and inferential statistics to fully describe and explain conditions of the present using many subjects and questionnaires as explained by (Jackson, 2009). The design was used since the study involved observing and describing behaviours of different groups of respondents from various institutions without influencing them in any way. (Orodho, 2009, and Borg and Gall, 2007) also observed that the design was cost effective and had the advantage of reaching a large number of people within a short period of time.

The quantitative methods used in this study involved quantifying data and generalizing results from a sample of the target population (Yin 2010; Yin 2013). Surveys and interviews were used for this purpose. Qualitative methods, on the other hand, were used to gain an understanding of underlying reasons and motives of respondents. Qualitative methods therefore enabled some analytical procedures to be followed in a variety of settings and consequently allowed new information and results to be included in the study (Creswell et al., 2003). Further, qualitative methods were used since they were flexible and allowed the analysis to accommodate new ideas and results as they were discovered which was the case with this study as observed by (Creswell et al., 2003). Besides, focus group discussions were used for this purpose.

### 3.2 The scope of the study

This study was carried out in TVET institutions offering diploma programmes and university hospitality schools offering degree programs in Kenya. The TVET institutions

included Polytechnics, Institutes of Science and Technology and Technical Training Institutions (TTIs). The inclusion criteria consisted of all third year students in TVET institutions who were almost graduating, and third year students from Universities who had covered three quarters of the course-work. First and Second years were excluded from the study as they had not had enough exposure in food production or food and beverage service. Heads of Departments of these courses were also included, as they represented their various institutions.

### 3.3 Target Population

The target population of this study comprised seven hundred and eighty seven (787) hospitality students. The institutions were categorised into two major categories namely TVET and university hospitality Schools. TVET and university hospitality departments in the entire country were considered as reliable sources of information. By considering all these institutions in the entire country, the study aimed at obtaining as much representative data as possible.

It was established that there were over 44 TVET institutions and over 10 university hospitality schools in Kenya that offered courses in food and beverage production and service. The targeted institutions were grouped into four categories as universities, institutes of technology, polytechnics and technical institutes. In these institutions, the specifically targeted respondents were final year students taking degree or diploma in food and beverage production and service.

The study also targeted heads of departments in the institutions. For comparison to achieve the objective of the study, the institutions were further categorized into two broad strata namely TVET and Hospitality schools in the universities.

Each of these institutions had an average of 500 students undertaking courses on food and beverage production and service and one head of department. Consequently, the target population was over 2000 individuals. All the heads of departments in the sampled institutions were included in the study while only a representative portion of the student body was included in the study.

### 3.4 Sample Size

A total of 768 individuals participated in the study. Table 3.1 summarizes distribution of the respondents according to the categories of the targeted institutions.

**Table 3.1:- Distribution of Respondents in the Targeted Institutions**

| Institution | No. of Respondents | Percent |
|---|---|---|
| Universities | 295 | 38.4 |
| Institutes of Technology | 280 | 36.5 |
| Polytechnics | 70 | 9.1 |
| Technical Institutes | 123 | 16.0 |
| **Total** | **768** | **100.0** |

Source: Researcher

The sample size was determined by using the formula proposed by Mugenda and Mugenda (2003).

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where; n = the desired sample size

z = the z score at the required confidence level $\alpha = 0.05$ (i.e. $z = 1.96$)

p = the probability of a student in the target population to be doing a course in food and beverage production and service

d = permissible marginal error (the level of statistical significance, set at $\alpha$ = 0.05).

The study assumed that a student picked at random in any sampled institution could be or could not be doing a course in food and beverage production and service. Consequently, the probability of the target population satisfying the conditions set for participants was 0.5. That is, the probability of doing a course related to food and beverage production and service was 0.5. Therefore, using the values of *z*, *p* and *d*, the value of *n* was computed as follows

$$n = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2}$$

$n$ = 384 (Approximately)

To get a large sample (relative to the size of the targeted population), this value was doubled to get a sample size of 768 (384×2 = 768).

### 3.5 Sampling Procedure

Stratified sampling technique was used to select the TVET and University Hospitality Schools to group the population into a homogenous subset and to ensure equitable representation of the population in the sample. Besides, it facilitated comparison of the two categories of institutions (Marshall and Rosemann, 2012). Stratified sampling technique was also used to ensure that the target population was divided into different homogenous strata and that each sub group was represented in the sample in a proportion equivalent to its size in the population. This was to ensure that each subgroup

characteristic was represented in the sample thereby raising the validity of the study. Simple random sampling was used to ensure that each member of the target population had an equal and independent chance of being included in the sample.

In selection of respondents, both probability and purposive sampling techniques were used. Probability sampling technique was used in selection of student-respondents. In this case, each target student-respondent was pre-assigned some chance of being included in the sample. This technique was used since it minimized biases in sample selection. As one method of probability sampling technique, lottery method was used to identify specific sample units. This was done using identical cards where numbers were written and cards drawn at random. Population unit whose identification number corresponded to a drawn card was selected. This procedure was repeated for all the sample units. On the other hand, purposive sampling technique was used in the selection of staff-respondents. This technique was used since it facilitated the provision of focussed information, besides being able to save time and money.

### 3.6 Data Collection Instruments

The study used both primary and secondary data collection methods to collect the data. Primary data sources included using structured questionnaires, taking photographs, oral interviews, direct observation and focus group discussions. Secondary sources, on the other hand, involved retrieving information from desk research where journals, books and other relevant literature were obtained.

### 3.6.1 Questionnaires

Questionnaires were used to gather data since they not only allowed a measurement for or against a particular viewpoint, but also gathered a large amount of information within a short time span (Orodho, 2004; Best & Khan, 1993). Two types of questionnaires were used in this study; one for students and the other for lecturers and/or heads of departments. Open and closed- ended questions were used. The open- ended questions gave respondents a chance to freely express their attitude or perception and a qualitative insight to the study. For the closed-ended questions, the study adopted a Five Point Likert Scale and consequently, most variables/questions were ordinal in nature. Nevertheless, a few nominal questions were also included. Research assistants under a close watch of the researcher did distribution of the questionnaires.

### 3.6.2 Semi- Structured Interview Schedule

The semi-structured interview schedules were used on Heads of Departments and were based on the themes highlighted in the study variables. Interview schedules were used since they allowed collection of in-depth information that could not be captured by other instruments and also increased reliability of the findings. Interviews were used to capture the meanings beyond the words, in addition to obtaining historical information (see Appendix 8).

### 3.6.3 Observation Checklist

Another method used was observation method. According to Mugenda (2008), observation was one of the most important and extensively used research instrument for data collection in the field of social sciences. Observation was used to capture practical

aspects of the study such as food handling, capacity, and facilities. It also bridged the gap between what the respondents said they did and what they actually did. The checklist was used to gather data on quality and quantity of physical facilities. Information from the checklist assisted the study to obtain information on the learning environment. In addition, observation check-list assisted in identifying and evaluating the availability and usability of the equipment in the training institutions. The observation checklist helped record the information as it occurred, and to gain first-hand experience on the ground, in addition to noticing unusual aspects which could not be obtained from other sources of information.

### 3.6.4 Photography

This study also adopted photography that captured the three aspects of hygiene as practised during the practical lessons in the workshops. The areas included food hygiene, personal, and environmental hygiene. The images obtained were very crucial in complementing the findings of observation check-lists. The study focused on availability of certain equipment and facilities as a means of comparing the capacity of institutions in undertaking food safety and hygiene measures. Besides, cleanliness of equipment, workshops and other facilities were also captured in the photos. In addition, waste disposal as executed in some of the institution were captured among others.

### 3.6.5 Focus Group Discussions (FGDs)

The student-respondents constituted the FGDs. The size of the focus groups varied between 6 and 12 members. FGDs were deliberately separated such that mature respondents were separated from the youthful respondents. This was necessary as it

viewed the mature student as respondents who had gained a lot of experience and exposure in the workshops and therefore, would be more objective in their discussions. The younger respondents, on the other hand, were viewed as respondents who would be inclined towards classroom orientation with less exposure to workshop practices. The researcher moderated the discussions, and one of the research assistants was assigned the responsibility of taking notes during such sessions. Focus group discussion guidelines were prepared according to the various sections of the study variables.

### 3.7 Pre- Test

Pre-test of the study was carried out two months prior to the study in similar institutions not sampled in the survey. Out of every county with more than three TVET and University Hospitality schools, one was selected for pre-test. The aim of pre-test was to check on the practicality of the instruments. This assessment included checking achievability of the study objectives and suitability of research tools. The pre- evaluation showed that some questions were poorly answered. Also, some questions were found to be ambiguous; therefore, some respondents could not understand the questions. As a result, no meaningful information could be obtained. The pre-test of this study, therefore assisted in weeding out errors to ensure proper applicability of the research instruments.

### 3.8 Test of Validity and Reliability of Data Collection Tools

Orodho (2005) and Mugenda (1999) defined reliability as a measure of the degree to which research instruments yielded consistent results after repeated trials. Mugenda (1999) added that reliability was influenced by random error, which meant that as random error increased, reliability decreased.

Validity and reliability of this study were proved in four different ways. One way was by applying randomized procedures in selecting sample units as observed by (Brussee, 2004). Randomization was done to eliminate any bias and, therefore, all responses reflected the true image of the target population. Repeatability of statistical tests was also used to justify validity of the study as was used in the triangulation of the tests in the hypotheses. Performing a test more than once and comparing results confirmed how valid and reliable analytical procedures were. In addition, consistency in procedures used in data analysis revealed how valid and reliable the study was (Lehmann & Romano, 2010). A reliable and valid study used similar procedures in all tests. Comparison of the study with findings of previous studies about the same topic confirmed validity of this research. There was no great difference between the study and previous researches. Despite all these procedures, reliability tests were also done and the value of the Cronbach's alpha showed how reliable the data collection instruments were.

Cronbach's Alpha was used to measure internal consistency (reliability) since it was applicable and relevant in the study questionnaires, which had multiple Likert questions. Cronbach's alpha reliability coefficient normally ranges between 0 and 1 (Brussee, 2004). The closer the coefficient was to 1.0, the greater the internal consistency of the items (variables) in the scale were. Interpretation of the value of alpha was as follows:

| | |
|---|---|
| Excellent: | Alpha (A) is greater than or equal to 0.9 ($A \geq 0.9$) |
| Good: | Greater than 0.8 (> .8) |
| Acceptable: | Greater than 0.7 (> .7) |
| Questionable: | Greater than 0.6 (> .6), |

Poor: Greater than 0.5 (> .5)

Unacceptable: Less than 0.5 (< .5)

Since the study had four independent variables, questions in the questionnaires used were categorized according to these independent variables. In each category, internal consistency was then examined. Table 3.2 gives the result of reliability analysis.

**Table 3.2:- Reliability Test**

| Variables | | Cronbach's Alpha | Standardized Cronbach's Alpha | No. of Items (n) |
|---|---|---|---|---|
| Appropriateness of training | Y | 0.75 | 0.74 | 7 |
| Food handling practices | $X_1$ | 0.87 | 0.88 | 19 |
| Barriers to food safety | $X_2$ | 0.90 | 0.90 | 9 |
| Level of Implementation of HACCP | $X_3$ | 0.78 | 0.80 | 6 |
| Suitability and Capacity | $X_4$ | 0.84 | 0.85 | 27 |
| HACCP Awareness | $X_5$ | 0.80 | 0.89 | 12 |

From the table, each of the independent variables and the dependent variable had Cronbach's alpha of more than 0.7. Even the standardized alpha was greater than 0.7. Based on the interpretation of Cronbach's alpha, table 3.2 revealed that research instruments used in the study had acceptable level of internal consistency.

### 3.9 Microbiological Analysis for Vegetables

Food analyses conducted for this study were vegetables commonly found in all parts of this country and which were used in menu planning across Kenya. The vegetables were preferred in this study since they were readily available and the methods of cooking were specific. Specific vegetables used in the study included spinach , coleslaw (cabbage and carrots) and vegetable macẽdoine (turnips, French beans, carrots and peas). Laboratory tests were carried out to determine microbial load of bacteria in vegetables served in

University hospitality Schools and TVET Food and Beverage departments (F & B). The tests sought to isolate and identify common microorganisms such as *E. coli, Salmonella, Staphylococcus* and other common bacteria found in food production workshops.

### 3.9.1 Sample Collection, Preparation and Transportation of Vegetables

Food samples were collected using spoons which had been previously thoroughly washed, sterilized, covered in aluminium foil and autoclaved. The foods were immediately transported to Kenyatta University laboratory in labelled plastic bags and placed in cooler boxes with ice. Upon arrival in the lab the samples were recorded in a register and given unique lab reference codes, which were later used as sample identification during analysis. Analysis was done according to the American Public Health Association methods (Blodgett, 2005). All the procedures were aseptically carried out and all apparatus and the media used were accordingly sterilized to precision.

### 3.9.2 Homogenate Preparation

Vegetable sample homogenate were prepared by weighing 10 grams of vegetable samples into 90 ml of buffered peptone water in a flask bearing the sample number. The sterilized mixture were then homogenized in a blender for 2 minutes at 800 rounds per minute and placed in sterile universal bottles. The blender homogenate was sterilized in between each successive sample preparation by swabbing it with 70% ethanol and rinsing it three times with hot sterile water. Using the pour plate method, serial dilutions were done from the homogenate.

### 3.9.3 Heterotrophic Plate Count (HPC)

Heterotrophic Plate Count (HPC) was done as follows: 1ml of homogenate was serially diluted in 9 ml sterile saline tubes up to the 3rd diluents. 1ml of the 3rd diluent was pipette and swirled into a petri dish containing 15mls molten plate count agar tempered at $45^0$C in water bath to mix well. The petri plates were labelled with the sample number, dilutions ($10^{-3)}$ and date and then left to solidify. Incubation was then done at $37^0$C overnight (for 12 hours). This was done in three replicates.

To prepare a Plate Count Agar, the plate contents were boiled and dispensed in the universal bottle then sterilized by autoclaving at$121^0$C and 15 bars pressure for a minimum of 15 minutes before putting in the water bath at $45^0$C. Plates with 30-300 colonies were counted using colony counter. The average of the replicates were determined and the number of bacteria or vegetative cells per gram of the sample were calculated by multiplying the reciprocal of the dilution factor by the number colonies countered dilutions to obtain the number of Colony Forming Units per gram (CFU/g of food).

### 3.9.4 Most Probable Number Count Methodology on Microbial Load

Most Probable Number (MPN) technique was used in estimating microbial populations in food samples (Garthright and Blodgett, 2003). MPN had the ability to estimate a microbial population size based on a process-related attribute. The technique estimated microbial population sizes in a liquid substrate. The methodology for the MPN technique was dilution and incubation of replicated cultures across several serial dilution steps. This technique relied on the pattern of positive and negative test results following

inoculation of a suitable test medium (with a pH sensitive indicator dye), that is tubes and micro well- plates. The results were used to derive a population estimate based on the mathematics of Halvorson and Ziegler (1933). The general equation used for determining the MPN of organisms in a substrate after it was serially diluted and several units of each dilution inoculated was

$$\sum_{i=1}^{k} \frac{a_i p_i}{(1-e^{-a})i^x} = \sum_{i=1}^{k} a_i n_i \qquad \text{(Halvorsonand and Ziegler, 1933)}$$

Where

a = the dilution level of each dilution,

x = no. of tubes,

n = the number of inoculated units at each dilutions level,

p = the number of positive units within each dilution level,

k = the highest dilution level of the series,

e = the base of the natural logarithm.

### 3.9.5 MPN-Screening for Total *Coliform* and *E. coli*

The analysis of food samples for presence of *Coliforms* were carried out using the multiple tube fermentation technique (Apha, 2003). This was done in three successive tests, which were presumptive, confirmed and complete tests. In presumptive tests, each sample needed three series of three tubes. The first set of three tubes contained 10mls of sterile Double Strength Lactose Broth (DSLB) and the remaining two sets 10mls of Single Strength Lactose Broth (SSLB). 10mls aliquots of the sample were aseptically pipetted in each of the three DSLB tubes. 1ml in the second set of the three SSLB tubes and 0.1ml aliquot to the last set of three SSLB tubes. All these tubes had Durham tubes

for gas collection. Inoculated tubes were then placed in an incubator at $37^0$C for 48 hours. Gas productions in a fermentation tube within 24 hours were considered as a presumptive positive reaction.

The estimated number of total *coliform* present in 1 gram of sample was read from a tabulated probability table using corresponding results of various combinations of positive and negative results in each of the three batches. For confirmation, samples considered to have a presumptive reaction from the lactose broth were streaked on a plate of Eosin Methylene Blue (EMB) agar to give well- isolated colonies. Incubation was carried out at $37^0$C for 24 hours. Development of the typical E. *coli* colonies on the plates were observed and a gram stain was carried out (greenish colour indicated presence of *E. coli.)* A complete test was carried out when a colony considered to be of *E. coli* was picked and transferred to agar slant and fermentation tube containing brilliant green lactose broth. Incubation of the agar slants and tubes were again carried out at $37^0$C for 36 hours. From the agar slope (slants), a gram stain was used to confirm *E. coli*. Brilliant green lactose was added and gas production confirmed a positive result hence a complete test.

### 3.9.6 Screening for *Salmonella* and *Shigella* Species

Detection of *Salmonella* and *Shigella* was done in three successive phases. The first phase involved selective enrichment of samples using selenite F. broth (APHA, 2013). 1.0 ml of each homogenate sample was mixed well with 10mls of selenite broth and incubated overnight for 14 hours at $35^0$C. In the second phase, the loop full of the incubated selenite and a fresh broth was streaked out on a Xylose Lysine Desoxycholate

(XLD) agar and incubated overnight at $37^0$C. In the third phase, typical *Salmonella* and *Shigella* species were picked and purified for various standard biochemical procedures (such as motility, indole production, TSI and urease tests). In the process of isolating the microorganism, *pseudomonas bacteria* was isolated by chance.

### 3.9.7 Colony Count

Plates containing 30-300 colonies were counted using the colony counter. Averages of the replicates were determined and the numbers of bacteria or vegetative cells per gram of sample were calculated by multiplying the reciprocal of the dilution factor by the number of colonies counted (Cochran, 1950). Interpretations of the counts were done using most probable number method.

## 3.10 Data Analysis and Reporting

### 3.10.1 Analysis from Secondary Data

Analysis of secondary data started at the beginning of this study and it involved review of literature. In addition, it involved retrieving information from already stored data from both off-line and on-line secondary sources. Off-line sources included textbooks, journals, articles and various publications on food safety and hygiene. On-line sources involved various articles and other soft copied information found on the Internet that could not be accessed in hard copies. Information obtained from secondary sources mainly formed the literature review in chapter two.

### 3.10.2 Analysis from Primary Data

Data analysis involved computation of both descriptive and inferential statistics. Descriptive statistics analysis was used in calculation of means, variances, and

coefficients of variation of the responses without giving detailed explanation of the values computed (Healey, 2008). Descriptive analysis gave the general description of responses. The single variables were described through frequency distribution tables, measures of central tendency and measures of dispersion. This was depicted in tables and graphs. In inferential procedures, interpretations of values obtained from descriptive procedures were given. Descriptive analysis was done in all study variables.

Inferential statistics were used to provide deeper understanding of descriptive statistics. As inferential steps, univariate, bivariate and multivariate procedures were performed that led to either acceptance or rejection of hypothesis. The corresponding tests for univariate, bivariate and multivariate procedures were chi-square and T-test tests. All inferences and conclusions were made at 95% confidence level. Therefore, rejection criteria involved rejecting the null hypothesis whenever the p-value was less than the significance level of the test ($p\text{-}value < 0.05$) (Newton & Rudestam, 1999).

### 3.10.3 Hypotheses Testing

The section of hypothesis testing was organized according to the specific objectives. All analyses in this section combined univariate, bivariate and multivariate procedures. In univariate, individual variables were studied while in bivariate analysis, two variables were analyzed jointly (Lehmann & Casella, 1998). Multivariate analysis, on the other hand, involved analyzing more than two variables jointly. Univariate analysis was done using Chi-square test while bivariate analysis was performed through paired sample t-test. Multivariate analysis was done through multiple regressions.

In all the tests, the best critical region was such that the computed p-value was compared with the level of the test. The tests were done at $\alpha = 0.05$. The decision was to reject the null hypothesis whenever p-value was less than the level of the test. T-test was found appropriate since the study was testing the significance of mean difference in the two categories of institutions. These were TVET and hospitality universities. Chi square was relevant in testing the significance in relationships while multiple regression was appropriate for developing a model from the conceptual framework.

### 3.11 Ethical Considerations

Prior to field activities, permission was sought and an introductory letter obtained from Kenyatta University Graduate School. The study also obtained approval from the Ministry of Education, Science and Technology and from Kenyatta University. Quality of the study was assured through observance of certain research ethics, which ensured that rights of all participants were observed. One research ethic was the principle of voluntary informed consent (Sharmoo and Resnik, 2009). The ethic involved informing participants on the importance of the study, their role before onset of the study and the overall guiding principle governing the entire study. All the students signed an agreement, which ensured that any information they would give would remain confidential and anonymous. Though the researcher discouraged respondents from withdrawing their participation once the study had kicked off, the respondents had room to withdraw their participation at any stage of the study. The researcher also highly regarded the principles of informed consent, confidentiality and protection of participants from harm. In addition, respondents were assured that the findings of this study would not be used for any other

purpose but for academic purposes only. Ethics permit was also obtained from Kenyatta University. The documents are attached at the appendix section (see Appendix 9).

# CHAPTER 4 - RESEARCH FINDINGS AND DISCUSSIONS

## 4.0 Introduction

This chapter presented the findings of the study. The chapter was organized into three sections, where the first section discussed how sampling was done and the overall response rate. Section two discussed the general demographic information of respondents and general knowledge of food safety and hygienic practices. Section three gave responses of participants in relation to the study objectives. In addition, the section included how the study hypotheses were tested.

## 4.1 Study Response Profile

The study used two main respondent groups to gather data. Response rate measured how well the targeted sample size was achieved. It was expressed as a ratio of the actual number of respondents used in the study in a percentage form. Since response rate was related to sampling fraction, which is the ratio of the sample size to the population size, the higher the response rate, the higher the sampling fraction and consequently, a good sample representation. High response rates minimized obtaining biased statistics and consequently, made study findings valid and reliable.

**Table 4.1 Response Rate**

| Category | Expected | Actual | Response Rate (%) |
|---|---|---|---|
| Universities | 295 | 249 | 84.4 |
| Institutes of Tech. | 280 | 250 | 89.3 |
| Polytechnic | 70 | 64 | 91.4 |
| Technical Institutes | 123 | 108 | 87.8 |
| **Total** | **768** | **671** | **87.4** |

The overall response for the study was 87.4 percent, which was far much above the recommended threshold of 70 percent. According to Mugenda and Mugenda (2003), a response rate of 70 percent was acceptable as a good representation of a targeted population. A high response rate in this study, therefore, implied that the study used instruments and procedures that were clear, precise and within the acceptable number. A similar study conducted in the University of Massachusetts on students undertaking hospitality training, had a response rate of 78.48%.

### 4.2 Distribution of Respondents by Institution Category

A total of 23 institutions were used in the study with the actual number of respondents of 671 persons. The study gave a breakdown of the two categories of study institutions, TVET and Universities hospitality schools. The actual number of participants per institution category was represented as a percentage of the total actual number of participants. The percentages of participants per institution was expressed as shown in Figure 4.1

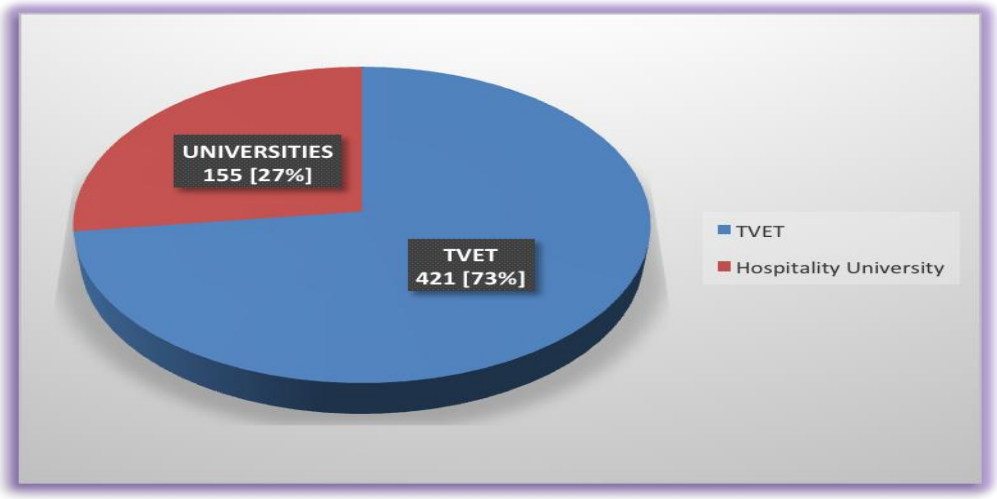



**Figure 4.1:- Distribution of Respondents by Institution**

Most of the students participating in this research 421(73%) came from TVET while 155(27%) were from Universities.

### 4.3 Distribution of Respondents by Gender

As one aspect of demographic data, the study compared the proportion of male and females in TIVET and Hospitality schools. This comparison revealed that of all respondents, 69% were females, while the remaining 31% were males. These percentages translated to 463 and 208 students respectively. The findings of a similar study conducted in the U.S had 62.5% female students against 37.5% males. This was an indication that it was not only in Kenya where female students out-numbered their male counterparts. This finding implied that the hospitality training was predominated by females. Besides, this finding could also be attributed to the attitude of people who view hospitality as a female oriented career, and therefore, enrolment of students in the career was perception based. However, by comparing gender distribution in the two categories of institutions, similarities also emerged that the number of females were higher in both institutions as represented in figure 4.2.

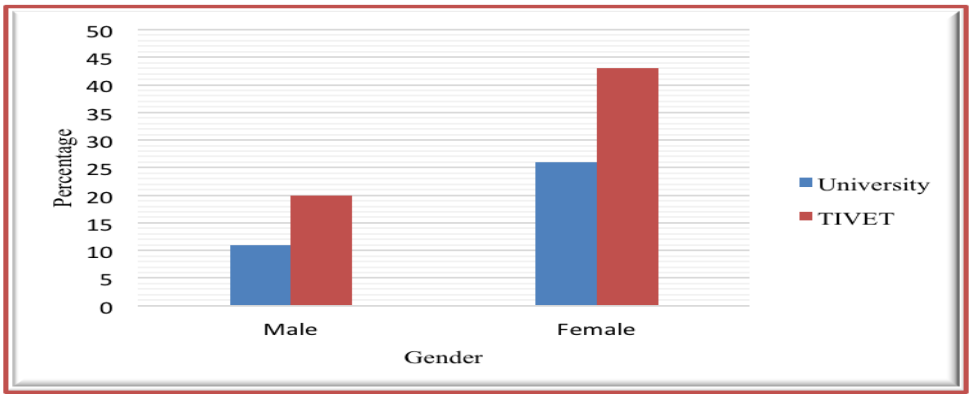



**Figure 4.2:- Distribution of Participants by Gender**

Although the study had a high representation of female students than male students, the conclusion made was based on responses from both sexes. The unequal gender representation was, therefore, considered as a reflection of the entire population.

### 4.4 Age Distribution of Participants

A larger percentage of all who participated in the study were aged between 18 and 25 years. Although the enrolment in the universities was slightly lower than TVET within the first age bracket, both institutions recorded high enrolment after secondary education.

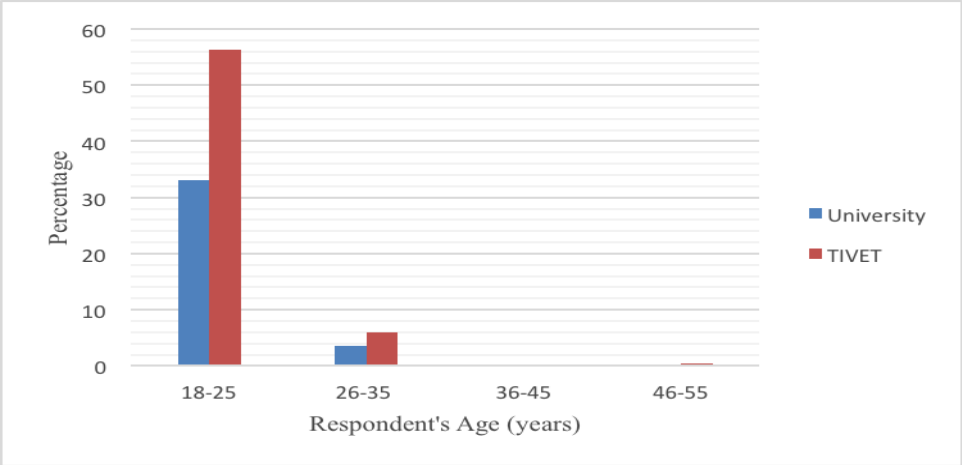



**Figure 4.3:- Distribution of Participants by Age**

This age distribution was considered to be of importance since, on average, a person decided on his/her career at this point. This argument was confirmed in a study conducted by Morrone and Rothman (2003) who also confirmed that majority of students chose their careers between 18-29 years old. On the contrary, a very small proportion of all participants were between 46 and 55 years old. This pointed to the fact that hospitality as a career was popular among the youth not only in Kenya but all over the world. Figure 4.3 also confirmed that TVET had the highest representation in all age brackets. This age distribution was considered important since it implied that there was continuity in the

career ladder as the majority of respondents in this category were considered to be the working class.

### 4.5 Comparison of Course Distribution

The other area of concern was the course distribution of the respondents. Four different courses were identified by this study as displayed in figure 4.4.

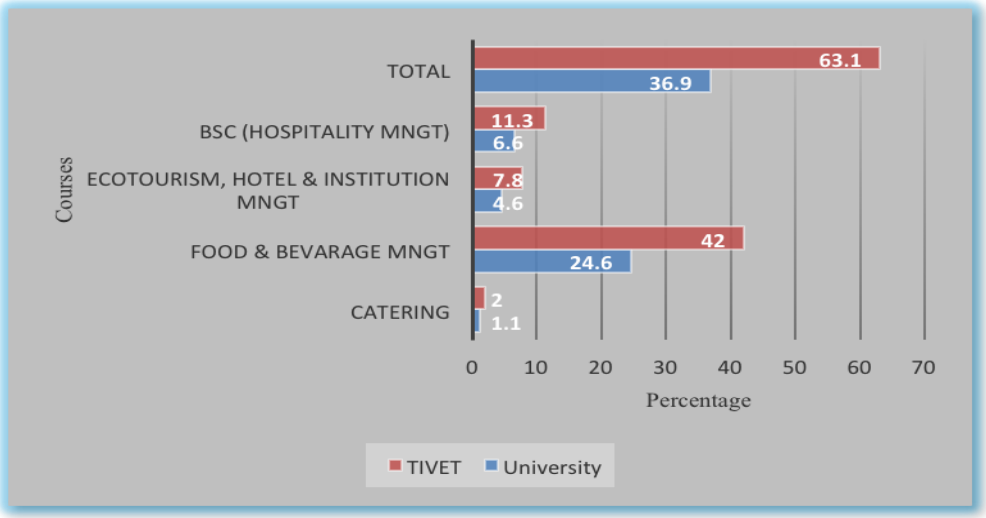



**Figure 4.4:- Distribution of Respondents by Course Enrolment**

When considering the number of students choosing particular courses within the hospitality discipline, Food and Beverage Management, topped the list with 66.6% of all participants in both TVET and University schools. Conversely, only 3.1 percent of all participants were taking catering as a course. Ecotourism, Hotel Management, Institutional Management and BSc. (Hospitality Management) had almost equal rankings of 12.4% and 17.9% respectively. These percentages were obtained by summing the percentages of all respondents, both in the universities and TVET institutions. Nevertheless, the notable similarity was that food safety and hygiene was a core unit

covered in the four hospitality courses. Consequently, all participants were considered to be important irrespective of the course being taking since they all practised the same safe and hygienic principles when undertaking practical lessons.

### 4.6 Class Size

Class size, as a factor, was considered as crucial in determining the suitability and capacity of institutions in creation of ample space and environment for training. Large classes hampered effective content delivery, which in turn, made an institution not able to provide quality training on food safety and hygienic practices. In addition, large classes would require bigger workshops, more teachers, appropriate and adequate equipment and better sanitary facilities. For instance, courses outlined in Figure 4.4 involved practical sessions. Large classes would have implied that students attended practical sessions in two or three groups at a time, which would be expensive in terms of time and cost of ingredients (materials) used for training. Small workshops, on the other hand, led to congestion in the laboratory. Such problems compromised the quality of training. Responses obtained from participants regarding their class sizes were summarized in Figure 4.5.

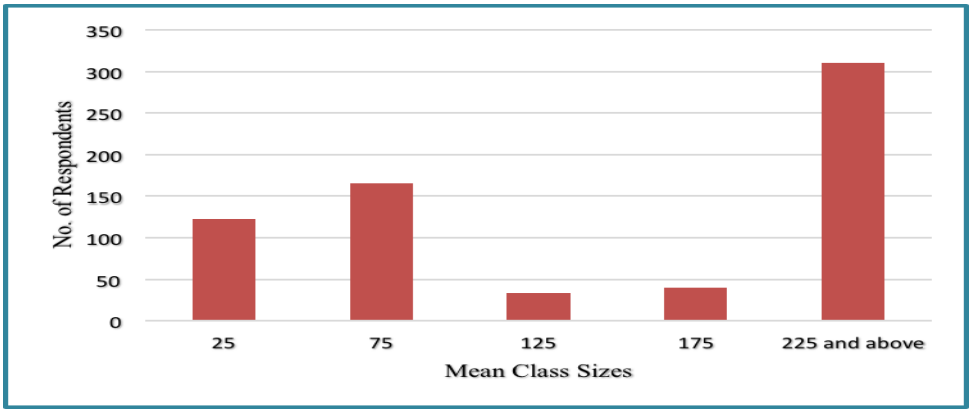



**Figure 4.5:- Comparison of Class Size in Hospitality Schools**

From Figure 4.5, it was clear that almost half of the interviewed students attended classes that had a population of 100 and above. A large practical class called for a large food laboratory to complement the number of students in a session.

### 4.7 Years of Experience of Staff

This study considered work experience of the lecturers as an important factor in determining the level of performance. In particular, it had an impact on the level of operation, concept and perception on food safety, knowledge and skills. In response to the question on years of experience the results were summarized in figure 4.6.

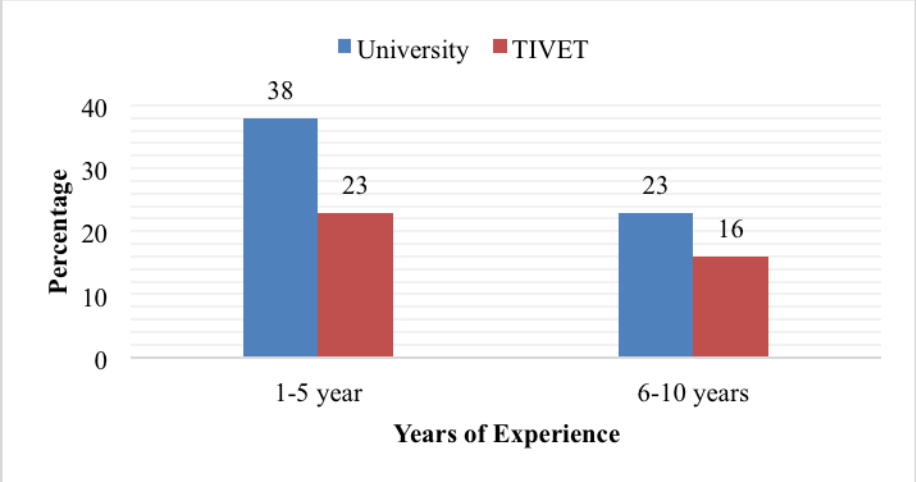



**Figure 4.6:- Years of Experience of Staff**

From Figure 4.6, majority of the interviewed staff members (60.9%) had an experience of between 1 and 5 years. The remaining 39.1% (9 lecturers) had an experience of between 5 and 10 years. Farrieet. (2009) observed that knowledge increased with age as confirmed in a study conducted between 31-40 year olds who had better scores compared to those less than 30 year olds. The two levels of institution had similarities in the level of

experience from the sampled lecturers. However, the graph indicate that the level of University slightly had more years of experience than TVET in food related courses.

### 4.8 Objective 1: To establish the level of HACCP Awareness in TVET and University Hospitality Schools

The first objective of the study sought to know the level of awareness of HACCP and food safety pre-requisites as stipulated by Codex Alimentarius regulations on food safety and hygiene. To achieve this, the students from the sampled institutions were required to state whether they were aware of the HACCP principles. The results were as shown in Figure 4.7

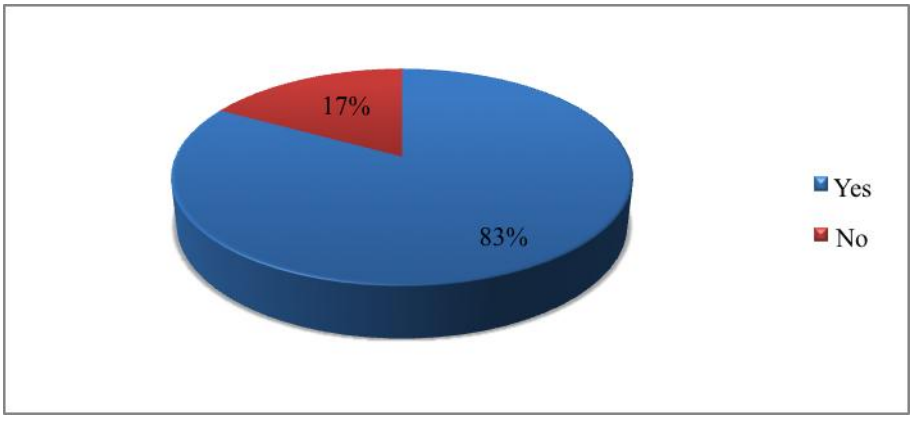



**Figure 4.7:- Awareness of HACCP and the Pre-requisites**

The finding indicated that a significant proportion of students (83%) in the hospitality institutions were aware of HACCP and food safety codes of practice. This implied that food safety and hygiene practices were no longer a new concept in the training institutions. The finding on awareness was consistent with the report given by Minnesota Department of Health (2010). In that report, it was observed that there has been a significant improvement in the knowledge and awareness of food safety code of practice in the recent years in many countries.

Existence of a smaller percentage (17%) of respondents who responded that they were not aware of HACCP implied that there was a major disparity among the graduates of various hospitality schools in Kenya. This disparity in the awareness of HACCP though small, posed a big challenge to institutions and industries hiring Food Managers and food handling personnel in Kenya who are trained from these institutions. Although this was considered important, an interesting observation by Roberts (2008) revealed that food service managers and employees who had received training on food safety knowledge did not translate the knowledge into practice. Despite this observation, Hertzman and Bannash (2007) advised that personnel who handled food must be knowledgeable and adhere to sanitation guide lines and practices. King (2013) also echoed the same sentiments that there was need for formal trainings targeted to the required level of knowledge.

A similar research was conducted to assess food hygiene awareness of professional food handling personnel from institutional catering companies in Portugal (Martins, Hogg and Otero, 2012). The results indicated that the level of formal education (56%) significantly influenced the level of knowledge with a standard deviation of 3.22. Birchenough (2000) also observed that there were strong correlations between awareness and positive food handling practices. This result reinforced the importance of conducting a preliminary assessment of training needs and evaluating the effectiveness of the training as suggested by Rennie (1999). From the finding it was concluded that the student could know what to do but if emphasis was not enforced by their lecturer they would ignore the food safety measures. This could be one of the reasons why food safety was still a challenge in many

countries including Kenya. A summary of the level of awareness of food safety hygiene code of practice between TVET and University hospitality schools is shown in Figure 4.8.

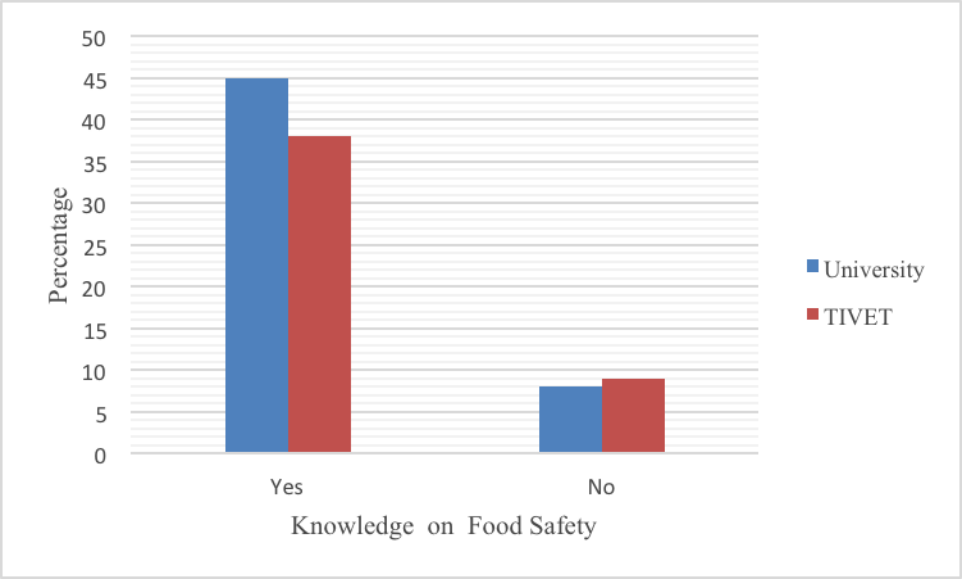



**Figure 4.8:- Awareness of Food Safety Hygiene Code of Practice (HACCP) between TVET and University Hospitality Schools**

From the summary in Figure 4.8, it was evident that respondents from Universities (45%) were aware of food safety and hygienic practices compared to respondents from TVET colleges at (38%). Conversely, only 8% of all respondents from Universities and 9% of the respondents from TVET colleges were not aware of food safety and hygiene practices.

### 4.8.1 Testing Hypothesis 1

Findings in Figure 4.8 suggested that there was disparity in the level of awareness of food safety and hygiene practices between Universities and TVET institutions. To assess whether the differences in the level of awareness of HACCP between the institutions was

significant, hypothesis testing techniques were employed. The hypothesis was therefore formulated as

**$H_{01}$ There is no significant difference in awareness food safety hygiene code of practice (HACCP) between TVET and university hospitality schools**

To test the hypothesis, chi square, was conducted to ascertain the significance in the relationship between level of awareness in TVET and University institutions. The tests were conducted at 95% confidence level. The level of significance (p-value) was set as $\alpha$=0.05. The significance of the variations would therefore be confirmed if p-value <0.05.

**Table 4.2:- Cross Tabulation between Category of Institution and Awareness of HACCP**

| | | **Awareness of HACCP** | | |
|---|---|---|---|---|
| | | **Yes** | **No** | **Total** |
| **Category of Institution** | **TVET** | 334 (79 %) | 88 (21%) | 422(100%) |
| | **University** | 224 (90%) | 25(10%) | 249 (100%) |
| | **Total** | 558 (83%) | 113 (17%) | 671 (100%) |
| $\chi^2$ = 8.320, *p-value*=0.001 | | | | |

From the Table 4.2, 90% of students from University hospitality schools indicated that they were aware of food safety measures and HACCP compared to 79% in TVET institutions. As previously mentioned, this variation in awareness posed a big challenge to institutions entrusted with the mandate of training on food safety and hygiene practices in Kenya.

### 4.8.2 Chi-Square Test on Institution Category and Awareness of Food Safety Hygiene Code of Practice

In testing the independence of institution category on awareness, the test yielded a *p-value* = 0.001, which was less than 0.05. Since the *p-value* was less than the level of significance, the null hypothesis of independence was rejected. This decision implied that there was a significant relationship between institution category and code of practice on awareness.

Based on the Chi-square test and previously presented tables and figures, the study deduced that even though a significant portion of students were aware of Food Safety Code of Practice control system, a good number still had inadequate information about Food Safety Code of Practice. King (2013) also highlighted this observation by indicating that there was need to appropriate food safety training, the education needed and the level of comprehension of the trainees. From the hypothesis tested, it was concluded that there was a close association between the institution category and awareness of Food Safety Code of Practice (HACCP). This relationship, however, significantly varied from one institution to another.

## 4.9 Objective 2: To Compare Food Handling Practices in TVET and University Hospitality Schools

In this section, respondents were asked about various aspects of food safety and hygiene practices observed during the food flow from the supplier to the table. It specifically focused on procedures followed while choosing food suppliers, delivery and reception of food supplies, storage of food, food preparation, cooking and service of food in the restaurant. Various practices related to each of these aspects were rated on a five-point

Likert Scale. As the first step, the study identified some crucial six factors that should be considered while sourcing food. Participants were then asked about the extent to which such factors were considered in an attempt to apply the Food Safety Code of Practice. Averages of responses in each point on the scale were obtained and expressed in percentages. These values were then represented in a pie chart as shown in Figure 4.9

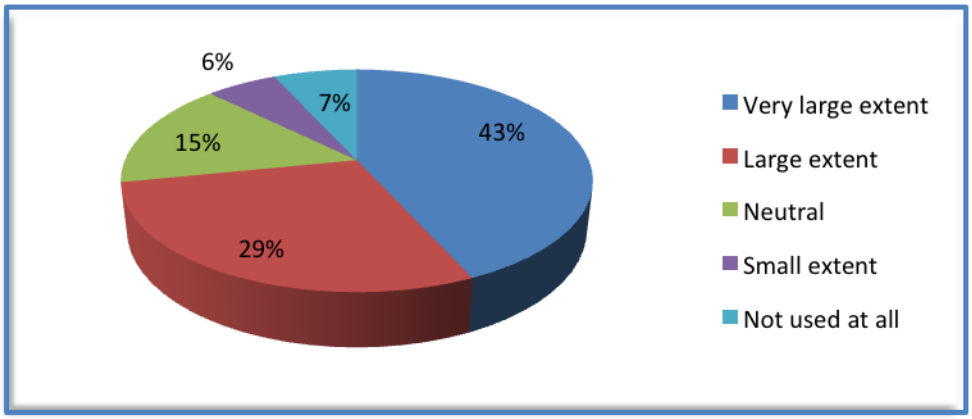



**Figure 4.9:- Extent to Which Correct Procedures Are Followed**

From Figure 4.9, it was observed that some institutions (7%) still did not follow the safety code in relation to sourcing of food. Only few institutions (6%) applied proper procedures while choosing food suppliers. Significant proportions (15%) were not aware whether their institutions applied proper procedures while selecting suppliers. This observation, therefore, implied that students do not know the procedures used when purchasing training materials. Thus, purchasing in relation to food code of practice might not be the responsibility of the students, but they could have the theoretical knowledge.

While assessing how often correct procedures were followed, the survey focused on the level of adherence to standards set by the HACCP control system. Figure 4.10 summarized the percentages of the responses.

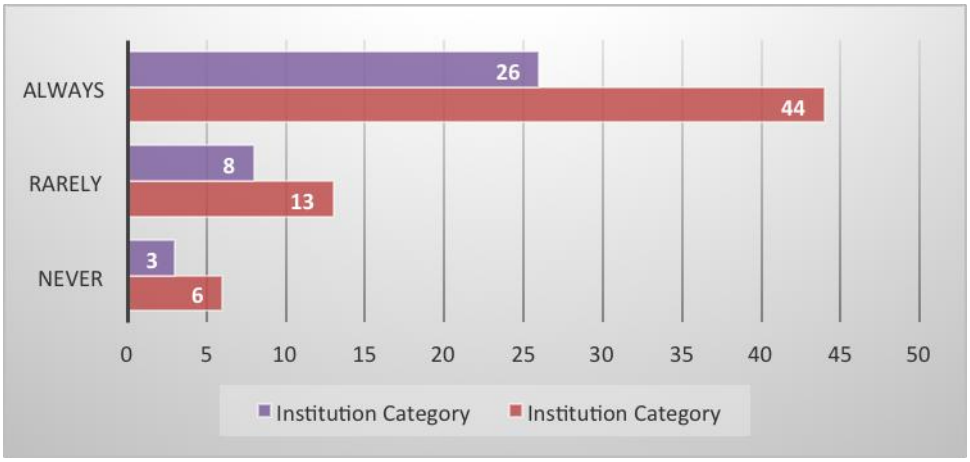



**Figure 4.10:- How Often Correct Procedures Are Followed**

Figure 4.10 was consistent with Figure 4.9 because there was still a small fraction (9%) which said that correct procedures were never followed in the entire food flow. Also, it was clear that even though more than half of the respondents (70%) noted that correct procedures were always followed, some institutions rarely followed any correct procedures (21%). This fraction could have been from institutions that had not fully embraced the importance HACCP system and how it should be implemented.

On the contrary, in a study carried out in Turkey from two different Universities to assess the knowledge and practice in food safety and hygiene practices among students undertaking cookery program, it was observed that although the students regarded the issue of food safety and personal hygiene as important, they had inadequate knowledge (Giritioglu, Batman & Terik, 2006).

In a study conducted by Arendt and Sneed (2008) on how to motivate employees to practice proper food safety and hygiene practices, the researchers found that employees were poorly motivated towards embracing suitable food safety practices. As reported from the research, poor employee motivation consequently led to adoption of

inappropriate food safety measures and/or practices. In another study conducted by Philip and Anita (2005) in food handling processes, the report indicated that majority of food-borne disease outbreaks resulted from malpractices during food preparation in small food businesses. The study also observed that safe food handling practices learnt during food safety training programs were the best strategy to limit incidences of food poisoning,

In testing about food safety and hygiene practices, all the stages in the food flow were identified and respondents asked whether correct procedures were followed in each of the stages. Positive responses in these questions were summarized in table 4.3.

**Table 4.3:- Cross-Tabulation between Food Safety Practices in Food Flow and Institution Category**

| | | **Institution Category** | |
|---|---|---|---|
| | | **University** | **TVET** |
| **Food Safety Practices** | Selection of food supplier | 73 | 106 |
| | Delivery and reception of food | 172 | 268 |
| | Storage of supplied food | 224 | 341 |
| | Food preparation and cooking | 137 | 184 |
| | Serving of food | 137 | 195 |
| | **Average response (n, %)** | **149(59.8)** | **219(51.9)** |
| $\chi^2 = 17.661$, *p-value*=0.047 | | | |

From Table 4.3, it was observed that there was a slight difference between the two institution categories. That is, the Universities had 59.8% while TVET institutions had 51.9%. A Chi-square test was performed to test whether this difference were significant.

### 4.9.1 Testing of Hypothesis 2

The second hypothesis sought to test whether there was a significant difference in the food safety and hygiene practices in TVET and University hospitality schools. This was done using Chi-square test. In this case, the hypothesis was formulated as follows:

**$H_{02}$ There is no significant difference in the food safety and hygiene practices in TVET and University hospitality institutions**

This test aimed at examining whether particular practices were associated with specific institutions. The *p-value* = 0.047 (< .05) implied that the null hypothesis was rejected and therefore a conclusion was made that there was a significant relationship between the institution categories and food safety and hygiene practices at 5 % level of significance. That is, there was no similarity in practices in all the institutions, meaning that an institution was defined by specific and different practices.

This inference could be compared with the findings of a study done by Blanton et al. (2006), on the relationship between food safety practices and organizational development. While investigating on key factors that determined the type of food safety and hygiene practices in any organization, Blanton et al. (2006) found that infrastructural development and availability of equipment and tools significantly influenced such practices. Therefore, in relation to the result of chi-square test, different institutions had different infrastructural development and so was the level of implementing certain practices or policies. This variation could be attributed to the fact that an institution could only adopt a practice if it had all the resources required for its full implementation.

### 4.9.2 Pair- wise Institutional Comparison in Food Safety and Hygiene Practices

Paired t-test was performed to test the significant differences in the food safety and hygiene practices in the TVET and University hospitality schools. Even though most previous studies had not been using this approach, this pairing was, important since the study involved a deep comparison of the practices in the institutions and not just a generalization on the similarity of the practices (Lelieveld, Holah & Napper, 2014). Output from this test was summarized in Table 4.4.

**Table 4.4:- Paired T-Test of Significant Difference in Food Safety and Hygiene Practices**

| | Mean | Std. Dev. | t-statistics | Degrees of freedom | p-value |
|---|---|---|---|---|---|
| University - TVET | 73.667 | 8.631 | 6.111 | 1 | .004 |

From the test, p-value was found to be less than 0.05 ($.004 < 0.05$) and therefore the null hypothesis was all rejected. This rejection implied that there was significant difference in the means of the two samples. This observation, therefore, indicated that there was a statistically significant difference between food safety and hygiene practices in TVET and University hospitality schools.

The findings on similarities in the food safety and hygiene practices did not vary so much from other previous studies. For instance, Davidson, Buchholz and Ryser (2013), in a study of food safety and hygiene practices, observed that various organisations both private and public had different food safety systems put in place. Karl (2013) also noted that the size and structure of an organization directly influenced the kind of practices adopted in an institution. Griffith, Liversey and Clayton (2010) observed that a new emerging risk in the food industry was the food safety culture. Griffin et al, (2010)

explained that an organization culture included beliefs, attitudes and values that the employees were exposed to everyday. Yiannas (2009) also observed that organizations could choose to create a strong food safety culture since they had power to influence the environment. He further reiterated that practicing positive food safety culture could reduce the global burden of food borne illness (Yiannas 2009).

### 4.9.3 Food Safety and Hygiene Practices

Apart from using the information collected through questionnaires, interviews, and focus group discussions, conclusions on similarities in food safety and hygiene practices were also made using captured images. The pictures were taken while administering observation checklists. Few pictures were sampled to show differences in food safety and hygiene practices. The sampled pictures were related to personal hygiene, food hygiene and environment hygiene. The sampled pictures are shown in Appendix VII.

### 4.9.4 Personal Hygiene and Grooming

In relation to personal hygiene, dress code was considered as one of the most important features of food handling personnel. A well-groomed food handler projected the standard of an establishment. He/she also represented qualities of good hygiene, professionalism, style and image of an institution. The finding of the images taken during observation revealed a number of gaps in the training workshops. Based on the three theme areas of the study, personal hygiene of the trainees was compromised as most of the students did not wear complete uniform as stipulated by the dressing code. These observations captured across the institutions were summarized in pictures 1 to 6. Good grooming entailed hair that was covered, spotless clean well- ironed uniforms well-polished flat

leather shoes and a shower every day. In addition, clean hands, well-manicured nails with no vanish play an important role in personal hygiene.

In fact, Clayton and Griffith (2008) noted that the caterer's hand hygiene practices were influenced by subjective norms and social pressures at work in relation to nature and load of work in particular workshops. The researchers pointed out that the individuals may know the importance of carrying out a duty but under certain circumstances may not do it. Clayton and Griffith (2008) reiterated that in order to improve caterers hand hygiene all members of staff must be trained. The report further showed that only 31% followed correct cleaning procedures of equipment and surfaces. 77% did not attempt to clean, while 85% use inappropriate procedures causing food to come into contact with potentially contaminated objects

From the photos some students appeared well- groomed while others were partially groomed, an indication that some institutions did not adhere to the standards of grooming. Additionally, in the photos some students did not have headgears, neckerchiefs and aprons. The findings implied that there was no uniformity in grooming in the workshops and this was an indication that students knew what they were supposed to wear but unless their lecturers reinforced the idea, the students would appear the way they wanted for practical lessons. This was also an indication that students did not have positive attitudes related to the culture in their respective institutions, and the lecturer did not put emphasis on personal hygiene.

### 4.9.5 Food hygiene

Food hygiene entailed ensuring that food was covered, kept at the correct temperature, cooked to the correct internal temperature and either served piping hot or chilled. Previous study carried out on food hygiene in the preparation areas by Clayton and Griffith (2008) observed that good food hygiene was a critical protective measure against contamination. NRAEF (2007) also reiterates that a successful good food handling behaviour depended on trained food handler who acquired the right knowledge, skills and attitude needed to keep food safe in a laboratory setting.

Observations made across the institutions regarding food hygiene were as summarized in pictures 7 to 10. The images showed congestion in the workshops with very small worktops. In some cases, some of the cooked foods were placed near the sinks and little separation was done between cooked and uncooked foods. The images on food hygiene indicate that cooked foods were exposed at room temperature as the students engaged in other activities. Some foods were not covered as depicted in the images, raw foods were also not covered during the preparation stage creating a good attraction for flies and a suitable environment for the growth of bacteria and other microorganisms. Based on these exposures, there was a high possibility of cross contamination where cooked food were not separated from raw foods. Also, some students were not keen on the use of colour-coded chopping boards. As seen in image 12, a red chopping board was used for cutting vegetables, an indication that food safety standards were not being followed. Interviews confirmed that some institutions did not have colour coded chopping boards. The fact that some foods were left exposed during preparation stage, Inappropriate handling procedures used during preparation and incorrect temperatures maintained

before and during service, confirmed that a number of institutions did not adhere to the stipulated regulations regarding food safety code of ethics.

### 4.9.6 Environmental Hygiene

The environment where food is prepared plays an important role in the prevention of food contamination in any institution. The areas covered in this Section included the types of fuel used, equipment, storage including the other facilities in the work-shops, wash-up areas and the management of waste.

#### 4.9.6.1 Type of Fuel and Equipment

The most common cooking fuel used by institutions was gas, electricity and charcoal. Observations made across the institutions based on cooking method were as summarized in pictures 13 to 16. Some institutions used charcoal cookers (jikos) while others used small gas cylinders to complement the use of charcoal. Charcoal was time-consuming, dirty and risky to use from a health perspective. Since all types of cooking fuel were expensive, most of the institutions preferred the use of gas and charcoal, where gas was used for foods that took a short time to cook, while charcoal was used for foods that required stewing and simmering and took a long time cook.

#### 4.9.6.2 Wash up areas

Wash –up is a very important area in a food production and service as properly organized wash up area will reduce microorganisms to a significant level. Wash up areas are expected to be well organized, spacious with hot soapy waters for washing dishes, warm water for rinsing and hot water for sterilization. Additionally, there should be a wash- up trolley where washed item are separated and stacked accordingly. Utensils must be

separated according to use, and proper rinsing should be done. This practice, if not observed, compromises the overall cleanliness of all operations in a kitchen. Observations made across the institutions were as summarized in pictures 17 to 21, which clearly showed that there were differences in how various institutions outlined their wash-up areas Photos 21 to 24 showed how wash- up areas were organized in different institutions. Photos 22 and 23 showed improvised wash- up areas using basins. The challenge of using basins included the water getting cold, and rinsing not being done properly and this could result in food being served from dirty plates and cutleries. Picture 17 also depicted how utensils were being cleaned just adjacent to the waste not properly disposed. The fact that utensils were being washed next to garbage was an indication that hygiene is compromised in the training institutions.

Hand wash basins were significantly not available in a number of institutions. In one institution, a sink was labelled as a hand wash basin but totally used for a different purpose and seemingly, it was the only sink available in the kitchen. This was an indication that hands were never washed before and during the operation in a designated area.

#### 4.9.6.3 Storage Areas

Storage areas were expected to be well -organized. They were expected to have shelves that were used for storing different items which could be arranged according to use. Observations made across the institutions were as summarized in pictures 22 and 23. Assessments of these facilities indicated that many institutions did not have proper storage facilities especially for vegetables and other foodstuff.

#### 4.9.6.4 Waste disposal

Waste disposal within the workshop should be lined waste bins with lids to avoid attraction of insects and other pests from getting into the kitchen. Observations made across the institutions were as summarized in pictures 24 to 27. These photos covered environmental hygiene depicting waste disposal/management in the institutions. In the sampled photos, there was no proper waste management hence no hygiene was observed at all particularly on photo 25 as the institution used a wheelbarrow as a waste bin. The sight was not only offensive and unpleasant but also unhygienic. The fact that waste was exposed to flies and other pests clearly explained why rats were seen criss-crossing some of the workshops. Fire extinguishers were also examined in relation to fire accidents. Though not all institutions had properly installed and filled fire extinguishers, very few institutions had theirs in good condition, particularly the modern workshops.

The findings of this study implied that although training had a positive impact on the trainees, the institutions were still faced with a lot of challenges in ensuring that food safety practices were followed. These findings implied that personal hygiene of students in the workshops could be a possible root of infection in the training institutions. Given the sensitivity of this subject, institutions need to put policies on personal hygiene that must be followed by all students in the workshops.

## 4.10 Objective 3: To establish the capacity for TVET and University hospitality schools in offering food safety and hygiene training in Kenya

This objective focused on institutions' equipment and sanitary facilities. This variable also looked at how prepared institutions were in implementing proper measures that ensured maintenance of high hygienic standards. In so doing, the researcher considered the following aspects of suitability and capacity of the institutions:

- general availability of basic equipment/tools
- whether modern mechanical, electrical and large equipment/tools are available
- extent of use of available equipment
- Space available and workshop organization including drainage.

### 4.10.1 General Availability of Equipment/Tools

Several equipment/tools were identified and respondents asked whether the equipment/tools were available in their institutions or not. An average of the response category 'Available' was computed and cross-tabulated against the institutions.

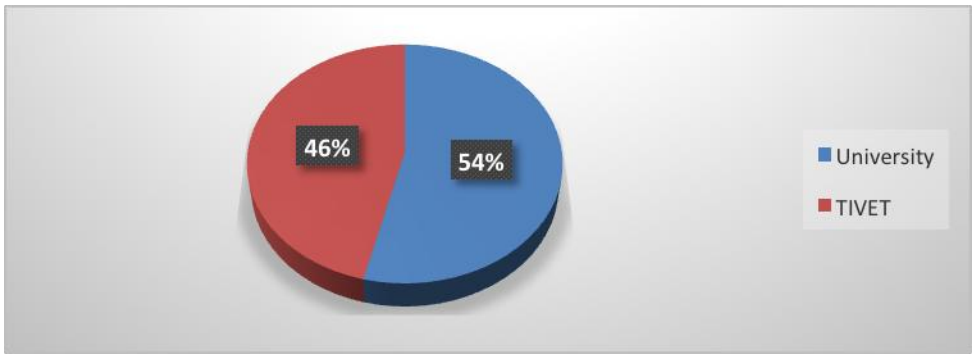



**Figure 4.11:- General Availability of Equipment/Tools**

Figure 4.11 indicated that though there was almost equality in the availability of basic equipment/tools in the two categories of institutions, availability of various equipment/tools in universities were, however, relatively higher than TVET colleges.

This was attributed to the fact that most university hospitality schools are relatively new and new equipment were purchased before undertaking the training. However, TVET colleges are old institutions and some of their equipment could be worn out, broken and not replaced immediately. The researcher further examined whether the available tools were modern. Responses in this question were summarized as shown in Figure 4.12.

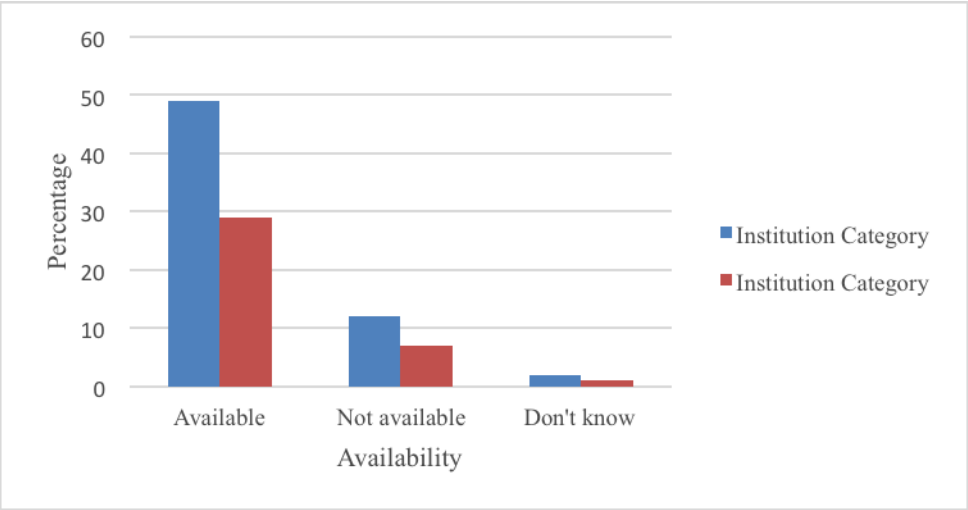



**Figure 4.12:- Availability of Modern Equipment**

Figure 4.12 revealed that majority of respondents (78 %) agreed that the equipment/tools available were modern. This was a good finding since it showed that most institutions used tools/equipment which is service-able. However, a significant proportion of respondents also agreed that they did not use or have modern tools/equipment. This was vital observation since it implied that dilapidated and old tools/equipment were still being kept in the institutions and these could pose a challenge to the industry of space in the workshops.

The study found out that quite a number of institutions had very old equipment which were also inadequate to cater for the number of students enrolled. Use of dilapidated

facilities, equipment and tools jeopardized adoption and implementation of food safety and hygiene practices in the training institutions. In addition, old equipment harboured rodents and other insects such as cockroaches. To check on the differences in availability of modern equipment in the institutions, Kruskall Wallis Test was performed between institution category and availability of modern equipment/tools. The result was summarized as shown in Table 4.5

**Table 4.5:- Kruskall-Wallis Test on Institution Category and Availability of Modern Equipment**

| | Modern Equipment | N | Mean Rank | Chi-square | d.f | Asymp. Sig. |
|---|---|---|---|---|---|---|
| Institution Category | Available | 523 | 432.38 | 13.002 | 2 | 0.01 |
| | Not available | 130 | 104.48 | | | |
| | Don't know | 20 | 16.07 | | | |
| | Total | 671 | | | | |

Based on the asymptotic significance (p-value = 0.01) value obtained from the Kruskall-Wallis test, the null hypothesis that tests on independence between institution category and availability of modern equipment was rejected. This rejection implied that availability of modern equipment and institution categories were dependent. The next question was whether usage of the available equipment/tools varied significantly from one institution to another. This called for a Chi-square test.

### 4.10.2 Chi-Square Test on the Use of Modern Tools

This test involved checking whether there was any significant relationship between an institution category and use of modern tools. The test yielded a *p-value* = 0.01. Since the test was performed at 5 % level of significance and the *p-value* was less than 0.05 (*p value*$< 0.05$), the null hypothesis was rejected. This implied that the use of modern

equipment/tools depended on institution category. This study, therefore, not only found that availability of modern equipment/tools varied from one institution category to another, but also the extent of use of available equipment/tools and facilities in training.

While focusing on capacity in terms of training students, respondents were asked about adequacy of training tools and equipment. Specific equipment were identified and cross-tabulation between respondents, who said the equipments were available, and institution category was done. Output of this procedure was summarized in Table 4.6.

**Table 4.6:- Adequacy of Training Tools and Equipment**

| | | **Institution Category** | | **Chi-square** | **p-value** |
|---|---|---|---|---|---|
| | | **University** | **TVET** | | |
| **Resource/ Equipment Adequacy** | Hood/steam extractors | 64 | 19 | 4.330 | 0.012 |
| | Small equipment/tools | 166 | 68 | | |
| | Hand wash basins/sinks | 79 | 28 | | |
| | Cookers/ovens | 175 | 59 | | |
| | Working space/table tops | 148 | 47 | | |
| Averages (%) | | 126(50.6) | 44(37.2) | | |

Table 4.6 revealed that adequacy of training tools and equipment was dependent on institution category. This was due to the observed p-value (0.012), which was less than 0.05. Of interest was, however, availability of hand wash basins/sinks. Out of the 671 respondents, only 79 from Universities and 83 from TVET responded that hand wash basins/sinks were available for training. Hand wash basins and/or sinks are known to form a very crucial aspect of food safety and hygiene practices and therefore, all institutions that handled food production were expected to focus on improving hand wash sinks and basins.

### 4.10.3 Testing of Hypothesis 3: Chi-Square Test on the Suitability and Capacity of Institutions

In this case, the tested null hypothesis was formulated as

**$H_{03}$ There is no significant difference in the capacity for the TVET and University hospitality schools in offering food safety and hygiene training**.

This test aimed at examining whether the level of suitability and capacity of institutions could be associated with specific institutions. The test was, therefore, performed after running a cross-tabulation between institution category, level of suitability and capacity of institutions. When the test was done, the *p-value* was found to be 0.004. This value was less than the 0.05 ($p\ value < 0.05$) and therefore the null hypothesis was rejected. The rejection led to a conclusion that there was a significant relationship between the institution categories and level of capacity of institutions in providing training on food safety and hygiene practices at 5 % level of significance. The finding, therefore, implied that different institutions had different levels of capacity of institutions in providing training on food safety and hygiene practices. These findings were consistent with the previously made observations about variations in availability and adequacy in training equipment/tools.

### 4.10.4 T-Test: Test for Differences in the Level of Capacity in Institutions

Having observed that there were variations from one institution category to another in terms of availability, adequacy and usage of training equipment/tools rendering the suitability and capacity of the institutions to also vary, the researcher performed a paired t-test to check whether the differences were significant. Output of this test was summarized in the table 4.7.

**Table 4.7:- One Sample T-test for Differences in the Level of Suitability and Capacity of Institutions**

| | Mean | Std. Dev. | t-statistics | p-value |
|---|---|---|---|---|
| Universities-TVET | 86.50 | 28.00 | 5.809 | .011 |

The t-test output gave $p - values = 0.011$ which was less than 0.05 ($0.011 < 0.05$) and therefore the formulated null hypothesis was rejected. The rejection implied that there were statistically significant differences in capacity level of TVET and University hospitality schools in providing training on food safety and hygiene practices.

### 4.11 Objective 4: To establish the level of implementation of HACCP system in TVET and University hospitality schools.

Establishing this objective was done using the pre-requisites of HACCP system. The procedure involved looking at the three aspects of food safety which included personal hygiene, food hygiene and environmental hygiene. Responses in these three aspects of HACCP system included frequency of adherence, level of achievement and adoption of the set standards by the University hospitality schools and TVET colleges. The findings were summarized in Table 4.8. The values given in the table represented respondents who agreed that various aspects of HACCP system had been implemented and were upheld in their institutions.

**Table 4.8:- Level of Implementation of HACCP System and Institution Category**

| | Universities | TVET |
|---|---|---|
| Personal hygiene | 196 | 113 |
| Waste disposal | 164 | 61 |
| Cleanliness and sanitation | 164 | 83 |
| Training | 131 | 56 |
| Design of food premises | 132 | 45 |
| Pest control | 115 | 48 |
| **Average (percentage)** | **150(60.2)** | **68(48.5)** |

Apart from the normal responses in various aspects of HACCP system, the average (percentage) row described how the system had been implemented and upheld in the two categories of institutions. The percentages gave the level at which the institutions had conformed to standards set by the HACCP system. According to Table 4.8, Universities still scored the highest percentage level of implementation of HACCP than TVET.

Taylor (2008) in conjunction with the University of Salford, developed a new method of applying HACCP in the hospitality industry in collaboration with Food Safety Agency (FSA). This method proved that there were valid alternatives to the classical codex method and that businesses could comply with HACCP principles without ever having to use the HACCP jargon. Taylor (2008) asserted that the method had been extended as Menu-Safe system was used for hospitality business in all types of institutions. While HACCP required documentation and records to be kept, Taylor (2008) argued that most knowledge and craft of the food handlers had been acquired, internalized and were used spontaneously with creativity. Therefore, based on Taylor's proposal (2008), there was no time for writing down whatever the food handlers did in the workshops.

### 4.11.1 Chi-Square Test for Differences in the Level of Implementation of HACCP System

In this test, the researcher examined whether applicability and implementation of HACCP system was related to specific institutions. The researcher, therefore, formulated the hypothesis

**$H_{04}$ There is no significant relationship between applicability of HACCP system and institutions category**

The test was done using values in Table 4.7 and at $\alpha = 0.05$ level. When the test was run, the *p-value* was found to be 0.016. This value was less than the 0.05 ($p\ value < 0.05$) and therefore the null hypothesis was rejected leading to a conclusion that there was a relationship between the institution categories and level of implementation of HACCP prerequisites at 5 % level of significance. This result implied that different institutions had applied and/or implemented standards outlined by HACCP prerequisites the way they understood it. That is, the finding indicated that universities had implemented the HACCP prerequisites at a different extent compared to TVET institutions. This meant that the training institution used their own discretion to apply food safety guidelines hence no standards were followed.

### 4.11.2 T-Test for Differences in the Applicability and Implementation of HACCP System

In this test, the study investigated whether the difference in the level of applicability and implementation of HACCP system per institution was significant. This test was also done at 5% significance level. Table 4.9 summarized the output of this test.

**Table 4.9:- T-test for Differences in the Level of Applicability and Implementation of HACCP System**

| | Mean | Std. Dev. | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Universities - TIVET | 82.667 | 18.177 | 13.718 | 1 | .012 |

From the output, it was evident that the p-value (= 0.012) was less than 0.05 ($p\ value < 0.05$). Based on this finding, the null hypothesis was rejected and a conclusion

that there was a significant difference in the level of applicability and implementation of HACCP system in the two categories of institutions was made. This variation could also be seen in the value of standard deviation of the mean difference, which was more than 10. This finding implied that the level of applicability and implementation of HACCP system varied from one institution to another.

### 4.12 Objective 5: To determine the barriers to food safety and hygiene practices in TVET and University hospitality institutions

In this section, the researcher focused on possible barriers to food safety and hygiene practices. Specific barriers included lack of motivation, lack of proper set standards, attitude of the staff and students, lack of knowledge, time, sanitary facilities, inadequate equipment and finance. Ratings of the effect of these factors were based on a Five-Point Likert Scale, which was 1-Very large extent, 2-Large extent, 3-Neutral, 4-Small extent and 5-Not used at all. Figure 4.13 summarized this finding.

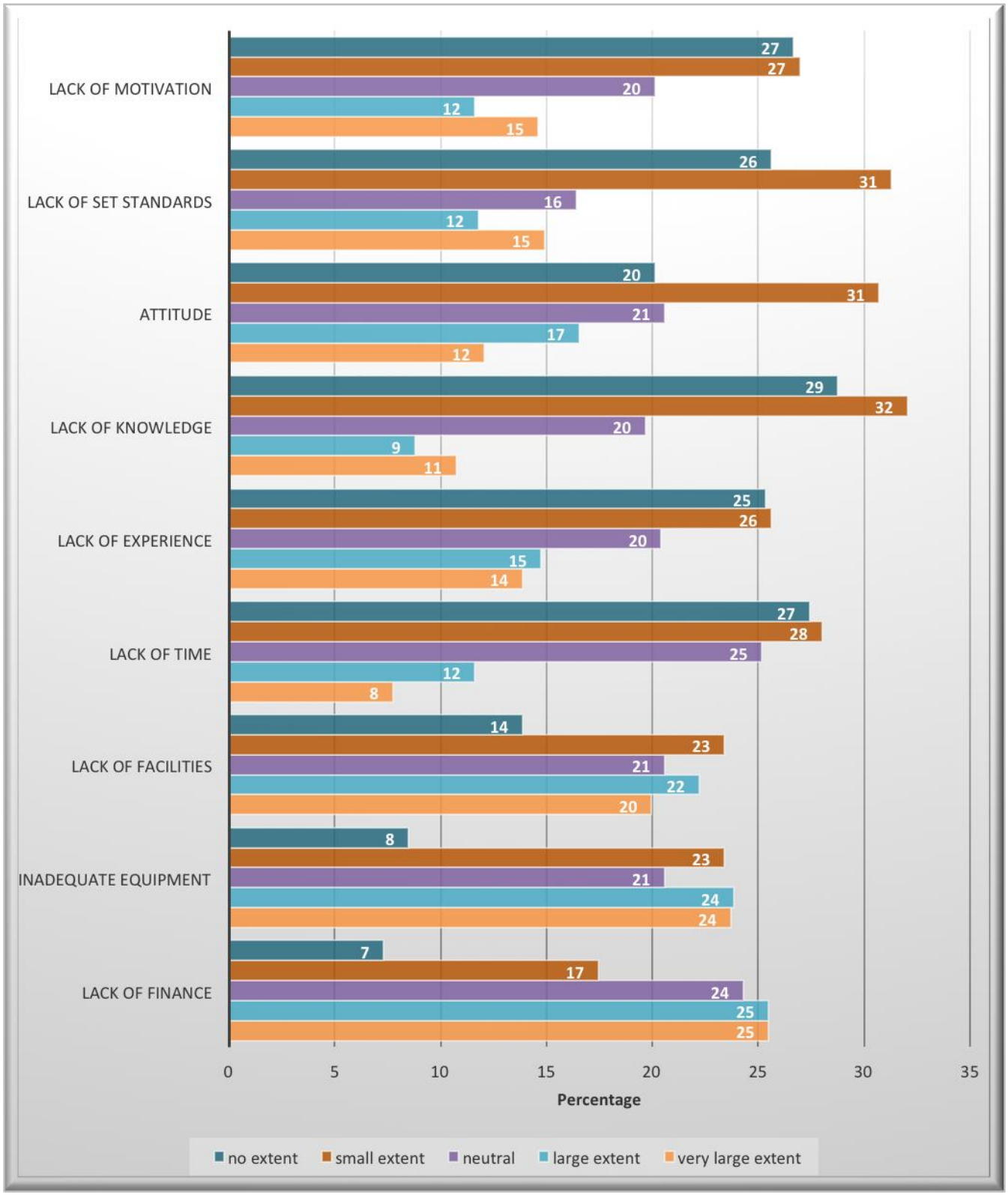



**Figure 4.13:- Barriers to Food Safety and Hygiene Practices**

From Figure 4.13, though all the previously stated factors were threats to food safety and hygiene practices, some factors posed more threats to proper food safety and hygiene practices. Such factors included lack of facilities, inadequate equipment and lack of finance. The study further sought to know the extent to which the three factors posed threat(s) to the two institution categories. The findings were summarized as shown in Figure 4.14.

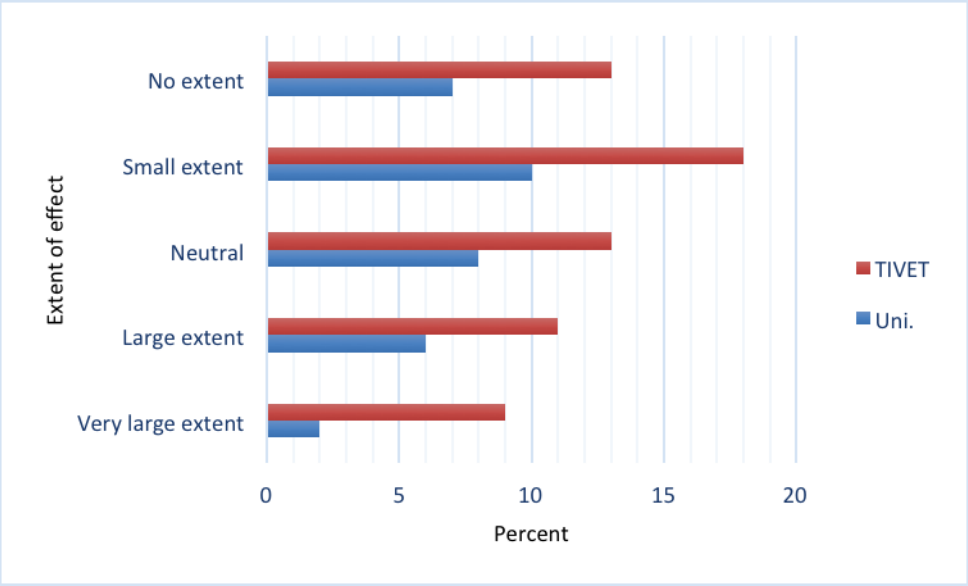



**Figure 4.14:- Extents of Effects of Barriers to Food Safety and Hygiene Practices**

Figure 4.14 illustrated that from all extent categories, responses for TVET were higher than those of University hospitality schools. Noted, also was that there was a slight skewness towards the *Large Extent* side in both institution categories. This can be seen as shown in Figure 4.15

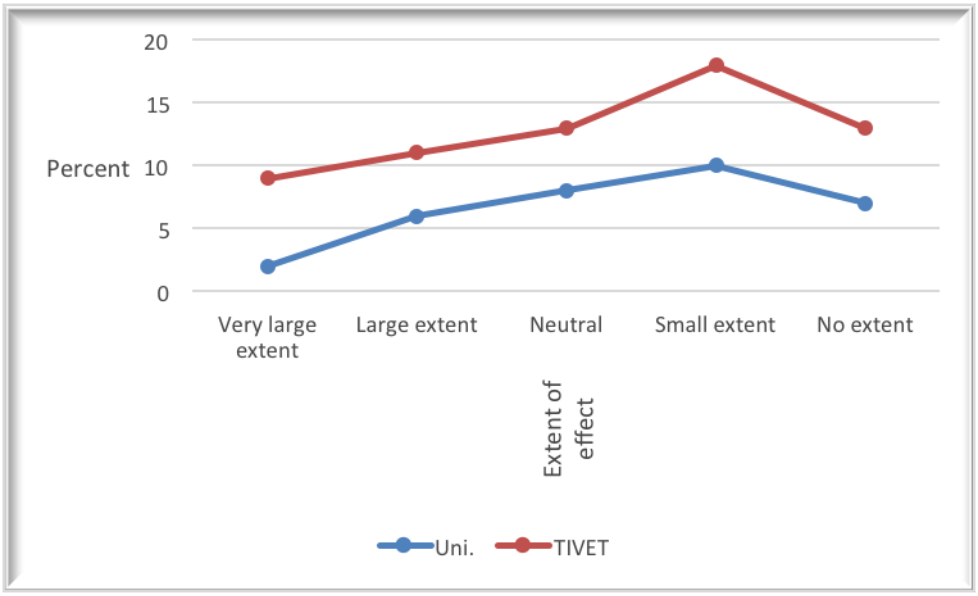



**Figure 4.15:- Line Graph Showing Extents of Effects of Barriers to Food Safety and Hygiene Practices**

Figure 4.15 showed that the distribution of the responses in the extents of effects of the identified barriers to food safety and hygiene practices was almost similar in the two institution categories. It was also observed that even though most respondents (48%) agreed that the factors had minimal effects, significant proportion (28%) did, however, respond that the identified factors had negative effects to a large extent.

As noted by Panisello and Quantic (2001), focus on barriers to food safety and hygiene practices was a vital component of attaining regulations provided by the HACCP system. In addition to inadequate finance and facilities, Panisello and Quantic (2001) observed that improper learning schedules, incompetent food handlers, poor motivation and cultural differences were among serious factors that thwarted proper food safety and hygiene practices. The report further revealed that there were many risks of food safety due to industrialization and mass food production due to longer and more complex food

chains involved. Besides, the fast growth of eating out habits was cited as a major cause of food safety problems and impediments to HACCP.

A study conducted by Lee and Lee (2005) in Seoul Women University in Korea found that the most important drive promoting implementation of HACCP was implementation in supplier facilities. Other observed challenges included lack of training methodology, incompetent teaching staff and limited facilities/equipment. The study suggested that more investments on facilities/equipment were needed for food safety improvement and successful implementations in schools and food service out-lets. The study also asserted that proper training of employees and availability of facilities enabled the employees to monitor Critical Control Points and take corrective actions. Another study by Mitchel, Fraser and Beacon (2007) postulated that job stress, work pressure and high placed environment contributed to poor food safety at the work-place. Moreover, the study observed that catering work-site was quite demanding and led to a stressful fast - paced environment making it vulnerable to food safety malpractice.

### 4.12.1 Testing of Hypothesis 5: Independent T-Test for Differences in Barriers to Food Safety and Hygiene Practices

In examining whether the barriers were similar in the two categories of the institutions, the researcher used independent T-test. This test was used to test hypothesis 5, which was formulated as

**$H_{05}$ There are no barriers to food safety and hygiene practices in TIVET Institutions and University hospitality schools.**

Similar to the previous t-tests, the test was done at 5 % level of significance and the output summarized as shown in Table 4.10

**Table 4.10:- Independent T-Test for Differences in Barriers to Food Safety and Hygiene Practices**

| | T | df | Sig. (2-tailed) |
|---|---|---|---|
| Universities - TVET | 14.643 | 1 | .012 |

In Table 4.9, the p-value (= 0.012) was less than 0.05 (*p value*< 0.05). Based on this finding, the formulated null hypothesis was rejected and consequently, a conclusion that there were significant differences in barriers to food safety and hygiene practices in the two institutional categories. This finding implied that the barriers to implementation of HACCP system varied from one institution to another. This implied that the allocation and utilisation of resources in the two categories of the institutions are prioritised differently,

### 4.13 Objective 6: To Establish the Microbial Load in Foods Prepared and Served in TVET and University Hospitality Schools

This objective sought to determine the microbial load in vegetables served in TVET and Hospitality schools. Both lab results and responses in the questionnaire were used. The vegetable samples were analysed and microorganisms isolated. In addition, bacterial loads from various institutions were used to test the hypothesis on significant difference in the microbial loads in foods served in the two categories of institutions. Responses in the questionnaire were used to test the general hypothesis, while lab tests were used to test for the significance of microbial load. Therefore, responses from questionnaires were validated using lab tests.

The first step in testing this hypothesis involved summarizing prevalence of food microorganisms. Responses in this question were summarized in Figure 4.16

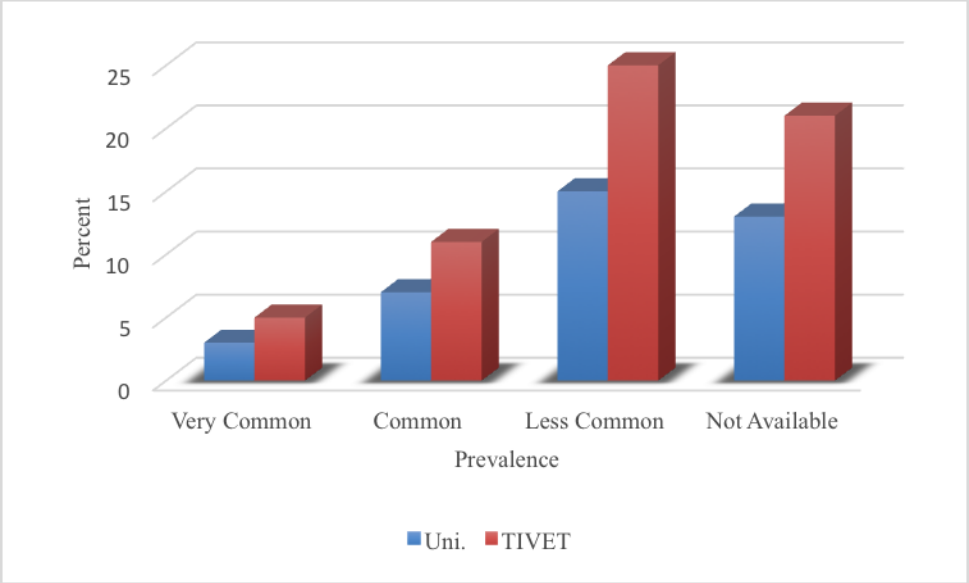



**Figure 4.16:- Prevalence of Food Micro-organisms**

Figure 4.16 showed that majority of the respondents (40%) responded that presence of bacteria in foods prepared and served in TVET and University hospitality schools was less common. This category of response was closely followed by those who said that foods prepared and served by the institutions were free of any food microorganism (34%). On the other hand, a cumulative total of 26% admitted that the foods prepared and served by the four categories of institutions did contain bacteria. It can also be noted that in all the two categories of the level of prevalence of food microorganisms, responses for University hospitality schools were relatively less than those of TVET.

### 4.13.1 Significance of Microbial Loads in Foods Served in TVET and University Hospitality Schools

Under objective 6, the corresponding hypothesis was

**$H_{06}$ There is no significant microbial load in foods served in TVET and University Hospitality Schools**

The study begun by investigating if there were similarities in the responses from the two categories of institutions. This was done using a paired T-test and the output summarized in Table 4.11

**Table 4.11:- T-Test for Difference in Microbial Loads in Foods Prepared and Served in TVET and University Hospitality Schools**

| | T | df | Sig. (2-tailed) |
|---|---|---|---|
| Universities – TVET | 12.560 | 1 | .013 |

From Table 4.11, the p-value (= 0.013) was less than 0.05 ($p - values < 0.05$) and therefore the null hypothesis was rejected. This decision implied that the responses regarding the presence of microbial loads in the foods prepared and served in TVET and University Hospitality Schools were different. This rejection implied that there were significant differences in the microbial loads in the foods prepared and served by the two categories of institutions. This conclusion was made based on opinions of the respondents. However, to ascertain validity of the responses, lab tests were done to determine food microbial load in the food samples obtained from the two categories of institutions.

### 4.13.2 Food Microbial Load Laboratory Analysis

As mentioned in chapter three, lab procedures involved isolation of food micro-organisms. Food samples obtained from all institutions and the quantities were shown in Table 4.12.

**Table 4.12:- Samples Collected in Institutions**

| Samples collected in institutions | Universities | TVET | Total |
|---|---|---|---|
| Spinach | 12 | 24 | 36 |
| Macedoine vegetables | 6 | 30 | 36 |
| Coleslaw | 10 | 14 | 24 |
| **Total** | **36** | **68** | **104** |

Micro-organisms isolated included *Salmonella, Straphylococcus, E. coli, Pseudomonas,*. Total plate count indicated high level of microorganisms. Contrary to popular belief, it was expected that *Salmonella/Shigella* would be higher given that the sanitary conditions of some institution were below the expectation. However, only a total number of 8 food samples indicated presence of *Salmonella*. This was attributed to the handling conditions during the preparation and production.

*E. coli* were associated with beef and poultry products, water or food contaminated with human faeces. *E. coli* were isolated in coleslaw and spinach. This was associated with water used for washing the vegetables given that coleslaw in most cases are eaten raw and in some cases with mere blanching while spinach is steamed or stir fried a few minutes before being served. This could also mean that the fertilizers used on the two vegetables were not from a reliable source and the water used for irrigation was from a dirty environment. *E. coli,* on the other hand, were associated with consumption of raw fruits and vegetables.

Generally, microbial load was significantly high before specific isolations were done. This was a clear indication that although other isolations were not done, food served from Universities and TIVET institutions were contaminated to a significant level of proteuse species (enteric bacteria). After isolation, the loads or counts were determined using the

procedure in chapter three. Though several food samples were used, only three samples gave consistent results. These samples were categorized according to the two institutional categories. Table 4.13 summarizes this output.

**Table 4.13:- Microbial Loads in Food Samples**

| Samples | University | TVET |
|---|---|---|
| A | $1.38\times10^{5}$ | $2.25\times10^{5}$ |
| B | $7.60\times10^{4}$ | $1.62\times10^{5}$ |
| C | $1.075\times10^{5}$ | $2.10\times10^{5}$ |
| Average | $1.07\times10^{5}$ | $1.99\times10^{5}$ |

Where, A – Spinach

B – Macedoine vegetables

C - Coleslaw

Table 4.13 shows that even though there were variations in the individual sample microbial load in each sample, average loads in each sample showed slight variation. Nevertheless, the Average row showed that food microbial load was slightly low in the Universities but slightly high in TVET. To test on whether there were significant differences in microbial loads in the samples from the two categories of institutions, t-test was conducted. Table 4.14 summarizes this analysis.

**Table 4.14:- T-test for Microbial Load in Foods Prepared and Served in TVET and University Hospitality Departments**

| | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| Universities – TVET | .5391 | .2641 | -.44034 | .1.49127 | 1 | .620 |

From Table 4.14, the p-value (.620) is greater than 0.05 ($p - value > 0.05$). This value implied that the null hypotheses was not rejected, but was instead described as of 'no significant difference.' This conclusion was consistent with the explanation given for Table 4.11. In the standard error of the mean column, it was observed that food microbial loads slightly varied between Universities and TVET (std. dev. = 0.2641). Therefore, consistency between Table 4.11 and Table 4.12 was further confirmed in the standard deviation values since there was slight difference between the samples from Universities and TVET (as shown in Table 4.11). To check on significance of the microbial loads, one sample t-test was conducted on the loads for each institution category. The average loads were compared against a constant, which was taken to be zero. The value was picked since it implied that there was no food microbial load in any food sample. In this test, the null hypothesis was that there was no significant difference between the food microbial loads and zero. That is,

$H_0: \mu_i = 0$

Where $\mu_i$, $i = 1,2,$ were the averages of food microbial loads in the two institutional categories.

Table 4.15 gave the output of this one sample t-test.

**Table 4.15:- One Sample T-test for Significance of Microbial Loads**

| | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | |
| | t | df | Sig. (2-tailed) | Mean Difference | Lower | Upper |
| Universities | 4.966 | 1 | .008 | 1.058 | .467 | 1.649 |
| TVET | 3.841 | 1 | .026 | 1.444 | .323 | 2.566 |

Table 4.15 gave the mean differences between the microbial loads and the arbitrarily picked constant zero. The corresponding confidence interval for the mean differences was also given. From the table, the p-values were both less than 0.05 ($p - values < 0.05$) and therefore the null hypotheses of no significant difference between the food microbial loads and zero in each case was rejected. This rejection implied that microbial loads in the foods prepared and served by the two categories of institutions were significant and the foods were therefore not fit for human consumption.

### 4.13.3 Pictures on Lab Isolation of Food Microorganisms

Lab isolation also gave positive results for various micro-organisms. The pictures 28-32 in Appendix VIII displayed the observed results and the corresponding micro-organisms that were isolated from the collected samples. The observed lab results showed that there were positive isolations for *E. coli*, *Salmonella*, and *Pseudomonas*. This observation implied that the food prepared and or served in the two categories of institutions had either or a combination of the positively isolated micro-organisms. This observation was consistent with the results of hypothesis testing, where it was found that the microbial loads were significant. However, a negative isolation was also found. Negative isolation implied that in the food sampled, none of the micro-organisms were successfully isolated. This revelation showed that not all foods prepared and/or served in the institutions had bacterial loads.

### 4.14 Multiple Regression Analyses

In this study, the researcher performed multiple regression analysis on two study objectives, which were food handling practices and barriers to food safety and hygiene practices. The two objectives were chosen because they had various aspects that could directly relate to good hygienic standards. In both cases, the dependent variable was, therefore, good hygienic standards.

#### 4.14.1 Model 1: Food Handling Practices and Good Hygienic Standards

To obtain Model 1, the researcher regressed food handling practices on good hygienic standards to obtain a multiple regression analysis as summarized in Table 4.16

**Table 4.16:- Multiple Regression of Food Handling Practices on Good Hygienic Standards**

| **Summary of Model 1** | | | | |
|---|---|---|---|---|
| | | **Statistic** | ***p-value*** | |
| R Squared | | .722 | | |
| Adjusted R Squared | | .701 | 0.003 | |
| Standard Error | | .211 | | |
| **Regression Coefficients** | | | | |
| | | **Beta** | **Std. Error** | **Statistic** | ***p-value*** |
| (Constant) | | .106 | 1.338 | -.079 | .038 |
| Selection of food suppliers | $X_1$ | .466 | .122 | 3.828 | .001 |
| Delivery and reception of food | $X_2$ | .269 | .233 | 1.158 | .040 |
| Storage of supplied food | $X_3$ | .025 | .015 | 1.643 | .020 |
| Food preparation and cooking | $X_4$ | .344 | .162 | 1.177 | .002 |
| Serving food | $X_5$ | .705 | .023 | 2.052 | .001 |
| Dependent Variable: Good Hygienic Standards | | | | | |

The output gave the values of the coefficients to be estimated and their corresponding significance values (p-values). The p-values were used to test the hypothesis about $\beta$, the coefficients. In this test, the decision was to reject the null hypothesis whenever the p-

values were less than .05. From the output, all the values of $\beta_i$ were significant since all the p-values were less than .05. Also since all the coefficients were positive, it implied that good hygienic standards were positively related with each of the stated aspects of food safety practices. From the values of the coefficients, the corresponding multiple linear regression equation on how various aspects of food safety practices affected food safety and hygiene practices was thus expressed as

$$y = 0.106 + 0.466x_1 + 0.269x_2 + 0.025x_3 + 0.344x_4 + 0.705x_5 \quad (1)$$

To interpret model 1, each of the independent variables $X_i$, i = 1, 2, 3, 4 and 5 were considered. $X_1$, for instance, corresponded to selection of food suppliers. The coefficient (0.466) was interpreted as any improvement in the selection of food suppliers by one unit led to a corresponding improvement in the overall good hygienic standards by 0.466 units. For $X_2$, any improvement in how food was delivered and received by one unit led to a corresponding improvement in the overall good hygienic standards by 0.269 units. For $X_3$, any improvement in how supplied food was stored by one unit led to a corresponding improvement in the overall good hygienic standards by 0.025 units. For $X_4$, any improvement in how stored food was prepared and cooked by one unit led to a corresponding improvement in the overall good hygienic standards by 0.344 units. For $X_5$, any improvement in how cooked or prepared food was served by one unit led to a corresponding improvement in the overall good hygienic standards by 0.705 units.

From the values of the coefficients, some three factors or stages in the food flow were very crucial in the entire food flow. The stages were selection of food suppliers, preparation and cooking of food and serving of food. This observation was due to the contributions (from the coefficient values, which were .466, .344 and .705) that each of

the stages had on the overall food safety and hygiene practices. Therefore, based on this finding, the researcher proposed that much attention needed to be given to how food was sourced, how it was prepared or cooked and how it was served. This model could, thus, not only be used to identify areas that are vital in the food flow, but also improve the literature of identifying areas or stages in the food flow that had direct influence on the overall quality of foods prepared and served in TIVET and University hospitality institutions.

### 4.14.2 Model 2: Barriers to Food Safety and Good Hygienic Standards

When the researcher performed multiple regression analysis of barriers to food safety on good hygienic standards, the output was summarized as shown in Table 4.17.

**Table 4.17:- Multiple Regression of Food Handling Practices on Good Hygienic Standards**

| **Model Summary** | | | | |
|---|---|---|---|---|
| | | **Statistic** | | ***p-value*** |
| R Squared | | .6241 | | |
| Adjusted R Squared | | .6235 | | 0.006 |
| Standard Error | | .2108 | | |
| **Regression Coefficients** | | | | |
| | | **Beta** | **Std. Error** | **Statistic** | ***p-value*** |
| (Constant) | | -.823 | 8.806 | -1.343 | .048 |
| Lack of motivation and negative attitude, | $X_1$ | -.551 | .171 | 3.226 | .005 |
| Lack of set standards | $X_2$ | -.104 | .058 | 1.796 | .031 |
| Lack of knowledge and experience | $X_3$ | -1.989 | .469 | 4.239 | .001 |
| Lack of facilities | $X_4$ | -1.112 | .221 | 3.334 | .000 |
| Inadequate equipment | $X_5$ | -1.325 | .300 | 2.885 | .007 |
| Lack of finance | $X_6$ | -2.110 | .219 | 2.891 | .001 |
| Dependent Variable: Good Hygienic Standards | | | | | |

Similar to Table 4.14, six hypotheses about coefficients were rejected since all the p-values were less than .05. Also since all the coefficients were negative, it implied that good hygienic standards were negatively related with each of the identified barriers to food safety practices. This implied that for any increase in the barriers to food safety by one unit there was a corresponding deterioration in the good hygienic standards by the corresponding coefficient values. The corresponding model was thus expressed as

$$y = 0.823 - 0.551x_1 - 0.104x_2 - 1.989x_3 - 1.112x_4 - 1.325x_5 - 2.11x_6$$

To interpret model 2, each of the independent variables $X_i$, i = 1, 2, 3, 4, 5 and 6 were considered. $X_1$, for instance, corresponded to lack of motivation and negative attitude. The coefficient (0.551) was interpreted as existence of lack of motivation and culture of negative attitude among cooks or generally all staff by one unit lowered the overall good hygienic standards by 0.551 units. For $X_2$, absence of set standards by one unit led to a corresponding drop in the overall good hygienic standards by 0.104 units. The same applied for lack of knowledge ($X_3$), lack of facilities ($X_4$), inadequate equipment ($X_5$) and lack of finance ($X_5$), which reduced the overall good hygienic standards by 1.989, 1.112, 1.325 and 2.11 respectively.

From the values of the coefficients, some two factors were found to be a serious threat to food safety. The factors were lack of knowledge and experience, and lack of finance. This observation was due to the contributions (from the coefficient values, which were -1.989 and -2.11) that each of the stages had on the overall food safety. Therefore, based on this finding, the researcher proposed that several trainings, seminars and workshops should be organized, so that knowledge and experience would be improved. This would, however, depend on whether adequate funds were there to finance such trainings.

Adequacy of finance also determined capacity of an institution to recruit competent staff. In fact, with adequate finance, none of the factors would be a challenge to food safety because employees would be motivated, thus reversing negative attitude. In addition, adequate finance would lead to availing modern equipment and facilities. Therefore, just like the first model, this model could also be used to identify factors that impeded the overall quality of foods prepared and served in TVET and University hospitality schools.

This finding was consistent with the finding of Little, Lock, Barnes and Mitchell (2003), who, despite using several simple linear regression models, found a significant relationship between good hygienic standards and various aspects of food safety practices. Also, the authors found that various barriers to food safety and hygiene practices had a negative effect on the overall good hygienic standards.

### 4.14.3 Understanding of Model 1 and Model 2

The two models represented how the identified two study variables (food safety practices and barriers to food safety) were influenced by other factors. The models were, thus, generated from the collected data. A deeper look at p-values corresponding to each coefficient in the two models revealed that some factors had significant effects than others. In both models, the smaller the p-value, the more significant a factor was. In model 1, for instance, selection of food suppliers and food preparation and cooking stages were crucial when it came to proper hygienic standards. That is, these stages directly influenced the final outcome or quality of food prepared in these institutions. Therefore, based on these findings, much attention should be given to these stages so that quality of the food is not compromised. The study also found that the final stage, which was serving of food, had an effect on the overall hygienic standards or level of an institution. The

same interpretation applied for model 2. That is, factors whose coefficients had the smallest p-values were significant barriers to proper food safety and hygiene practices. From Table 4.25, the study found that lack of knowledge and experience and inadequate finance posed a serious negative effect on proper food safety and hygiene practices. It implied that, from these two models, the study recommended that one way of improving hygienic standards of foods prepared in the Universities and TVET institutions involved availing adequate finance that would allow fully equipped facilities that met international standards of food safety and hygiene practices. Also, training of food handlers formed an integral part of this process. Moreover, institutions were to be careful about the steps they followed in sourcing food, storing, preparing and servicing of prepared food. However, of importance were the selection of food suppliers, actual food preparation and cooking stages and serving of food.

### 4.15 Qualitative Analysis

Apart from analysis of quantitative data, qualitative data also yielded findings that backed up the quantitative findings discussed above. Qualitative data was obtained from heads of departments and focus group discussions. The main focus in the discussions were the processes of implementation of HACCP system and barriers to implementation of the system. This process was looked at in terms of pre-requisites before implementing HACCP system, Figure 4.17.

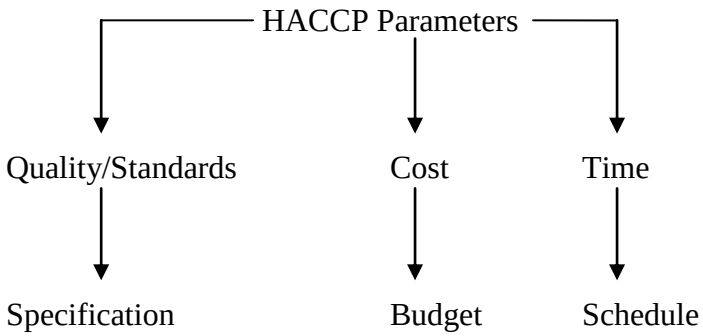



**Figure 4.17:- HACCP Implementation Procedure**

The process of HACCP implementation begun by the determination of the process, also referred to as scope of HACCP implementation. This step involved defining and managing all activities involved in the implementation process. Such activities included estimating duration of an implementation process, preparing and managing an implementation budget and setting certain standards that had to be met during the entire implementation process. Based on the collected qualitative data, implementation risk assessment as summarized in Figure 4.18

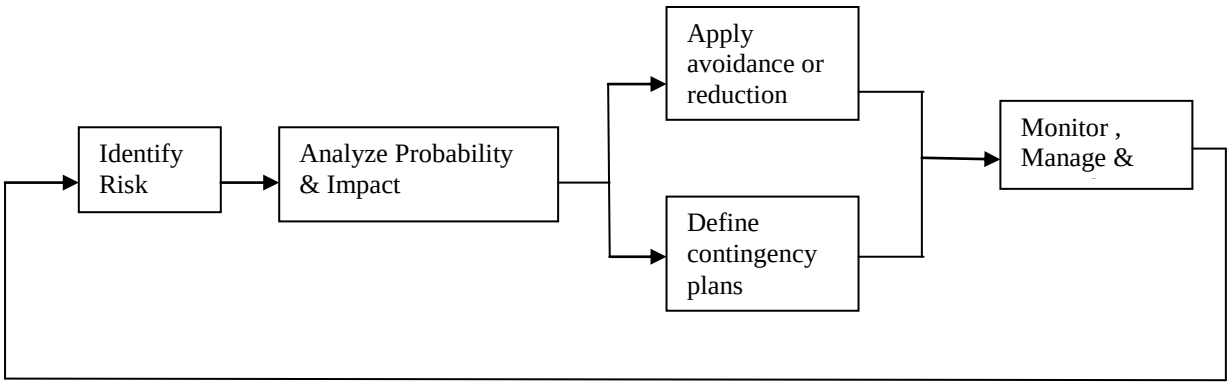



**Figure 4.18:- Implementation Risk Assessment**

Risk assessment procedure begun with identifying potential risks that possibly affected an implementation process (Codex, 1998). This initial step entailed analyzing probability of all identified risks and impacts in the implementation process. Based on the probability

and impact of an identified risk, an institution could avoid implementation procedure or define appropriate contingency plans to thwart potential risks. In addition, the monitoring and management of such plans are very crucial as implementation risk assessment is a continuous process.

While exploring barriers to implementation of proper food safety and hygiene practices as outlined by HACCP regulations, identified factors were grouped into four broad categories, which were external behavioural barriers, internal behavioural barriers, attitude or psychological barriers and knowledge or expertise barriers as shown in Figure 2.2 in Chapter Two. However, unlike the classification Figure 2.2, focus group discussions revealed another classification, which were knowledge or expertise barriers. Under this category, it was noted that lack of awareness about HACCP system, lack of food safety knowledge and lack of technical expertise were main components of knowledge or expertise barrier.

# CHAPTER 5 - SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter has summarized study findings as presented in the preceding chapters. The purpose of the study was to critically compare food safety and hygienic practices in TVET and university's hospitality schools in Kenya. It sought to ascertain the differences and similarities in the two categories of institutions in relation to food safety and hygiene practices. The study also gave insight not only to training institutions but also to stakeholders and policy- makers in the hospitality industry by identifying further research areas that might add value to the discipline of food hygiene. The conclusions and recommendations were highlighted through the six study objectives and hypotheses. The recommendations were made in relation to gaps in the study findings.

## 5.1 Summary of Key Findings of the Study by Objectives

### 5.1.1 Food Safety Awareness

The first objective of the study compared food safety awareness and knowledge in TVET and university hospital schools. In establishing the level of awareness and knowledge on food safety and hygienic practices, the study observed that although the majority of the respondents indicated that they were aware of food safety, they did not practice what they knew. On the same breath, the findings revealed that food service trainees had the theoretical knowledge but translating the same knowledge into practice was a big challenge. This confirmed the earlier findings from other researchers that the theoretical knowledge alone did not translate into safe food practice.

### 5.1.2 Food Handling Practices in TVET and University Hospitality Institutions

The study explored various aspects of food safety and hygiene practices mainly focusing on the procedure followed during the food flow from the supplier to the table, that is, from farm to fork. It investigated the various food procedures at different levels in the entire food chain, and it was observed that more than half of the respondents followed correct procedures. The findings indicated that (90%) of Universities and (79%) of TVET institutions followed the correct procedure.

While observing personal, food and environmental hygiene, it was observed that different institutions applied their own methods when observing food safety prerequisites. There was no uniformity. The study also found that personal hygiene was a challenge as food safety regulations were abused. Poor hand washing, incorrect uniform and incorrect shoes, among others, were very common practice in the workshops.

Arrangement of the cooking area, wash-up area and storage areas were totally different in all the sampled institutions, for instance. On waste disposal management, it was observed that some institutions had relatively poor methods of disposing waste. Thus, based on the collected data, results of the tests and the captured pictures, there was clear evidence that food safety and hygienic practices varied from one institution to another. Other observations included multiple use of chopping boards and dish clothes, which also served as oven gloves due to lack of gloves. Moreover, the technicians and domestic workers in the workshops did not have adequate knowledge on food safety and hygienic practices. The findings also revealed abuse of time/temperature, as both cooked and raw foods were not kept at the room temperature. Foods were exposed during preparation,

and raw and cooked were not separated, which could easily have led to cross contamination.

### 5.1.3 Capacity for the TVET and University Hospitality

The study also focused on the capacity of the institutions in providing training on food safety and hygienic practices. It looked at the availability of appropriate equipment, including mechanical, electrical, large and small basic equipment and tools available in the institutions. The findings revealed that in the two categories of institutions, equipment/tools in universities were relatively higher in number compared to the other categories. In addition, not all the available tools were modern. It was observed that only 78% of the available tools were modern while 19% were not. This finding revealed that there was underutilization of available facilities in the institutions. A summary of various aspects of capacity of institutions in providing training on food safety and hygienic practices and adopting proper hygienic practices revealed that universities had a high capacity (63.5 %) relative to the other categories. On the other hand, the lowest capacity level was observed in institutes of science and technology, which had 46.4%.

The second step taken was to ascertain the capability of TVET and universities schools offering training in hospitality courses. The findings revealed that some institutions were well-prepared in terms of equipment and facilities, while the majority were not. Observation revealed that most of the workshops used, particularly in TVET institutions, were originally used for other purposes such as classrooms, home economics laboratory or were stores converted to production workshops. As a result, such institutions lacked

basic equipment. The study concluded that there was need to construct large workshops that would cater for the number of students enrolled in these institutions.

### 5.1.4 Level of Implementation of HACCP System

HACCP system was one of the concepts that this study constantly referred to while addressing issues related to food safety and hygienic practices. The system focused on prevention of known food hazards. Assessing the level of implementation of HACCP system was done using various aspects of the system, which included frequency of adherence to required prerequisites of HACCP system, extent of achievement of various standards set by HACCP system and challenges facing adoption of HACCP system. After considering all these aspects, it was observed that the level of implementation of HACCP prerequisites system was high in universities when the two categories of the institutions were compared, it was found that none of the institutions had implemented HACCP standards at a similar level. This finding further showed that the level of applicability and implementation of HACCP system varied from one institution to another as confirmed by Chi-Square test. Despite these variations, it was clear that all institutions needed to formulate suitable procedures for implementing the system.

### 5.1.5 Barriers to Food Safety and Hygiene Practices

The fifth objective aimed at exploring factors that hampered the implementation of an effective food safety system (HACCP). Consequently, the factors were grouped into three major categories, namely behavioural, psychological and knowledge/expertise barriers. Responses indicated that only 31% admitted that there were barriers. On the other hand, a fairly large portion of respondents (41%) said that the effects are very low. The study

concluded that various factors posed serious threats to effective implementation of proper food safety system (HACCP).

### 5.1.6 Microbial Load of Foods Prepared and Served in Hospitality Schools

The cardinal objective was to determine the microbial load in vegetables served in the training institutions. The results from questionnaires indicated that 74% of participants responded that cases of food borne illnesses were not common. Laboratory results, however, showed otherwise. Using 36 samples of various vegetables collected from the institutions, lab analysis showed that microbial loads were very significant, at 0.05 levels. In fact, both paired and one sample t-tests yielded similar results; confirming that the microbial loads were significant. The tests also confirmed that microbial loads in the foods prepared and served in the institutions varied from one institution to another. Microorganisms that were isolated in the food samples included *E. coli, Shigella, Salmonella* and *Pseudomonas*. The bacterial load ranged from $2.63\times10^5$ to $4.40\times10^5$. The maximum permissible coliform count according to Gulf standard (2000) ranged between $1.8\times10^5$ to $2.6\times10^5$.

In summary, the observations on food safety and hygiene practices in the studied institutions led to the conclusion that actual food safety and hygiene standards have not been fully implemented in the institutions, as confirmed by the responses obtained from the second and the third specific objectives, focussing on assessing the capacity of the institutions in offering proper trainings on food safety, and the level of implementation of HACCP system respectively. It was observed that several challenges not only hindered effectiveness of the institutions in providing proper training, but also acted as barriers to

proper food safety and hygienic practices. More importantly, HACCP system had not been implemented in all institutions. This could be confirmed by how food was being handled in most institutions. Lack of proper food safety standards and good food handling procedures had rendered most institutions incapable of effectively training students on food safety. Apart from food safety standards, a significant proportion of institutions did not have adequate infrastructure for offering the trainings.

Based on these observations, it was anticipated that foods prepared and/or served in these institutions might be contaminated. This anticipation was confirmed by the results of the specific objective on microbial loads in the food prepared and served in the institutions. Lab analysis showed significant amount of microorganisms in the analysed samples of vegetables.

**5.2 Recommendations for Policy**

i. The Government should establish pre-requisite standard operation procedures in all institutions undertaking hospitality in relation to food safety.
ii. There is need to create food safety awareness by holding workshops, seminars and sensitization programme to the stakeholders of hospitality industry
iii. The ministry to identify a monitoring team to visit hospitality training workshops to assess the capacity in terms of infrastructure, facilities and equipment to determine the level of requirement in every institution.
iv. The government to establish a monitoring and surveillance team to check the capacity of institutions in terms of training facilities. This will not only assist in

upgrading the institutions but will enable the Government to achieve equality particularly in hospitality training.

v. HACCP prerequisites related to institutional facilities are put in place and stakeholders trained.

vi. The training may highlight the long - term benefits of HACCP and its implementation.

vii. Training institutions to make it mandatory for all food-handling personnel to adhere to specific personal hygiene standard when working in food production workshops.

viii. Kenyatta University to take the lead in the implementation of HACCP system. This would be a wider strategy to improve the institutions' capability in food safety management training and research.

ix. Government to allocate finances and other resources to facilitate HACCP implementation for at least one institution in a county.

### 5.3 Recommendation for Further Research

From the results of this study, four areas are suggested as deserving further research:

i. There is need to carry out experimental research to determine the chemical hazards likely to be found in fruits sourced from the markets.

ii. More research is needed to determine the microbial load in beef, poultry and milk.

iii. This study has not covered the magnitude and implications of food safety in details. A study on the same would add to the body of knowledge.

iv. For future generations and policy formulation, there is need to improve the

level of training by creating awareness and knowledge on the implications of poor standards of hygiene.

v. There is need to carry out a similar study in classified hotels, and hospitality related institutions such as hospitals, prisons and schools.

vi. A replica of the same study with more emphasis on training and teaching methods used in these institutions.

vii. The study was conducted in Government institutions only. As such there is need to extend the same study to private colleges in Kenya.

## 5.4 Contribution to the Current Study to Knowledge

i. This study has provided critique to the theory of knowledge and awareness of assumed understanding of food safety practices in hospitality training institutions.

ii. This study makes significant contribution to policy and stakeholders in the hospitality industry that knowledge alone does not translate into action unless the subjects are motivated and are involved into action.

iii. The study is an eye opener of the existence of food-borne microorganisms in the hospitality training institutions across the country.

iv. This study may be used by policy- makers to classify the training institutions to determine the level of implementation in different institutions.

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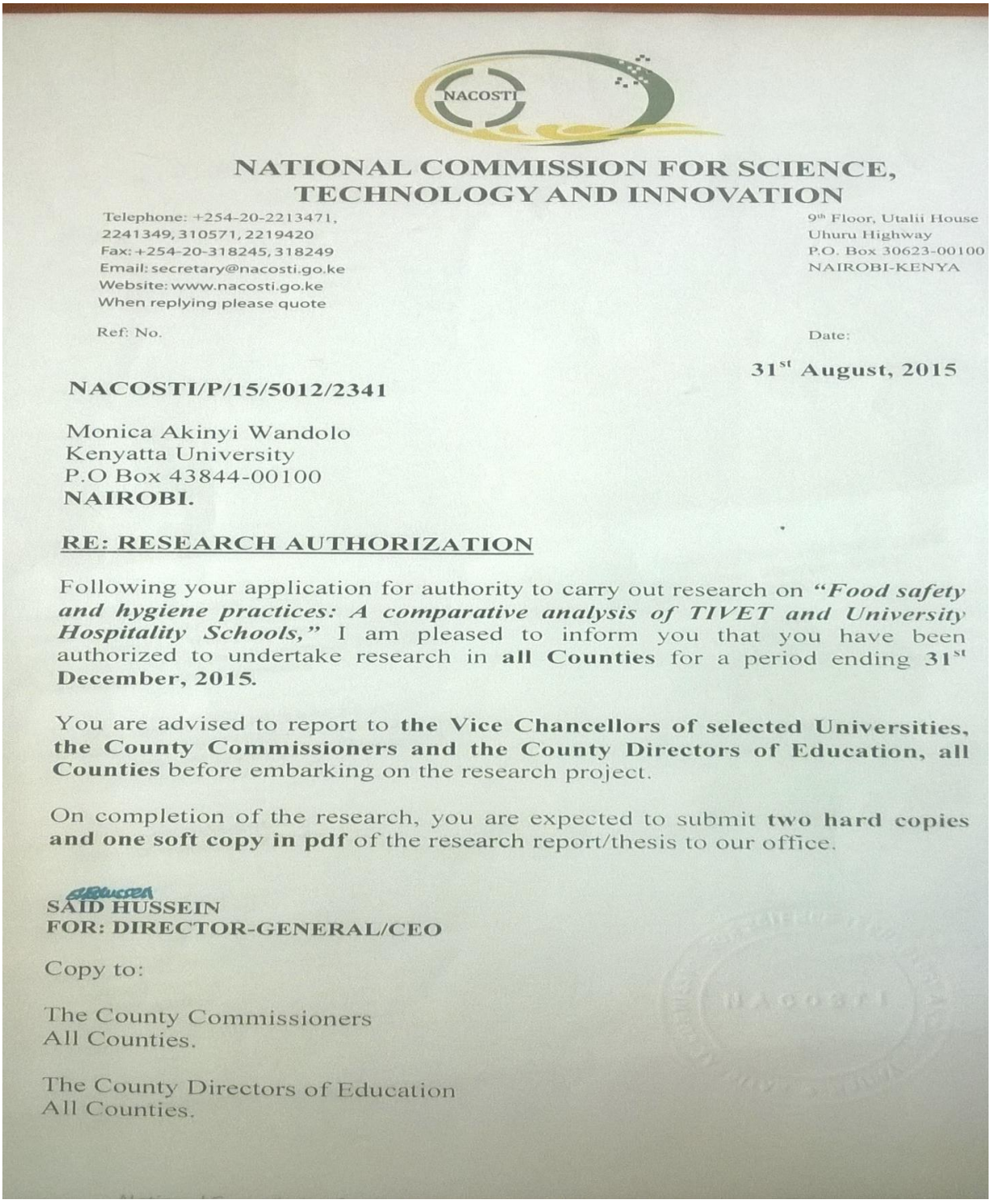
# APPENDICES

## APPENDIX I: RESEARCH PERMIT



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Date:

**31st August, 2015**

**NACOSTI/P/15/5012/2341**

Monica Akinyi Wandolo
Kenyatta University
P.O Box 43844-00100
**NAIROBI.**

**RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on ***"Food safety and hygiene practices: A comparative analysis of TIVET and University Hospitality Schools,"*** I am pleased to inform you that you have been authorized to undertake research in **all Counties** for a period ending **31st December, 2015.**

You are advised to report to **the Vice Chancellors of selected Universities, the County Commissioners and the County Directors of Education, all Counties** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

**SAID HUSSEIN**
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioners
All Counties.

The County Directors of Education
All Counties.

**CONDITIONS**

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

**RESEARCH CLEARANCE PERMIT**

Serial No. A 6421

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
*MS. MONICA AKINYI WANDOLO*
of KENYATTA UNIVERSITY, 0-618
Nairobi,has been permitted to conduct research in *All Counties*

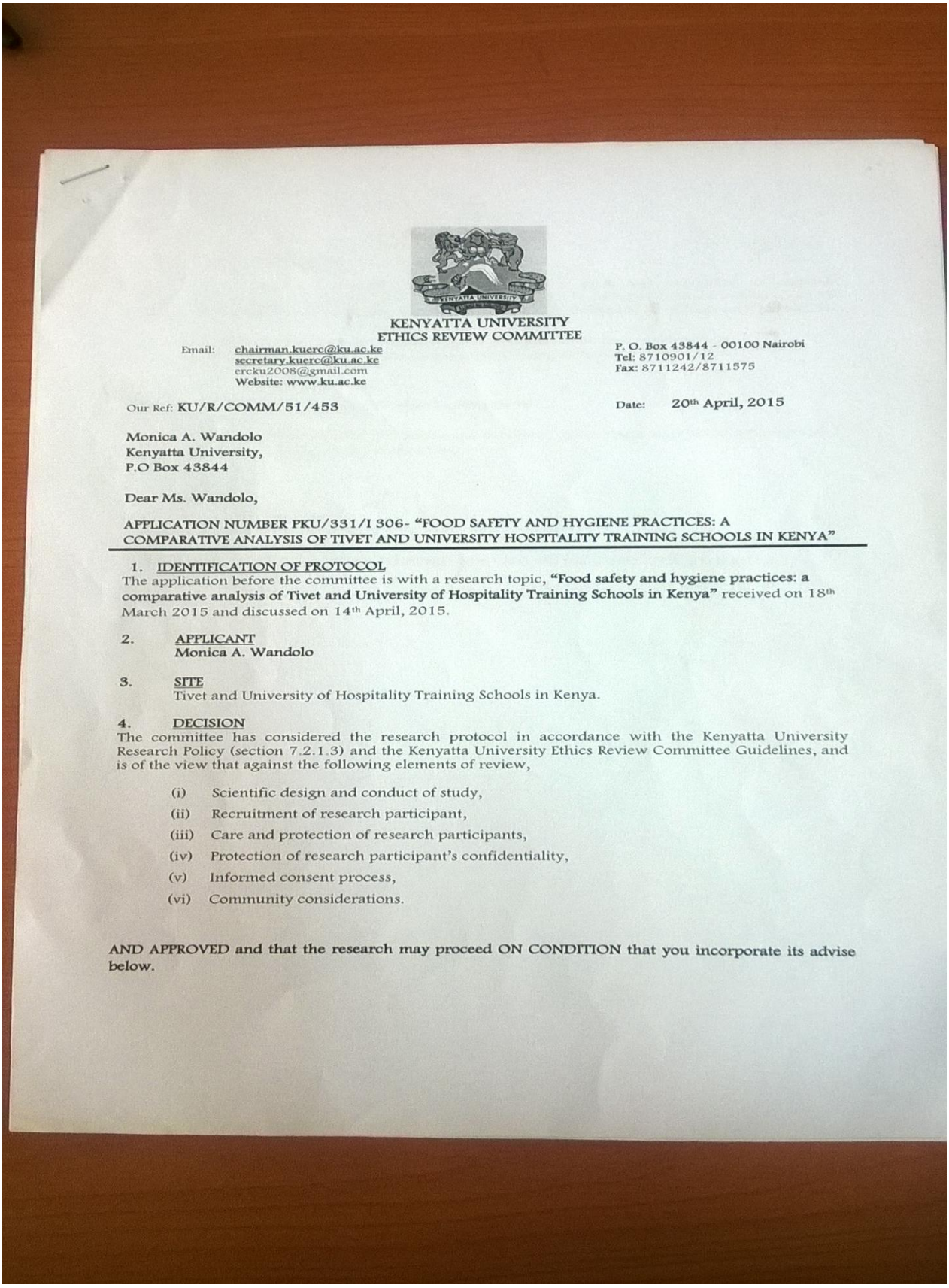
on the topic: *FOOD SAFETY AND HYGIENE PRACTICES: A COMPARATIVE ANALYSIS OF TIVET AND UNIVERSITY HOSPITALITY SCHOOLS*

for the period ending:
*31st December,2015*

Permit No : NACOSTI/P/15/5012/2341
Date Of Issue : 31st August,2015
Fee Recieved :Ksh 2,000


.....
*Applicant's Signature*

.....
*Director General*
*National Commission for Science, Technology & Innovation*



KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Email: chairman.kuerc@ku.ac.ke
secretary.kuerc@ku.ac.ke
ercku2008@gmail.com
Website: www.ku.ac.ke

P. O. Box 43844 - 00100 Nairobi
Tel: 8710901/12
Fax: 8711242/8711575

Our Ref: KU/R/COMM/51/453

Date: 20th April, 2015

Monica A. Wandolo
Kenyatta University,
P.O Box 43844

Dear Ms. Wandolo,

APPLICATION NUMBER PKU/331/I 306- "FOOD SAFETY AND HYGIENE PRACTICES: A COMPARATIVE ANALYSIS OF TIVET AND UNIVERSITY HOSPITALITY TRAINING SCHOOLS IN KENYA"

1. IDENTIFICATION OF PROTOCOL
The application before the committee is with a research topic, **"Food safety and hygiene practices: a comparative analysis of Tivet and University of Hospitality Training Schools in Kenya"** received on 18th March 2015 and discussed on 14th April, 2015.

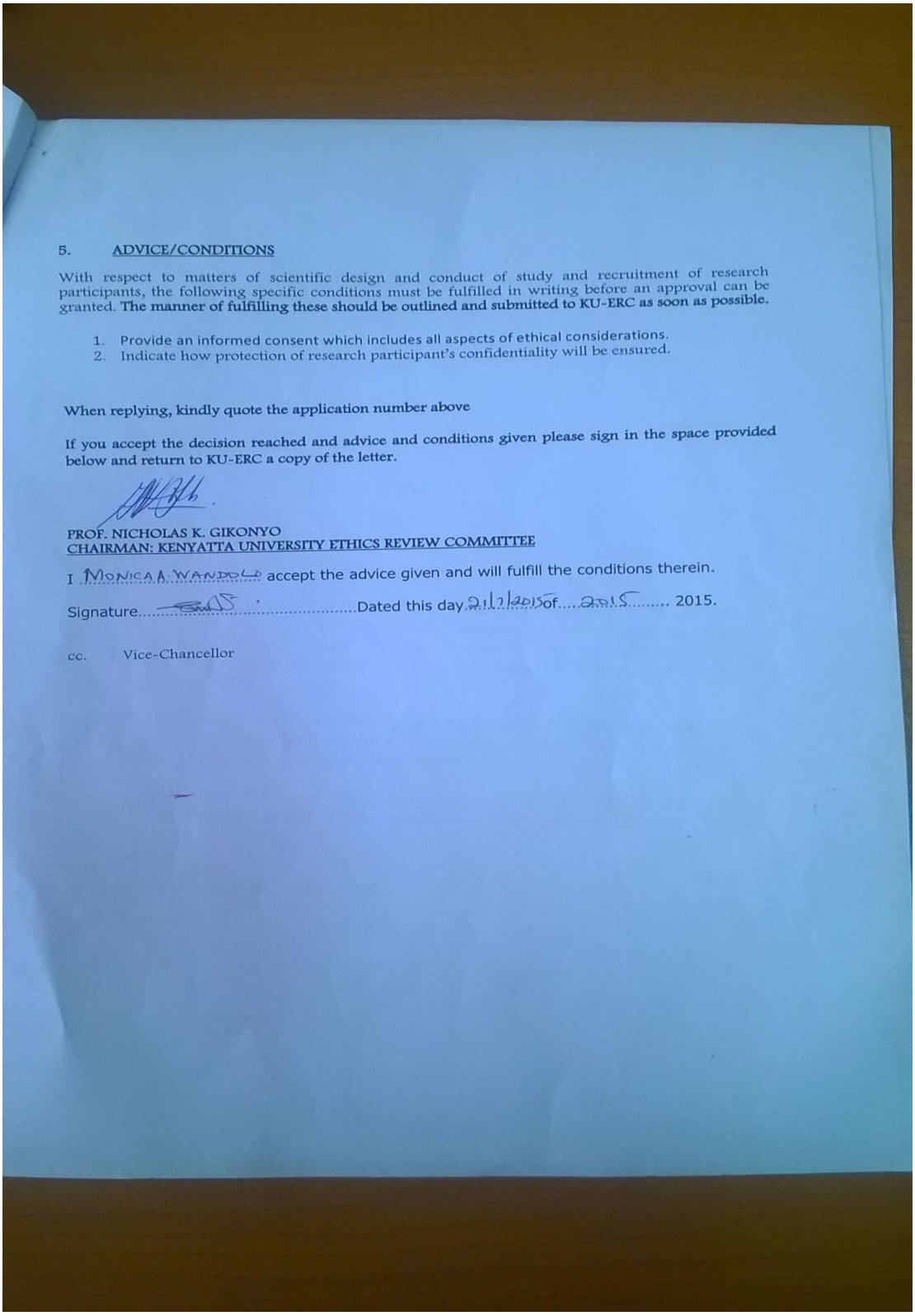
2. APPLICANT
**Monica A. Wandolo**

3. SITE
Tivet and University of Hospitality Training Schools in Kenya.

4. DECISION
The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines, and is of the view that against the following elements of review,

(i) Scientific design and conduct of study,
(ii) Recruitment of research participant,
(iii) Care and protection of research participants,
(iv) Protection of research participant's confidentiality,
(v) Informed consent process,
(vi) Community considerations.

**AND APPROVED and that the research may proceed ON CONDITION that you incorporate its advise below.**



5. ADVICE/CONDITIONS

With respect to matters of scientific design and conduct of study and recruitment of research participants, the following specific conditions must be fulfilled in writing before an approval can be granted. **The manner of fulfilling these should be outlined and submitted to KU-ERC as soon as possible.**

1. Provide an informed consent which includes all aspects of ethical considerations.
2. Indicate how protection of research participant's confidentiality will be ensured.

**When replying, kindly quote the application number above**

**If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.**

PROF. NICHOLAS K. GIKONYO
CHAIRMAN: KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE

I MONICA WANDOLO accept the advice given and will fulfill the conditions therein.

Signature..... Dated this day 2/12/2015 of 2015 2015.

cc. Vice-Chancellor

## APPENDIX II:- QUESTIONNAIRES FOR STUDENTS

I am a PhD student at Kenyatta University carrying out a research on the evaluation of the effectiveness training on food safety and hygiene practices in food production in TVET and university Hospitality schools. This questionnaire is designed to collect data that will help to achieve the objectives of this study. I would be most grateful if you would kindly participate in this interview by responding to all the questions in this questionnaire as candidly and precisely as possible. Your honesty and co-operation in responding to these questions will be highly appreciated. All information provided will be treated with utmost confidentiality.

Please fill in the required information in the spaces provided. Or tick (√) where necessary.

SECTION A: GENERAL INFORMATION OF THE RESPONDENTS

1. What is your gender Male [ ] Female [ ]

2. What is your age? 18 – 25 [ ] 26 – 35 [ ]

36– 45 [ ] 46 – 55 [ ] Over 55 [ ]

3. Course undertaken_____

SECTION B: SUITABILITY AND CAPACITY OF TVET AND UNIVERSITY HOSPITALITY SCHOOLS IN OFFERING FOOD SAFETY AND HYGIENE TRAINING IN THE COUNTRY

4. How many students take unit in food safety and hygiene in your Institution?_____

_____

_____

5. The following are some of the tools and equipment used training on food safety and hygiene. Please indicate whether each of the equipment is available or not.

| Resource/Equipment | Available | Not Available | Remarks |
|---|---|---|---|
| Slicers (Meat slicer) | | | |
| Food Chopper | | | |

| | | | |
|---|---|---|---|
| Chopping boards (colour coded) | | | |
| Hand wash basins | | | |
| Sanitizers | | | |
| Blender | | | |
| Mixer | | | |
| Deep- Fat Fryers | | | |
| Ovens | | | |
| Racks/food coolers | | | |
| Fire Extinguishers | | | |
| Thermometers | | | |
| Dishwashers | | | |
| Refrigerator | | | |
| Steamers | | | |

6. Are the equipment used in training on food and beverage production and service current/updated? (a) Yes [ ] (b) No [ ]

7. The following are some of the common equipment used in training students in food safety and hygiene management. Please indicate the extent to which each of the equipment is used during practical training?

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Equipment | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Blenders | | | | | |
| Food mixers | | | | | |
| Potato peelers | | | | | |
| Food Warmers | | | | | |
| Bain Marie | | | | | |
| Chaffing Dishes | | | | | |
| Stainless steel pots and pans | | | | | |

8. The following are some of the categories of equipment/facilities necessary for training of students on food and beverage production and service. Please indicate the level of adequacy of each of the categories of tools in your institution

1-Very adequate 2-Adequate 3-Average

4-Inadequate 5-Not available at all

| Category of Equipment/facilities | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Hood/steam extractors | | | | | |
| Cutleries | | | | | |
| Processing equipment | | | | | |
| Cookers | | | | | |
| Working space | | | | | |

SECTION C: APPLICABILITY OF FOOD SAFETY SYSTEMS IN TVET AND UNIVERSITY HOSPITALITY SCHOOLS

9. Are you aware of the Hazard Analysis Critical Control Point (HACCP) system used in ensuring food safety and hygienic standards are maintained in food handling.

Yes [ ] No [ ]

10. The following are some of the important stages in the food flow chain from production to consumption. Please indicate the level of effectiveness of the training given students in managing food flow from purchasing to service.

1-Very effective 2- Effective 3- Neither effective nor ineffective

4- Less effective 5- Not effective at all

| Stages in the food flow | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Selecting food suppliers | | | | | |
| Receiving food | | | | | |
| Storing already supplied food | | | | | |
| Preparation of food | | | | | |
| Holding food for service | | | | | |
| Cooling of leftovers | | | | | |
| Reheating | | | | | |

11. The following are some of the factors considered to ensure that appropriate food supplier is chosen. Please indicate the extent to which you check on each of the following qualities of the supplier in your attempt to apply Hazard Analysis Critical Control Point (HACCP) in your institution.

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Factors to be considered when choosing a food supplier | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Knowledge on the sources of suppliers' products | | | | | |
| Reputation of the supplier | | | | | |
| Inspection suppliers warehouse or plant if possible | | | | | |
| Ensuring whether the suppliers have HACCP program in place | | | | | |
| Finding out whether the supplier's employees are trained in food safety or not | | | | | |
| Checking the condition of the supplier's delivery trucks | | | | | |

12. The following are some of the steps taken during the delivery of food by the suppliers. Please indicate how often your carry out the mentioned steps/process at the reception of food from a supplier in an attempt to ensure that Hazard Analysis Critical Control Point (HACCP) standards are adhered to.

| Steps/processes | Always | Rarely | Never |
|---|---|---|---|
| Inspection of the delivered food to confirm the qualities, quantities and conditions | | | |
| Taking temperature for the supplies especially for foods such as meat, fish etc | | | |
| Any other step/process | | | |

13. The following are some of the factors to be considered when storing food after the supplies. Please indicate how often you consider the following factors to ensure that food supplied is appropriately stored.

| Factors considered in storing food | Always | Rarely | Never |
|---|---|---|---|
| Storage temperature | | | |
| Cleanliness of the storage areas | | | |
| Any other factor | | | |

14. The following are some statements on the processes involved in food preparation and cooking. Please indicate the extent to which you adhere to each process in your institution

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Steps/processes in food preparation and cooking | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Thawing food to a temperature below the room temperature | | | | | |
| Use of clean and sanitized work areas, cutting boards, knives and utensils | | | | | |
| Washing hands before handling food | | | | | |
| Cooking food as quickly as possible once it is taken from the refrigerator | | | | | |
| Cooking food within the required time and at the recommended temperature | | | | | |
| Use of utensils or gloves to handle food after cooking | | | | | |
| Use of gloves/sanitized hands in salad preparation | | | | | |

15. The following are of the factors to be considered in serving food. Please indicate the level to which your institution adheres to the standards for serving food.

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Serving food | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Serving food at the right temperature | | | | | |
| Use of clean sanitized utensils for service | | | | | |
| Use of serving utensils with long handles | | | | | |
| Serving food in clean restaurant environment | | | | | |
| Organized wash up area<br>Availability of hot water<br>Availability of sanitizers<br>Availability of drainage and storage racks | | | | | |
| Minimizing bare hand contact with food | | | | | |
| Protecting food on display with sneeze guards | | | | | |
| Use of scoops and tongs | | | | | |
| Proper handling of glassware and dishes | | | | | |
| Use of clean serving plates and silverware for reserves | | | | | |
| Practicing good personal hygiene | | | | | |

16. The following are some of the aspects covered by Hazard Analysis Critical Control Point (HACCP) system in ensuring good hygiene practices. Please indicate the extent to which each of the aspects has been achieved in your school.

1-Very large extent 2-Large extent 3-Moderate extent

4-Small extent 5-No extent at all

| Aspects covered by HACCP | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Personal hygiene | | | | | |
| Waste Disposal | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Cleaning and sanitation | | | | | |
| Training | | | | | |
| Design of food premises | | | | | |
| Pest control | | | | | |

17. What are the challenges facing the adoption and use of Hazard Analysis Critical Control Point (HACCP) system in training students in learning institutions?

_____

_____

_____

SECTION D: BARRIERS TO FOOD SAFETY AND HYGIENE PRACTICES IN TVET AND UNIVERSITY HOSPITALITY SCHOOLS

18. The following are some of the perceived barriers to food safety and hygiene practices in TVET and university Hospitality schools in Kenya. Please indicate the extent to which each is a challenge in your institution. 1- Very large extent 2-large extent

3-Neutral extent 4- Small extent 5- No extent at all

| Challenges | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Lack of finances | | | | | |
| Inadequate equipment | | | | | |
| Lack of facilities | | | | | |
| Lack of time | | | | | |
| Lack of experience | | | | | |
| Lack of knowledge | | | | | |
| Attitude | | | | | |
| Lack of set standards in the Institution | | | | | |
| Lack of Motivation | | | | | |

19. What are other barriers to food safety and hygiene practices in TVET and university Hospitality schools?

---

E: MICROBIAL LOAD OF FOODS PREPARED

20. The following are some of the sources of food contamination. Please indicate the frequency of occurrence of each cause of food contamination in your institution?

| Cause of food contamination | Very common | common | Less common | Not available at all |
|---|---|---|---|---|
| Viral food-borne infection | | | | |
| Bacterial food poisoning | | | | |
| Micro-biological hazards | | | | |
| Chemical hazards | | | | |
| Physical hazards e.g entry of foreign bodies | | | | |
| Any other (specify) | | | | |

21. What are some of the precautions you take to prevent and control the occurrence of food-borne illnesses in your Institution?_____

_____

_____

_____

22. What would you recommend to be done to improve food safety and hygiene training in TVET and university Hospitality schools in Kenya?

_____

_____

_____

*Thank you for your time and cooperation*

## APPENDIX III:- INTERVIEW SCHEDULES FOR LECTURERS

I am a PhD student at Kenyatta University carrying out a research on the evaluation of the effectiveness training on food safety and hygiene practices during food production in TVET and university Hospitality schools. Thank you for the opportunity to discuss with you about food safety practices in your institution. Please be free to say when you are not ready to answer any of the questions

1. For how long have you served as a lecturer in food safety and hygiene unit?

_____

_____

2. The following are some of the tools and equipment used for training on food safety and hygiene. Please indicate whether each of the equipment is available or not.

| Resource/Equipment | Available | Not Available | Remarks |
|---|---|---|---|
| Slicers (Meat slicer) | | | |
| Food Chopper | | | |
| Chopping boards (colour coded) | | | |
| Hand wash basins | | | |
| Sanitizers | | | |
| Blender | | | |
| Mixer | | | |
| Deep- Fat Fryers | | | |
| Ovens | | | |
| Racks/food coolers | | | |
| Fire Extinguishers | | | |
| Thermometers | | | |
| Dishwashers | | | |
| Refrigerator | | | |
| Steamers | | | |

3. The following are some of the important stages in the food flow chain from production to consumption. Please indicate the level of effectiveness of the training given students in managing food flow from purchasing to service.

1-Very effective 2- Effective 3- Neither effective nor ineffective

4- Less effective 5- Not effective at all

| Stages in the food flow | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Selecting food suppliers | | | | | |
| Receiving food | | | | | |
| Storing already supplied food | | | | | |
| Preparation of food | | | | | |
| Holding food for service | | | | | |
| Cooling of leftovers | | | | | |
| Reheating | | | | | |

4. The following are some of the factors considered to ensure that appropriate food supplier is chosen. Please indicate the extent to which you check on each of the following qualities of the supplier in your attempt to apply Hazard Analysis Critical Control Point (HACCP) in your institution.

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Factors to be considered when choosing a food supplier | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Knowledge on the sources of suppliers' products | | | | | |
| Reputation of the supplier | | | | | |
| Inspection suppliers warehouse or plant if possible | | | | | |
| Ensuring whether the suppliers have HACCP program in place | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Finding out whether the supplier's employees are trained in food safety or not | | | | | |
| Checking the condition of the supplier's delivery trucks | | | | | |

5. The following are some of the steps taken during the delivery of food by the suppliers. Please indicate how often you carry out the mentioned steps/process at the reception of food from a supplier in an attempt to ensure that Hazard Analysis Critical Control Point (HACCP) standards are adhered to.

| Steps/processes | Always | Rarely | Never |
|---|---|---|---|
| Inspection of the delivered food to confirm the qualities, quantities and conditions | | | |
| Taking temperature for the supplies especially for foods such as meat, fish etc | | | |
| Any other step/process | | | |

6. The following are some of the factors to be considered when storing food after the supplies. Please indicate how often you consider the following factors to ensure that food supplied is appropriately stored.

| Factors considered in storing food | Always | Rarely | Never |
|---|---|---|---|
| Storage temperature | | | |
| Cleanliness of the storage areas | | | |
| Any other factor | | | |

7. The following are some statements on the processes involved in food preparation and cooking. Please indicate the extent to which you adhere to each process in your institution

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Steps/processes in food preparation and cooking | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Thawing food to a temperature below the room temperature | | | | | |
| Use of clean and sanitized work areas, cutting boards, knives and utensils | | | | | |
| Washing hands before handling food | | | | | |
| Cooking food as quickly as possible once it is taken from the refrigerator | | | | | |
| Cooking food within the required time and at the recommended temperature | | | | | |
| Use of utensils or gloves to handle food after cooking | | | | | |
| Use of gloves/sanitized hands in salad preparation | | | | | |

8. The following are of the factors to be considered in serving food. Please indicate the level to which your institution adheres to the standards for serving food.

1-Very large extent 2-Large extent 3-Neutral

4-Small extent 5-No used at all

| Serving food | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Serving food at the right temperature | | | | | |
| Use of clean sanitized utensils for service | | | | | |
| Use of serving utensils with long handles | | | | | |
| Serving food in clean restaurant environment | | | | | |
| Organized wash up area<br>Availability of hot water<br>Availability of sanitizers<br>Availability of drainage and storage racks | | | | | |
| Minimizing bare hand contact with food | | | | | |
| Protecting food on display with sneeze guards | | | | | |
| Use of scoops and tongs | | | | | |
| Proper handling of glassware and dishes | | | | | |
| Use of clean serving plates and silverware for | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| reserves | | | | | |
| Practicing good personal hygiene | | | | | |

9. The following are some of the aspects covered by Hazard Analysis Critical Control Point (HACCP) system in ensuring good hygiene practices. Please indicate the extent to which each of the aspects has been achieved in your school.

1-Very large extent 2-Large extent 3-Moderate extent

4-Small extent 5-No extent at all

| Aspects covered by HACCP | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Personal hygiene | | | | | |
| Waste Disposal | | | | | |
| Cleaning and sanitation | | | | | |
| Training | | | | | |
| Design of food premises | | | | | |
| Pest control | | | | | |

10. The following are some of the perceived barriers to food safety and hygiene practices in TVET and university Hospitality schools in Kenya. Please indicate the extent to which each is a challenge in your institution. 1- Very large extent 2-large extent

3-Neutral extent 4- Small extent 5- No extent at all

| Challenges | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Lack of finances | | | | | |
| Inadequate equipment | | | | | |
| Lack of facilities | | | | | |
| Lack of time | | | | | |
| Lack of experience | | | | | |
| Lack of knowledge | | | | | |
| Attitude | | | | | |
| Lack of set standards in the Institution | | | | | |
| Lack of Motivation | | | | | |

11. What are the challenges facing the adoption and use of Hazard Analysis Critical Control Point (HACCP) system in training students in learning institutions?

_____

_____

20. The following are some of the sources of food contamination. Please indicate the frequency of occurrence of each cause of food contamination in your institution?

| Cause of food contamination | Very common | common | Less common | Not available at all |
|---|---|---|---|---|
| Viral food-borne infection | | | | |
| Bacterial food poisoning | | | | |
| Micro-biological hazards | | | | |
| Chemical hazards | | | | |
| Physical hazards e.g entry of foreign bodies | | | | |
| Any other (specify) | | | | |

21. What are some of the precautions you take to prevent and control the occurrence of food-borne illnesses in your Institution?_____

_____

12. What are other barriers to food safety and hygiene practices in TVET and university Hospitality schools?_____

_____

_____

13. What would you recommend to be done to improve food safety and hygiene training in TIVET Institutions in Kenya?

_____

_____

Thank you once more for taking time to discuss with me about food safety practices in your institution

## APPENDIX IV:- OBSERVATION CHECKLIST

A. EQUIPMENT AND FACILITIES

| Equipment and Facilities | Availability | | Remarks |
|---|---|---|---|
| | Available | Not available | |
| Cooking equipment | | | |
| Cooking vessels | | | |
| Fryers | | | |
| Cutting/chopping board | | | |
| Refrigerators | | | |
| Deep freezers | | | |
| Cleaning equipment | | | |
| Tools and equipment store | | | |
| Dry goods store | | | |
| Cold room | | | |
| Vegetable rack | | | |
| Fuel and wood supply | | | |
| Gas cooker | | | |
| Workshops | | | |
| Charcoal Jikos | | | |
| Other Equipment and Facilities | | | |

B. PERSONAL HYGIENE

| | | | |
|---|---|---|---|
| Personal Hygiene | | | |
| Hand wash basins/sinks | | | |
| Protective clothing/Uniform/Aprons | | | |
| Short nails | | | |
| Not Smoking in the kitchen | | | |

| | | | |
|---|---|---|---|
| Flat comfortable shoes | | | |
| Staff wash rooms/Changing rooms. | | | |
| Hair Restraint | | | |
| Use of Neckerchief | | | |
| Use of clean dish clothes /kitchen Rags | | | |
| Use of handkerchiefs | | | |

## C. ENVIRONMENT HYGIENE OBSERVATION CHECKLIST

| | | | |
|---|---|---|---|
| Food lab | | | |
| Rodents | | | |
| Cockroaches | | | |
| Drainage system | | | |
| Clean walls | | | |
| Proper ventilation | | | |
| Cemented floor | | | |
| Clean ceilings | | | |
| Artificial and natural lighting | | | |
| Washable windows and doors | | | |
| Covered dust bins/litter bins | | | |
| Proper garbage dumpsite | | | |
| Sinks for washing utensils | | | |
| Supply of portable water | | | |
| Utensil /Cutlery cupboards | | | |
| Sanitizing sinks | | | |
| Other environment related concerns | | | |

## D. FOOD HYGIENE

| | Appropriateness | | |
|---|---|---|---|
| Food Hygiene | Appropriate | Not appropriate | Remarks |
| Sources of food (suppliers)<br>Packaging materials<br>Means of Transport | | | |
| Food Storage<br>1. Storage bins labeling<br>2. Rotation of food (FIFO)<br>3. Storage temperature<br>4. Adequate storage area<br>5. Food thawing<br>6. Chilling temperatures | | | |
| Food Preparation<br>1. Washing/cleaning food<br>2. Availability of variety Cutting/chopping<br>3. Colour coded chopping boards<br>.4Food prepared in separate sections | | | |
| Cooking Food<br>1. Food tasting- Use of spoon<br>2. Cleanliness of cooking utensils<br>3. Thorough cooking –correct temperature | | | |

| | | | |
|---|---|---|---|
| Holding food for Service<br>1. Food holding temperatures<br>2. Clean equipment/Utensils<br>3. Clean work surfaces | | | |
| Service<br>1. Use of clean and sanitized utensils<br>2. Storage racks for serving utensils<br>3. Contact with already cooked food<br>4. Hand washing before serving | | | |

## APPENDIX V:- OBSERVATION SCHEDULE

ON-SITE OBSERVATIONAL INSPECTION OF PRACTICES IN FOOD HANDLING IN TIVET INSTITUTIONS

For the evaluation of practices of food handling and performance of TIVET Institutions, on-site observational inspection will be used. The inspection will be based on the following areas: Personal hygiene, food hygiene and environmental hygiene.

| | | | | |
|---|---|---|---|---|
| Personal Hygiene | Checking self-health condition (fever, diarrhea, injury) every working day.<br>Health certificates | Yes | No | Comment |
| | Checking cleanliness of clothes, hair restraints and shoes before work | | | |
| | Washing hands before food handling<br>Any other | | | |
| Food Hygiene | Receiving, foods right after delivery and storing them in store area after removing their package. | | | |
| | Checking temperatures of the frozen /refrigerated foods and if having problems, rejecting them. | | | |
| | Checking and verifying whether temperatures of refrigerators and freezers are appropriate. | | | |
| | Recording the temperature log of refrigerators and freezers for managing temperature control. | | | |
| | Taking temperature of the foods in cooking/reheating process with thermometer | | | |
| | Storing separately raw foods and cooked foods in refrigerator and freezers | | | |
| | Labeling cleaning and sanitizing chemicals and storing them at safer place away from foods. | | | |
| | Screening all windows and vents for controlling pest, and verifying if there are gaps and cracks in walls and ceilings | | | |
| | Cleaning and sanitizing knives, cutting boards and wiping cloths | | | |
| | Clean and sanitize properly storing sanitized/cleaned equipment and utensils using shelving unit.<br>Any other<br>Use Of Insectulators. | | | |
| | Verifying if the plumbing system installed well and maintained it properly | | | |
| | Seeing if equipment and facilities work well and | | | |

| | | | | |
|---|---|---|---|---|
| Environment Hygiene | maintaining them properly | | | |
| | Verifying heat and water vapor in the kitchen are removed immediately through hood exhaust system and maintaining it properly | | | |
| | Verifying if lightness and illumination of working area are appropriate and managing them properly | | | |
| | Cleaning and maintaining toilet facility regularly | | | |
| | Waste disposal,Proper drainage facilities<br>Any other<br>Use of Incinerators to dispose waste | | | |

## APPENDIX VI:- FOCUS GROUP DISCUSSIONS

### FOCUS GROUP DISCUSSION GUIDELINE

**TOPIC: FOOD SAFETY AND HYGIENE PRACTICES: A COMPARATIVE STUDY OF SELECTED TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING AND UNIVERSITY HOSPITALITY SCHOOLS IN KENYA**

**Introduction**

Hello, my name is Monica Wandolo I am a postgraduate student in the School of Hospitality and Tourism Management at Kenyatta University, carrying out research for my Ph.D. degree on Food Safety and Hygiene Practices: A comparative Study TVET and University's Hospitality Schools. My purpose today is to get your views on food safety and hygiene practices in your college. Feel free to make any positive and/or negative comments about any of the things we will be discussing today. This is a free flowing discussion and there is no right or wrong answer.

Before we get started, here are some points of information to help you alleviate any fears in regard to this exercise.

***Confidentiality***: Everything that you say here will be kept strictly confidential. Nothing said will ever be associated with any individual by name or organization.

***Voluntary participation***: Your participation is entirely voluntary. You may stop at any time although you are encouraged to participate till the end of the discussion.

Your cooperation in this discussion will be highly appreciated.

**Section 1: Establish the Level of Awareness and Implementation of HACCP System**

1. What are the pre-requisites of HACCP system? (***Probe for the level of awareness on the stated pre-requisites***)
2. How does awareness about HACCP system compare between TVET and University Hospitality Schools? (***Probe for possible rating on the level of awareness in the two institution categories***)
3. What is the level of implementation of HACCP system in your institution? (***Probe for ratings on each of the pre-requisites of HACCP system***)

**Section 2: Compare Food Handling Practices in TVET and University Hospitality Schools**

1. Are there food handling procedures you would consider to be incorrect in your institutions? (***Let the participants clarify whether all food handling procedures are correct. Probe for specific incorrect procedures followed***)
2. To what level are correct procedures followed? (***Probe for the ratings on the extent of use and how often correct procedures are followed; use a 5-point Likert scale. Let the participants specify the ratings for TVET and Universities***)

**Section 3: Assess the Capacity Level of TVET and University Hospitality Schools in Offering Training on Food Safety and Hygiene Practices**

1. How available are the basic tools in your institution? (***Probe for examples of basic tools/equipment. Further probe on whether the stated tools/equipment are modern or not. Let the participants rate the availability level with respect to student population. All responses to be categorized as either for TVET or Universities***)
2. To what extent are the available equipment/tools used? (***Probe for the frequency of use of the available tools***)
3. Comment on the adequacy of both teaching staff and technical staff (***Probe for availability, competence and attainability of the cost for maintaining teaching staff and technical staff***).
4. Comment on the adequacy of infrastructure (***Probe for whether the infrastructures are modern in terms of design, suitability in offering trainings, sizes relative to the class sizes and location***).

**Section 4: Identify Various Barriers to Food Safety and Hygiene Standards**

1. What are the common barriers to food safety and hygiene standards? (***Probe for as many factors as possible. Help the participants to classify the factors into these categories: external, internal, psychological/attitude and knowledge/expertise***)
2. To what extent are the factors identified above affect food safety and hygiene standards? (***Probe for 'HOW' and the extent of the effect***)

**NB: In each of the question/section, ensure the participants categorize their responses as either for TVET or University Hospitality Schools**

# APPENDIX VII:-MULTIPLE LINEAR REGRESSION ANALYSIS ON FOOD SAFETY PRACTICES

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .113[a] | .013 | .002 | .974 |
| 2 | .111[b] | .012 | .003 | .973 |
| 3 | .110[c] | .012 | .005 | .973 |
| 4 | .108[d] | .012 | .006 | .972 |
| 5 | .103[e] | .011 | .006 | .972 |
| 6 | .085[f] | .007 | .004 | .973 |
| 7 | .067[g] | .004 | .003 | .973 |

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.057 | .104 | | 29.444 | .000 |
| | Selecting food suppliers | -.080 | .054 | -.089 | -1.487 | .138 |
| | Receiving food | .114 | .056 | .126 | 2.022 | .044 |
| | Storing already supplied food | -.021 | .041 | -.028 | -.523 | .601 |
| | Preparation of food | .025 | .052 | .024 | .483 | .629 |
| | Holding food for service | .011 | .016 | .030 | .709 | .479 |
| | Cooling of leftovers | -.015 | .034 | -.023 | -.460 | .645 |
| | Reheating | -.063 | .039 | -.082 | -1.624 | .105 |
| 2 | (Constant) | 3.045 | .100 | | 30.359 | .000 |
| | Selecting food suppliers | -.079 | .054 | -.089 | -1.478 | .140 |
| | Receiving food | .115 | .056 | .127 | 2.039 | .042 |
| | Storing already supplied food | -.026 | .040 | -.034 | -.660 | .510 |
| | Preparation of food | .023 | .052 | .022 | .437 | .662 |
| | Holding food for service | .012 | .016 | .030 | .717 | .474 |
| | Reheating | -.071 | .034 | -.093 | -2.102 | .036 |
| 3 | (Constant) | 3.056 | .097 | | 31.577 | .000 |
| | Selecting food suppliers | -.074 | .052 | -.083 | -1.418 | .157 |
| | Receiving food | .116 | .056 | .129 | 2.068 | .039 |
| | Storing already supplied food | -.022 | .039 | -.029 | -.581 | .561 |
| | Holding food for service | .013 | .016 | .034 | .830 | .407 |
| | Reheating | -.069 | .034 | -.090 | -2.064 | .039 |
| 4 | (Constant) | 3.046 | .095 | | 32.009 | .000 |
| | Selecting food suppliers | -.080 | .051 | -.090 | -1.563 | .119 |
| | Receiving food | .106 | .053 | .117 | 1.987 | .047 |
| | Holding food for service | .012 | .016 | .032 | .789 | .430 |
| | Reheating | -.071 | .033 | -.093 | -2.128 | .034 |
| 5 | (Constant) | 3.050 | .095 | | 32.104 | .000 |
| | Selecting food suppliers | -.078 | .051 | -.087 | -1.519 | .129 |
| | Receiving food | .108 | .053 | .119 | 2.020 | .044 |
| | Reheating | -.066 | .033 | -.086 | -2.017 | .044 |
| 6 | (Constant) | 3.013 | .092 | | 32.770 | .000 |
| | Receiving food | .052 | .039 | .057 | 1.341 | .180 |
| | Reheating | -.069 | .033 | -.090 | -2.111 | .035 |
| 7 | (Constant) | 3.064 | .084 | | 36.540 | .000 |
| | Reheating | -.051 | .030 | -.067 | -1.710 | .088 |

a. Dependent Variable: Bacterial food poisoning

# APPENDIX VIII:- MULTIPLE LINEAR REGRESSION ANALYSIS ON BARRIERS TO FOOD SAFETY AND HYGIENE PRACTICES

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .246[a] | .061 | .048 | .952 |
| 2 | .246[b] | .060 | .049 | .951 |
| 3 | .245[c] | .060 | .050 | .950 |
| 4 | .244[d] | .059 | .051 | .950 |
| 5 | .242[e] | .059 | .052 | .950 |
| 6 | .240[f] | .057 | .052 | .950 |

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.560 | .136 | | 18.890 | .000 |
| | Lack of finances | .188 | .041 | .240 | 4.537 | .000 |
| | Inadequate equipment | -.085 | .043 | -.113 | -2.005 | .045 |
| | Lack of facilities | .026 | .040 | .036 | .647 | .518 |
| | Lack of time | -.028 | .043 | -.036 | -.661 | .509 |
| | Lack of experience | .054 | .049 | .076 | 1.094 | .275 |
| | Lack of knowledge | .107 | .046 | .141 | 2.331 | .020 |
| | Attitude | -.014 | .037 | -.019 | -.385 | .700 |
| | Lack of set standards in the Institution | -.085 | .046 | -.119 | -1.824 | .069 |
| | Lack of Motivation | -.021 | .045 | -.029 | -.462 | .645 |
| 2 | (Constant) | 2.550 | .133 | | 19.198 | .000 |
| | Lack of finances | .184 | .041 | .236 | 4.553 | .000 |
| | Inadequate equipment | -.085 | .042 | -.112 | -1.997 | .046 |
| | Lack of facilities | .027 | .040 | .038 | .690 | .490 |
| | Lack of time | -.030 | .043 | -.037 | -.691 | .490 |
| | Lack of experience | .053 | .049 | .074 | 1.070 | .285 |
| | Lack of knowledge | .104 | .045 | .137 | 2.301 | .022 |
| | Lack of set standards in the Institution | -.088 | .046 | -.123 | -1.914 | .056 |
| | Lack of Motivation | -.023 | .045 | -.032 | -.503 | .615 |
| 3 | (Constant) | 2.544 | .132 | | 19.246 | .000 |
| | Lack of finances | .186 | .040 | .238 | 4.605 | .000 |
| | Inadequate equipment | -.088 | .042 | -.117 | -2.103 | .036 |
| | Lack of facilities | .028 | .040 | .038 | .697 | .486 |
| | Lack of time | -.030 | .043 | -.038 | -.699 | .485 |
| | Lack of experience | .048 | .048 | .067 | .990 | .323 |
| | Lack of knowledge | .102 | .045 | .134 | 2.262 | .024 |
| | Lack of set standards in the Institution | -.099 | .039 | -.140 | -2.527 | .012 |
| 4 | (Constant) | 2.546 | .132 | | 19.282 | .000 |
| | Lack of finances | .190 | .040 | .243 | 4.765 | .000 |
| | Inadequate equipment | -.078 | .039 | -.103 | -1.986 | .047 |
| | Lack of time | -.028 | .043 | -.036 | -.666 | .506 |
| | Lack of experience | .052 | .048 | .072 | 1.075 | .283 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Lack of knowledge | .103 | .045 | .135 | 2.282 | .023 |
| | Lack of set standards in the Institution | -.094 | .039 | -.133 | -2.442 | .015 |
| 5 | (Constant) | 2.517 | .125 | | 20.205 | .000 |
| | Lack of finances | .192 | .040 | .246 | 4.835 | .000 |
| | Inadequate equipment | -.081 | .039 | -.107 | -2.087 | .037 |
| | Lack of experience | .044 | .047 | .062 | .947 | .344 |
| | Lack of knowledge | .091 | .041 | .120 | 2.197 | .028 |
| | Lack of set standards in the Institution | -.095 | .039 | -.134 | -2.463 | .014 |
| 6 | (Constant) | 2.510 | .124 | | 20.187 | .000 |
| | Lack of finances | .197 | .039 | .251 | 4.977 | .000 |
| | Inadequate equipment | -.079 | .039 | -.105 | -2.051 | .041 |
| | Lack of knowledge | .114 | .034 | .149 | 3.344 | .001 |
| | Lack of set standards in the Institution | -.078 | .034 | -.110 | -2.286 | .023 |
| a. Dependent Variable: Bacterial food poisoning | | | | | | |

# APPENDIX IX:- FOOD SAMPLES ANALYSIS

## HANDWASH BASIN


## PERSONAL HYGIENE

Personal Hygiene

Grooming

## FOOD HYGIENE

**ENVIRONMENTAL HYGIENE**
**WASH UP AREAS**

**ENVIRONMENTAL HYGIENE**
**USED UTENSILS**

**DURING WASH UP**

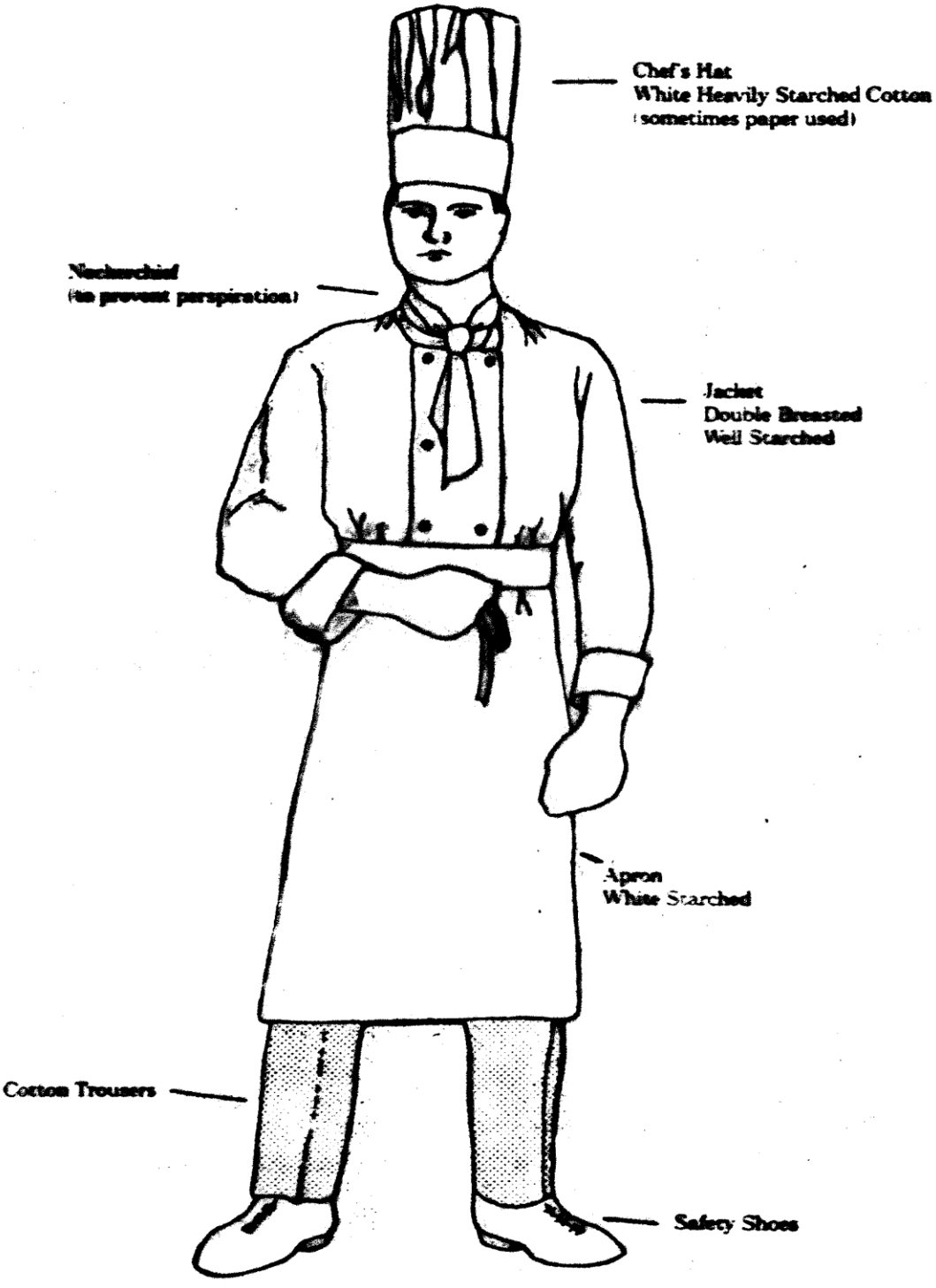
**PILED PLATES/CUTLERY**

**WASH UP SESSION**

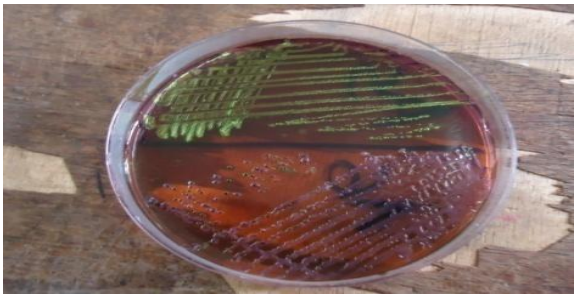
**COOKING EQUIPMENT**

## WASH UP AREAS


## APPENDIX X – APPROPRIATE GROOMING

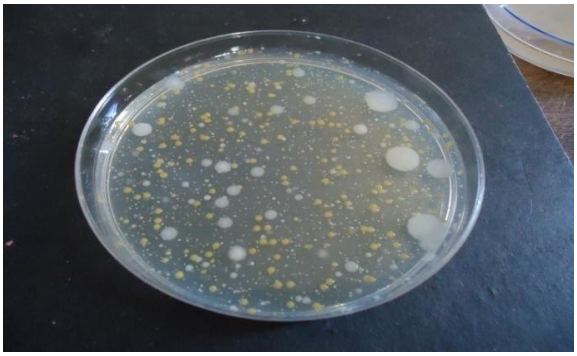


# APPENDIX XI: - ISOLATION OF MICROORGANISMS

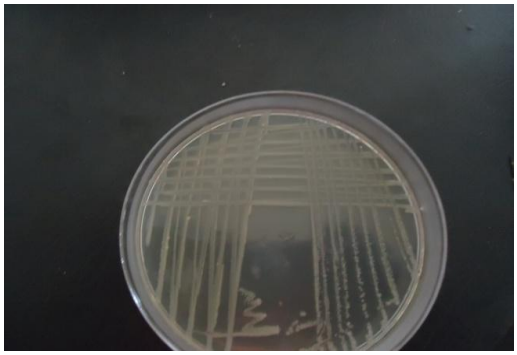


E. coli (Green), Salmonella (Purple)

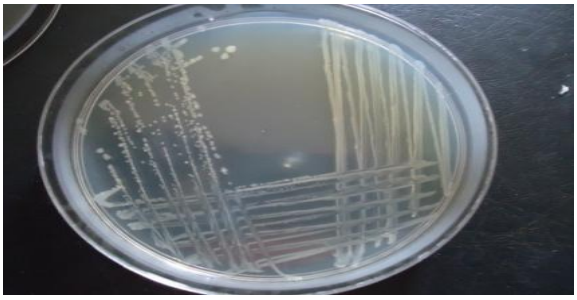
Shigella (Pink)



Pseudomonas



Negative Isolation



Vibrio (Yellow)