

**COMPARATIVE ANALYSIS OF FOOD HANDLING PRACTICES EMPLOYED BY
REGISTERED AND UNREGISTERED QUICK SERVICE RESTAURANTS: THE
CASE OF CITY OF MUTARE, ZIMBABWE**

BY

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**A DISSERTATION PRESENTED TO THE DEPARTMENT OF GEOGRAPHY AND
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ABSTRACT

The fast food industry has an important role in meeting the ever increasing food demands of the urban dwellers in developing countries. The catering industry in Zimbabwe is growing exponentially as evidenced by the opening of new takeaways, restaurants, lodges and hotels. It is estimated that 15 percent of the total population in Zimbabwe buy food from various food outlets on a daily basis. The aim of the study was to make an inference on the food handling practices currently prevalent in registered and unregistered quick service restaurants in the City of Mutare. The research was made of two main phases; the first phase involving the use of a structured questionnaire to assess employees' and clientele food safety opinions, knowledge, attitudes, and self-reported practices. The second phase included the use of detailed food safety observation guide to determine food safety and hygiene practices of food handlers. Collected data were subjected to analysis by a Portable IBM Statistical Package for Social Scientists version 11.0. The results for both registered and unregistered restaurants revealed significant p value > 0.05 indicating that there was no significant relationship between the registration status of restaurants and effectiveness of food handling practices employed. The microbial tests for *Escherichia coli*, *Bacillus*, *Salmonella* and *Staphylococcus aureus* were conducted on selected food samples, hand swabs, kitchen equipment and food contact surfaces. The results from the assessment indicated that *E. coli* was detected in all categories of samples, while the *Staphylococcus aureus* was found mostly on the hands of food handlers. *Klebsiella* occurred mostly on food contact surfaces and equipment, signifying inadequate hygiene and sanitation. However, *Salmonella* was detected in a few samples of meat, soup and stew.

DECLARATION

I **FORICHI TENDAI** do hereby declare that I am the sole author of this thesis. I authorize the **Midlands State University** to lend this thesis to other institutions or individuals for the purpose of scholarly research.

Signature Date

APPROVAL

This dissertation entitled ‘**Comparative analysis of food handling practices employed by Registered and Unregistered Quick Service Restaurants. The case of City of Mutare, Zimbabwe**’ by Forichi Tendai meets the regulations governing the award of the degree of MSc in Safety, Health and Environmental Management Degree of the Midlands State University, and is approved for its contribution to knowledge and literal presentation.

Supervisor

Date

DEDICATION

This dissertation is dedicated to my parents, Mrs E Forichi and my late father Mr A Forichi. Your legacy still lives on.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Fast food has become a popular form of a meal for many people around the world. It is thought to be the quickest and easiest method of eating. However, cleanliness of the environment in which food is being prepared and consumed is critical in avoiding the possibility of contracting a foodborne illness. Outbreaks of foodborne diseases normally paint a bad picture and attract many questions from members of the public regarding the adequacy of food safety practices of restaurants. This has resulted in restaurant management adopting modern food safety principles and some seeking certification on food quality and food safety. Restaurant management realized that perceptions of poor hygiene, sanitation and food handling practices might result in them losing clientele to those restaurants deemed safer leading to a decline in revenue. Previous research has found that 70 percent of respondents would no longer buy food from food service establishment where they had concerns about hygiene (Marter, 2005). A study conducted by Anderson *et al* (2007) found that people who perceived that a restaurant was “not at all” committed to food safety were less likely to choose the restaurant when eating out. In fact, at least one study found that cleanliness was the most important determinant for consumers’ perceptions of restaurant food safety (Minor and Cichy, 1984).

On a global scale, the problem of food poisoning affects between 25 percent and thirty percent per annum (Jacob and Powel, 2009). This then implies that almost everyone

living in developing and developed parts of the world is at risk. Foodborne illnesses constitute an important health problem in both developed and developing countries. Statistics from the World Health Organization (WHO) highlight that food poisoning affects a total of up to 1.5 billion children annually who fall sick (WHO, 2005). Diarrhea has been reported as the most common sign of food poisoning among children who are reported ill as a result of food poisoning. WHO attributes high morbidity among children to poorly developed immune system as compared to adults.

The discipline of food epidemiology has proved that the majority of foodborne disease outbreaks reported in various parts of the world emanate from unsafe handling and preparation of food in various eating houses which include restaurants, hotels and canteens (Mead, *et al.* 1999). In industrialized countries, 30% of the society suffers from food-oriented diseases. According to Marter (2005), one hundred and thirty million people are affected by food-oriented diseases in Europe and Asia each year. Marter (2005) further asserts that contaminated food in America has led to 5,000 deaths and 76 million disease events.

According to Green (2008), a total of 84,340 and 77,515 cases of foodborne disease were notified in 1999 and 2000, respectively, in Turkey. A number of bacteria, viruses and parasites have emerged as foodborne pathogens and resulted in numerous foodborne disease outbreaks. These outbreaks have had a major impact in terms of loss of human lives and increase in economic costs for health care. Changes in social attitudes and eating habits, changes in food production and distribution systems, increase in the number

of immune-compromised individuals, and improved pathogen-detection methods are some of the factors that have contributed to the emergence or recognition and persistence of foodborne pathogens (Manning and Snider, 1993).

While most food borne diseases are sporadic and often not reported, food borne disease outbreaks may take on massive proportions. For example in 1994 an outbreak of salmonellosis due to contaminated ice cream occurred in the United States of America (USA) affecting an estimated 224,000 persons (Mead *et al.*, 1999). In 1988, an outbreak of hepatitis A, resulting from the consumption of contaminated clams, affected some 300,000 individuals in China. In 1996, an outbreak of *Escherichia coli* 0157:H7 in Japan affected over 6,300 school children and resulted in 2 deaths (Anderson *et al.*, 2004). This was considered the largest outbreak ever recorded for this pathogen. In most parts of Africa, food poisoning is a notifiable disease, but the surveillance system is not effective. In South Africa for example, a few hundred cases are reported per year, whereas the incidences are more likely to be in the regions of hundreds of thousands of cases.

Mishandling of food plays a significant role in the occurrence of foodborne illness. Improper food handling may be implicated in 97% of all foodborne illness associated with catering outlets (Anderson *et al.* 1996). Microbiological risk in the kitchen may be decreased significantly by preparing food properly; otherwise, kitchens in hotels, restaurants and other places can also become an important contamination point for food. Therefore, the kitchen staff plays an important role in food safety. It is pointed out that the hands of foodservice employees may be causing cross-contamination because of poor

personal hygiene (Anderson, *et al.*, 1996). All the problems related to food handling, inadequate or insufficient storage, and poor hygienic conditions increase the risk of contracting foodborne diseases. If food handlers develop a correct perception of hygiene, it is possible to succeed in this field, and as a result of this success, the risk of foodborne illnesses will decrease (Clayton *et al.*, 2002).

The decade long economic meltdown of Zimbabwe between the year 2000 and 2009 resulted in many restaurants and fast food outlets scaling down operations and an increase in food safety violations in a bid by restaurant operators to stay in business. Zimbabwe has experienced an economic meltdown which has seriously impacted on the lives of ordinary people (FAO, 2007). Industries have closed, banks are unable to give affordable loans, parastatals are struggling, the private sector continues to retrench many of its employees and the government is struggling to create jobs for the school leavers and ordinary citizens. This leaves people with a cocktail of challenges and grappling for accommodation, food or a job. All these factors have resulted in people finding alternative ways to earn money and so there are more people working in the informal sector than the formal sector. This has put pressure on existing services and caused chaos even in the food service sector where food safety standards are being compromised at the expense of consumers.

The catering industry in Zimbabwe is developing rapidly with a huge number of restaurants, takeaways and fast food outlets being opened. Before the dollarization of the economy, the fast foods business was not well entrenched and was dominated by Innscor

Africa's Chicken Inn brand, and hotels (FAO, 2007). The dollarization of the Zimbabwean economy at the beginning of 2009 coupled with the government's advocacy for indigenization and black empowerment, has seen rapid entry of new entrants into the market for the provision of Fast Foods. This move by the government saw the sudden mushrooming of a number of micro, small and medium firms entering into the Fast Foods market. New more players have announced their presence since 2011 such as TN Grill and Chicken Slice. According to Makwanda and Moyo (2013), it is estimated that out of a possible 13 million people in Zimbabwe, 2 million people were recorded in 2011 to have been eating out around Zimbabwe.

Most food safety violations by restaurants and other food outlets in Zimbabwe have been observed as emanating from a combination of negligence and inadequate training of food handlers on principles of food safety (Makwanda and Moyo, 2013). Makwanda and Moyo (2013) maintain that poor sanitation and personal hygiene of staff including holding cooked food under unsafe temperature top the list of food safety violations observed in hotels and restaurants in Zimbabwe. The key drivers of most food safety violations in Zimbabwe include poor remuneration for most food service staff, inadequate training on proper food handling practices, high operating costs and the dominance unskilled kitchen staff that is reluctant to adhere to best practices of food safety. The Food Hygiene by-laws of 1975 which were formulated before the country's independence in 1980 govern the establishment and operation of food outlets in Zimbabwe (WHO, 2005). Mutare Registered premises By-laws of 1981 and Food Hygiene By-laws of 1979 govern the establishment and operation of restaurants in the City of Mutare. Similarly, the

Hawkers and Street Vendors by-laws of 1978 regulate the activities of vendors operating under urban and rural district councils in Zimbabwe

High density suburbs in Mutare namely Sakubva, Chikanga and Dangamvura have their economy centered on large outdoor food and flea market due to unprecedented poverty. Some sections of closing factories are also increasingly converted to restaurants most of which operate without licenses from the City Health Department. According to a study by Poverty Reduction Forum Trust (2011), 41% of residents in Mutare engage in part-time jobs. The ever rising rate of unemployment in the country has led to the ballooning of informal economic activities that most residents in Mutare are already engaged in. A significant number of adults living mainly in the high density suburbs of Mutare are known to be involved in chores such as laundry and gardening done in exchange for money. However, the majority of residents engaged in such piece meal jobs seldom earn more than \$30 a month (Poverty Reduction Forum Trust, 2011).

1.2 STATEMENT OF THE PROBLEM

There are approximately 200 food outlets in the City of Mutare of which 91 are unregistered and thus operating illegally (Mutare City Health Department, 2013). Unregistered restaurants, though currently operational, their activities are not monitored or inspected thus posing the health of the general public at risk. Registered restaurants have in some cases been implicated in foodborne disease outbreaks (Jacob and Powell, 2009). Since the year 2000, isolated cases of food poisoning have been reported with the

latest being the poisoning of over 50 Mutare Girls High pupils in 2013 (Mutare City Health Department, 2013). In addition, there has been a sharp increase in cases of diarrhea linked to food and water contamination with local council clinics recording 400 more cases in 2012 as compared to the year 2000 (Mutare City Health Department, 2013). Table 1.0 shows a summary of unregistered food outlets by location.

Table 1.0: A Summary of Unregistered Restaurants in Mutare Urban (Source – Mutare City Health Department)

Area	Number of unregistered food outlets
High Density Suburbs (Sakubva and Chikanga)	47
Central Business District (CBD)	22
Low Density Suburbs (Fairbridge Park & Darlington)	10
Medium Density Suburbs (Yeovil)	6
Industry	6
Total	91

Although health inspectors use an inspection manual and the food code to inspect restaurants, their judgments also rely heavily on visual assessment. In fact, a previous study found health inspectors did show variations in regards to their opinions of

cleanliness (Kassa *et al.*, 2001). Microbiological assessment of restaurants is generally not done as part of the inspection process since traditional microbiological analyses take up to 48 hours after the sample is collected. Also the equipment that provides a real-time microbiological analysis is expensive. This has become an issue however, as bacterial and viral contaminations are not detectable by visual assessment. The practice of using hygiene swabs in environmental microbiological assessments has proved that reliance on visual inspection alone is misleading (Griffith *et al.*, 2002).

1.3 OBJECTIVES

1.3.1 General Objective

- To assess the adequacy and appropriateness of food handling practices in quick service restaurants

1.3.2 Specific Objectives

- To identify prevailing food handling practices
- To assess the food safety knowledge of food handlers
- To analyze food samples, work surfaces and equipment for pathogenic microorganisms

1.4 RESEARCH QUESTIONS

- What are the current food handling practices in quick service restaurants?
- What food handling practices do food handlers need to change to reduce the risk of foodborne illness?

- Are food handlers aware of basic food hygiene information?
- What is the relationship between food handling practices and knowledge of food handlers?
- What is the general food safety perception of quick service restaurants clientele?
- What is the microbial quality of food and food contact surfaces?
- Do food handlers meet basic hygiene standards?

1.5 HYPOTHESIS

1.5.1 H₀1 Hypothesis

Registered restaurants in the City of Mutare employ ineffective food handling practices.

1.5.2 H₀2 Hypothesis

Unregistered restaurants in the City of Mutare employ ineffective food handling practices.

1.6 SIGNIFICANCE OF THE STUDY

Very minimal priority has so far been accorded on this topic and only a few studies have been done in Zimbabwe. This study sought to examine the food handling practices and knowledge of food handlers in registered and unregistered quick service restaurants in the City of Mutare. Results of the survey will be used by the local authority to develop effective educational materials and intervention programs for food handlers. This study provides insight on food handling practices in both registered and unregistered food outlets in a bid to identify training needs for restaurant management and shop floor staff.

Through this study, the City of Mutare will find avenues for regularizing operating licenses for unregistered food outlets in line with the country's indigenization and economic empowerment policy while reinforcing and continually improving monitoring and inspection activities for the already registered players. It is generally acknowledged that food small and medium enterprises (SMEs) present a number of important potential economic and social benefits which should be integrated with public health principles. Socio-economic benefits linked to food SMEs include: generation of employment opportunities and promotion of traditional food production.

Through the study, gaps in food safety knowledge, attitudes, and practices among food service workers and clientele are noted and recommendations on training and education made based on the findings.

- **DELIMITATIONS**

Data collection was carried out in selected registered and unregistered quick service restaurants in the city of Mutare. Laboratory analysis of samples was done at Midlands State University and Midlands Laboratories.

- **LIMITATIONS**

This study mainly focused on activities of food workers of the selected types of registered and unregistered restaurants in the city of Mutare. The researcher was not able to conduct

research with some quick service restaurants that were initially sampled as they later closed down operations due to viability constraints. More so, the researcher in some instances had to endure fairly long period of waiting for approval from top management of some restaurants, some of which failed to respond at all. The researcher could not stretch the study to include both winter and summer seasons due to limited time.

1.9 ACRONYMS AND DEFINITION OF TERMS

Cleaning - the removal of soil, food residue, dirt, grease or other objectionable matter.

Contaminant - any foreign agent of physical, biological or chemical nature that is unintentionally introduced in food making the food unsuitable for human consumption.

Contamination - the occurrence of a contaminant in food, kitchen or dining rooms.

Cross contamination- is the passage of pathogenic organisms from dirty to clean areas or from raw to cooked food.

Disinfection - the measures aimed at reducing the presence of pathogenic microbes on equipment and work areas to less harmful levels.

Establishment – is any premise or building including the immediate environment where food is prepared.

Food hygiene – refers to conditions and measures aimed at enhancing the safety and suitability of food right from the farm to the table.

Hazard – it is a situation of food, whether physical, chemical or biological with the potential to cause adverse health impacts.

HACCP - a system which identifies, evaluates, and controls hazards which are significant for food safety.

Food handler - any person who directly handles raw or cooked food including kitchen utensils, equipment and food packaging material.

Foodborne illness –is any food related illness food or drinks contaminated with pathogens or toxins.

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

Pathogen - is a bacteria or virus that, if consumed together with food or drink, may result in illness.

PHF(s) - means Potentially Hazardous Food(s).

Practices – the ways of cleaning, sanitizing and or handling.

Prevalent – widespread in a particular area or at a particular time.

Product – is any food item on a menu

Ready-to-eat food – is any food that can be eaten without cooking or any other additional preparation, and can be served this way.

Sanitize – is the act of introducing heat or chemical substances on work surfaces and equipment in order to eliminate or reduce pathogens.

Risk - is the likelihood that food poisoning or illness will occur due to mishandling food and practicing poor hygiene.

CHAPTER TWO
LITERATURE REVIEW

2.0 INTRODUCTION

This chapter basically focuses on the review of related literature to this study and the manner in which previous researchers have handled this area of research.

2.1 HISTORICAL BACKGROUND AND DEVELOPMENTS IN FOOD SAFETY

On a large scale, in history, there are records of early communal feedings by armies where soldiers would die from food they took than the enemy's weapon (Scheusner, 1982). During the Spanish-American war, only 379 soldiers died in combat while over 1000 died from food poisoning (Scheusner, 1982). In wartime, even today, safe food and water supplies to the soldiers feature prominently among the vulnerable items. Communal feeding in earlier days gave rise to an increased interest in food hygiene for any careless handling by one person could suddenly affect a large number of people.

Microbiologist Louis Pasteur in year AD 1864 proved that invisible organisms or bacteria causing food spoilage could be killed by heat application (Green, 2008). The whole scientific approach to food preservation then followed. The process of pasteurization today stands as a memory to the great scientist Louis Pasteur. This development has ensured the safety of food than any other development thereafter (Green, 2008). Later, the introduction of laboratory techniques to grow and isolate different types of bacteria and other micro-organisms has given man the means by which he can now identify these invisible "enemies", thereby making the task of controlling them far much easier.

From earlier learnings, man realized that food kept better and longer in cold surroundings,

and that unclean hands could contaminate food and make people ill (Green and Selman, 2005). From history, it is known that eating certain animals and plants was frowned because they had been associated with illness (Norton, 2002). Although the precise reasons for illness were not known, early man began to understand that sound food, properly prepared and well-kept was essential to sound health. The need for food hygiene has increased over the years due to a number of factors. Earlier influence was the knowledge that unsound or ill-handled food could cause illness (Jones and Angulo, 2006). In small communities where each family produced and prepared its own food, the effect of poor handling was confined to the family.

2.2 PAST STUDIES ON FOOD HANDLING PRACTICES

Many studies on food handling have been undertaken in different parts of the world especially among street food vendors and kitchen staff working in hotels and fast food outlets. The importance of the cleanliness of the food contact surface has been recognized. However the cleanliness of non-food contact surface such as menus is thought to be under estimated.

The role of foodservice workers in upholding food safety cannot be overemphasized. Mishandling of food as well as unhygienic or unsanitary conditions may result in food poisoning and foodborne disease outbreaks. It is thus the onus of food handlers to ensure that food is prepared under sanitary and hygienic conditions using appropriate food handling techniques. Risky food safety practices such as the holding of food under unsafe temperature zones; use of uncleaning utensils and cutting boards; and failure to put in

place measures aimed at preventing cross contamination of pathogens have been observed in many studies (Wie and Strohbehn, 1997). More so, some studies revealed found that the implementation of food safety training programs is an important step in promoting safe food handling practices among food workers (McElroy and Cutter, 2004). However, other studies highlight the need to develop food safety risk perception skills among food workers (Marriott, 1990).

Holtby *et al* (1997) in their study of pathogenic microorganisms associated with food contact surfaces including menus revealed that regular cleaning and sanitization of both kitchen and dining work surfaces is fundamental. Dining tables for instance are easily contaminated by guests who come to buy. If food handlers fail to effectively clean the surfaces, there is likely to be cross contamination of pathogens. (Tebbutt *et al.*, 2007) postulate that managers of food establishments should not take for granted the importance of correct hand washing procedure. In fact, Marriott and Gravani (1996) recommend the design and implementation procedures on hand washing. Similarly, training on correct hand washing cannot be overemphasized. In fact, one study found higher bacterial counts on tabletops in restaurants and bars that had already been cleaned with a dishcloth than before they were cleaned (Yepiz-Gomez *et al*, 2006). Hence, surface sampling has become important in determining the sanitary condition of environmental, food and hand contact surfaces (Scheusner, 1982). Several studies have found microbiological contamination in foodservice kitchens.

A study by Tebbutt *et al* (2007), which investigated the cleanliness kitchen utensils and

equipment such as knives, spoons, cutting boards, sinks and handles of pots, refrigerators and ovens showed that a significant number appeared clean but failed the hygiene swab test done in the laboratory. A similar study by Moore and Griffith (2002) in a cheese production company concurred with the findings of the preceding study. In this study, it was revealed that 90% of hygiene surface swabs had pathogens that suggested inadequate cleaning, sanitization and hand washing among employees. Another study of the cleanliness of surfaces in a hospital kitchen showed that there was need for improvement in cleaning and disinfection of kitchen equipment and working surfaces (Aycicek *et al.*, 2006). The series of cleanliness and sanitization studies that were undertaken by different researchers around the world generally support environmental microbiological monitoring in addition to routine inspections by environmental health officials.

The notion of having food safety training as a stand-alone measure was struck down by a study of food handlers' performance in Wales that proved that even food workers that had received training and knowledge on food safety also deviated from proper and safe food handling procedures (Clayton, 2002).

Bean and Griffin (1990) in their review of over 7000 reports on foodborne disease outbreaks that occurred between 1973 and 1987 came up with epidemiologic facts on the causes or drivers of the outbreaks. The two researchers attributed the outbreaks of foodborne diseases to contamination by either pathogenic microbes or chemical substances. The study also implicated human error and in some cases absolute negligence by food service workers. According to Bean and Griffin (1990) one of the leading food

safety violations was the preparation and storage of food under unsafe temperatures as shown in Figure 2.1. The two researchers observed that turkey meat was implicated in outbreaks of foodborne diseases that occurred soon after Thanksgiving Day dinners. Turkey is a bulky bird that is difficult to cook thoroughly in order to satisfy the recommended internal temperature of at least 70°C.

Figure 2.1: Factors contributing to food poisoning in the United States

According to figure 2.1, large portions of beef or pork are capable of presenting the same challenge as turkeys.. Bean and Graffin (1990) investigated food handling practices employed by kitchen staff preparing various food styles in the United States. Their findings are summarized in Figure 2.2.

Figure 2.2: Food poisoning in relation to different styles of food in the US

According to detailed shown in figure 2.2, the main factor contributing to food poisoning is related to 'holding temperature'. This means that food is held for too long at temperatures where food poisoning bacteria can grow. Food under refrigeration must be held at 5°C or less and food displayed hot for service must be 60°C or more. Food between 5° and 60°C is in the temperature danger zone where food poisoning bacteria can grow. The time that food is in the danger zone must be kept to a minimum. The time food takes to cool or reheat is often overlooked and problems can result.

A group of experts from the United States Food and Drug Administration (FDA, 2000)

studied foodborne illness risk factors. Nine hundred inspections were undertaken by a team of twenty food safety specialists. They inspected institutions, restaurants and retail stores and assessed compliance with important food safety requirements. Figure 2.3 illustrates results obtained in restaurants.

Figure 2.3: Problems observed by food inspectors in US restaurants

Full service restaurants face more problems because they have more complex menus and prepare food ahead of time. In addition, they also face the problems of cooling and reheating. US inspectors identified ‘holding temperature’ as the most frequent problem observed. Kitchens were marked down for slow cooling of foods, poor refrigeration temperatures and hot holding temperatures below 60°C.

Due to fluctuations in business volume, many caterers rely on part-time, temporary, or contract employees. In general, companies invest little effort in training or providing guidance and support to temporary employees (Aycicek *et al.*, 2006). These part-time workers have also been found (Tebbutt *et al.*, 2003) to lack commitment to the organization and displayed less favorable behaviors than full-time employees. Due to high turnover among these employees, many companies consider them less valuable and not worth the investment in training (Aycicek *et al.*, 2006). These factors contribute to the lack of food safety knowledge and skills needed for catering employees.

Kentucky Fried Chicken better known as KFC, although being one of the best fast food

restaurant faced decrease in sales and also minor difference in the points of hygiene level given by people after the issue of dirty kitchen and floor that happened in one of the its branch at Leicester Square in London (Manes *et al.*, 2013). Manes *et al.* (2013) went on to reveal that the sales graph of KFC had gone down by 4 % at the end of third quarter of September 6 2009. 5300 unit chains faced an operating loss and there was also decrease of 4 points in hygiene level given by people after the issue of hygiene problem, that means there was also a decrease in people who want to eat food of KFC, which shows there is decrease in frequency of people in KFC because of change in their perception about KFC's hygiene factor

A recent study in the *Journal of Environmental Health* discovered an unsettling gap in Chicago food handlers' food safety knowledge (Manes *et al.*, 2013). More than 700 English and Spanish-speaking food workers participated in the food safety knowledge survey covering topics from food storage to cooking temperatures and hygiene (Manes *et al.*, 2013). The participants were of varied racial and educational backgrounds, and many were seasoned employees with an average of ten years' experience in the food industry. The average knowledge score of these food handler veterans, however, was only a meager 72% according to American standards (Manes *et al.*, 2013).

The concepts that stumped nearly all of the survey participants related to temperatures for cooking and holding foods. Less than 2% of the food handlers surveyed knew that bacteria grow best between 5°C and 60°C (the Temperature Danger Zone), and only 17% knew that ground beef must be cooked to 70°C to reduce germs to safe levels. Just 20% of those surveyed knew the necessary temperature for cooking poultry, and less than 40%

of participants knew that cooked rice can harbor dangerous bacteria. Knowledgeable food managers, however, could potentially fill these food safety knowledge gaps for food handlers, especially in states like Illinois where food handler certification is not required. In fact, the managers participating in this study achieved higher scores on their knowledge surveys, with a 79% average. The food managers' knowledge gaps were very similar to those of their employees: less than a third of the managers knew the correct cooking temperatures for hamburger and chicken.

Another recent study by Chapman *et al.* (2010) on food worker habits published in the *Journal of Food Protection* found that 60 percent of restaurant employees said they had worked a shift while ill, with 20 percent saying that, in the past year, they had worked at least one shift while experiencing vomiting or diarrhea. Chapman *et al.* (2010) conducted interviews with 491 food workers from 391 randomly selected restaurants in nine states to discover trends behind worker motivations for working while ill. 60 percent of restaurant workers said they had worked a shift while ill. Of those who had done so, 89 percent said they made the decision independently, while the decision was influenced by management 11 percent of the time.

According to Chapman *et al.* (2010) those who worked while ill did so for one or more reasons: no paid sick leave (44 percent); understaffed or no staff available to cover shift (32 percent); symptoms did not feel contagious or bad enough (31 percent); feelings of obligation or strong work ethic (31 percent). Chapman *et al.* (2010) found out that more than 70 percent said that the severity of illness, type of symptoms and possibility of making others ill each influenced their decision to work. 20 percent of workers said they

had worked one or more shifts while experiencing vomiting or diarrhea in the previous year. Of those, 61 percent did so on two or more shifts. Managers were aware of sick employees working in 63 percent of circumstances, usually because the employees informed them. About half of the employees who said they worked while ill changed their behavior in some way, but only one-third of those changes related to food safety, such as more frequent hand washing or avoiding food preparation. “These data suggest that food workers are working while ill and are not taking the necessary precautions to prevent their customers from getting ill,” the authors wrote.

A closer look at food handling studies that until now have been conducted and published reveals that little has been done to compare food handling practices that are prevalent in registered and unregistered food outlets. Most studies focus on isolated practices related to food handling such as hand washing, cross contamination, thoroughness in cooking food, adequacy of equipment sanitation and knowledge of food handlers and supervisors among the others. The researcher therefor sought to adopt a holistic approach in investigating food handling practices in the two major categories of restaurants with particular focus on cleanliness and hygiene, food safety practices and microbiological assessments of food handlers’ hands, work surfaces, equipment and cooked food.

2.3 EPIDEMIOLOGY OF FOODBORNE DISEASES

According to Bean *et al.* (1996), many countries have not yet established adequate surveillance or reporting mechanisms to identify and track foodborne illness. Bryan et al. (1971) observes that data on foodborne diseases are extremely scarce and improvements are needed to better identify the causes of foodborne diseases. In the African Region, for

example, improper coordination between surveillance, food laboratories, and food inspection services commonly leads to disorganized sampling (FAO, 2005). Furthermore, the emphasis is on sampling for enforcement purposes and often there is no systematic monitoring for food contaminants. Inadequate recordkeeping can create a vicious cycle that results in the absence of information on which to base local decision-making, regulations, and food standards. Chao (2003) opines that few countries have surveillance systems sensitive enough to identify common agents of foodborne diseases. Therefore, surveillance data are patchy and unreliable.

Foodborne illnesses caused by microorganisms are a large and growing public health problem. Approximately 1.8 million children in developing countries (excluding China) died from diarrhoeal disease in 1998, mostly caused by microbiological agents, mostly originating from food and water (Mitchell, 2007). Food poisoning occurs when a person gets sick from eating food that has been contaminated from harmful bacteria, parasites or viruses. The most common symptoms of food poisoning include stomach cramps, nausea, vomiting, diarrhea and fever.

Thus food poisoning is caused by the consumption of contaminated food or water. In the United States of America (USA), some 76 million cases of foodborne illness, resulting in 325 000 hospitalizations and 5000 deaths, are estimated to occur each year with an estimated cost of US\$6.5-35 billion (Cruz *et al.*, 2001). Every year more than 4 million Canadians get food poisoning also known as foodborne illness.

According to Patil *et al.* (2005) poor hygiene, cross contamination, improper handling

and inadequate heat treatment are the most common causes of foodborne disease. Food poisoning is believed to be widely under reported in most parts of the world. In 2007, there were an estimated 850 000 United Kingdom (UK) cases of food poisoning, over 19 500 hospitalizations and over 500 deaths (Jacob and Powell, 2009). The same researchers discovered that restaurants (42%), non-residential caterers (21%) and retail (7%) sectors were the major sources of outbreaks. The main hazards in food processes are contamination with bacteria that cause disease (pathogenic bacteria) such as *Campylobacter*, *Salmonella*, *E. coli* O157:H7, *Listeria monocytogenes*, and *Clostridium perfringens* (Green and Selman, 2005). Green (2008) asserts that vulnerable groups such as the elderly, the sick, babies, young children and pregnant women are most at risk from food poisoning. The UK's largest outbreak of *E.coli* O157 in Scotland in 1996 resulted in 17 deaths of elderly people (Jacob and Powell, 2009). Another major outbreak of the same pathogen in Wales in 2005 led to the death of a school child (Jacob and Powell, 2009).

McSwane *et al.* (2005) in their study conducted in Korea observed that 56.0% of the foodborne outbreaks (286 out of 510 cases) are caused by the microbial infection. In the case of microbial substances, time and temperature control and prevention of cross-contamination could be effective methods for the prevention of foodborne illness. Therefore the reinforcement of safety education for food handlers and managers in foodservice establishments is on the rise. According to McSwane *et al.* (2005) several food safety-related problems requiring effective safety training programming are prevalent in Korea. These include, having small scale facilities and capital, low

education/low technical skill of employees, and a high turnover rate of employees. Studies for testing the effectiveness of hygiene education pointed out that hygiene knowledge education alone was not sufficient to improve the hygiene attitude and practices of foodservice workers and a discrepancy between hygiene attitudes and practices existed. Chapman *et al.* (2007) assert that in order to induce to positive changes in hygiene attitude and behavior in foodservice workers, they should be equipped through safety training; hands-on training materials and the training program should be angled towards worker viewers with various activities. A design for planning, implementing, and evaluating a safety training program appropriate for employees' characteristics in the organization is necessary.

2.3.1 Food-Borne Disease Surveillance in Zimbabwe

Pathogenic bacteria are the most commonly reported agents of food borne illness, closely followed by viruses (Bean *et al.*, 1996). Further, most reported cases of food borne illness are attributed to poor handling at the home or at retail food establishments rather than failures at the food processing level (Anderson *et al.*, 2004). It is not possible to determine with certainty the cause of food borne illness in roughly 50% of all food borne illness cases (Bean *et al.*, 1996). Most cases of food poisoning go unreported to health agencies. This is partly because, for normal healthy adults, food-borne pathogens only cause mild symptoms and medical health may not be necessary. Food poisoning is much more serious in young children, and in the frail and immune-compromised people (Bean *et al.*, 1996). Diarrhea and vomiting can, for example cause life threatening dehydration in babies and young children.

Data for a few food-borne diseases in Zimbabwe is currently collected in the context of hospital and clinic based disease surveillance. Cases of cholera, dysentery and anthrax are reported through the hospital and clinic based weekly disease surveillance system. Other food-borne diseases are reported as general poisoning and diarrhea cases in the monthly T5 reporting system. The Food Safety Control Authority (FSCA) acts as the reference laboratory for such investigations. The Food Safety Advisory Board (FSAB) has a mandate to record and compile data on incidences of genetically modified associated diseases that can be reported to them.

It is estimated that at least 440 children under the age of five died of diarrheal diseases in 2013 (Ministry of Health and Child Care, 2013). The Minister of Health and Child Care David Parirenyatwa was quoted in one of the newspapers saying “*the country has been experiencing an increased number of diarrhea cases in recent years. This year alone (2013), over 48 000 cases and 440 deaths from common diarrhea have been reported countrywide. The deaths reported have happened in health facilities with diarrhea as the cause of death*”. Parirenyatwa said his ministry receives between 8 000 and 15 000 diarrhea cases per week

According to the Centre for Disease Control and Prevention (2011) Typhoid cases continue to be reported in an outbreak that began since the first case was reported on 10 October 2011. According to the health cluster, by end of September 2012, a cumulative 4,912 suspected typhoid cases and two deaths had been reported since October 2011. Of these, 80 cases were confirmed. The case fatality rate (CFR) was 0.04 per cent.

2.4 FOOD CONTAMINATION

Clayton *et al.* (2002) postulate that most food raw materials have a primary flora of microorganisms which originate from the production environment. A flora of microorganisms may come from the air, especially from dust in the air, from process water, process equipment, or from humans which handle the food. During the subsequent storage of the product the different species develop differently depending on the environment.

2.4.1 Food Contamination Sources

According to Leach *et al.* (2001) food provides an ideal nutrition source for microorganisms and generally has a pH value in the range needed to contribute to proliferation. During harvesting, processing, distribution, and preparation, food is contaminated with soil, air, and waterborne microorganisms. Scott (2003) postulates that extremely high numbers of microorganisms are found in meat animals' intestinal tracts and some of these find their way to the carcass surfaces during harvesting. Some apparently healthy animals may harbor various microorganisms in the liver, kidneys, lymph nodes, and spleen. These microorganisms and those from contamination through slaughtering can migrate to the skeletal muscles via the circulatory system. When carcasses and cuts are subsequently handled through the food distribution channels, where they are reduced to retail cuts, they are subjected to an increasing number of microorganisms from the cut surfaces (FAO, 2005). The fate of these microorganisms and those from other foods depend on several important environmental factors, such as the ability of the organisms to utilize fresh food as a substrate at low temperatures. In

addition, oxygenated conditions and high moisture will segregate the microorganisms most capable of rapid growth under these conditions.

Refrigeration, one of the most viable methods for reducing the effects of contamination, is widely applied to foods in commercial food processing and distribution. Its use has prevented outbreaks of foodborne illness by controlling the microbes responsible for this condition (Frean *et al.*(2003). However, correct techniques for cold storage frequently are not followed, and food contamination may result (Marriott and Gravani, 2006). Jones and Angolo (2006) point out that foods cool slowly in air, and the cooling rate decreases with increased container size. Therefore, it is difficult to properly cool large volumes of food. According to Olsen *et al.* (2000) many of the *Clostridium perfringens* foodborne illness outbreaks have been caused by the storage of a large quantity of food in slowly cooling containers. Identification of contamination sources in a food production facility impacts directly the ultimate effectiveness of an establishment's sanitation control strategies. Anon (1995) is of the opinion that both direct and indirect food-contact surfaces, water, air, and personnel are primary areas of concern as contamination sources in a food plant.

According to Marriott and Gravani (2006), food products may transmit certain microorganisms, causing foodborne illness from infections or intoxications. Foodborne infections can result in two ways:

1. The infecting microorganism is ingested and then multiplies, as is true for *Salmonella*, *Shigella*, and some enteropathogenic *Escherichia coli*.

2. Toxins are released as the microorganisms multiply, sporulate, or lyse. Examples of such infections are *C. perfringens* and some strains of enteropathogenic *E. coli*.

2.4.2 TRANSFER OF CONTAMINATION

Before a foodborne illness can occur, foodborne disease transmission requires that several conditions be met. The presence of only a few pathogens in a food will generally not cause an illness, although regulatory agencies still consider this a potentially hazardous situation. Bryan (1979) cited several models that have been used to support this hypothesis and to illustrate the relationship among factors that cause foodborne illness. Two of the models that will be discussed briefly are the chain of infection and the web of causation.

2.4.2.1 Chain of Infection

A chain of infection according to Marriott and Gravani (2006) is a series of related events or factors that must exist or materialize and be linked together before an infection will occur. These links can be identified as **agent**, **source**, **mode of transmission**, and **host** as shown in the figure 2.4 below.

Figure 2.4: The Chain of Infection (*Adapted from Principles of Food sanitation p77*)

Marriott and Gravani (2006) further postulate that the essential links in the infectious process must be contained in such a chain. The causative factors that are necessary for the transmission of a bacterial foodborne disease are:

1. Transmission of the causative agent from the environment in which the food is produced, processed, or prepared to the food itself.
2. A source and a reservoir of transmission for each agent.
3. Transmission of the agent from the source to a food.
4. Growth support of the microorganism through the food or host that has been contaminated.

According to Langree and Armbuster (1996), conditions such as required nutrients, moisture, pH, oxidation–reduction potential, lack of competitive microorganisms, and lack of inhibitors must also exist for contaminants to survive and grow. Contaminated food must remain in a suitable temperature range for a sufficient time to permit growth to a level capable of causing infection or intoxication. The infection chain emphasizes a multiple causation of foodborne diseases. The presence of the disease agent is indispensable, but all of the steps are essential in the designated sequence before foodborne disease can result.

2.4.2.2 Web of Causation

The web of causation as modified by Bryan (1979) is a complex flow chart that indicates

the factors that affect the transmission of foodborne disease. This presentation of disease causation attempts to incorporate all of the factors and their complex interrelationships. These webs, generally oversimplified schematic representations of disease transmission processes, will not be illustrated because a very large and comprehensive figure would be required to include all pathogenic microorganisms affecting all foods.

2.4.3 CONTAMINATION OF FOODS

A viable way for the identification of contamination sources in food establishments is to incorporate the “zonal” approach to environmental monitoring that has been advanced by Kraft Foods and adopted by other food companies (Slade, 2002). This technique is an effective way to identify potential trouble spots and maintain effective sanitation control strategies through targeting appropriate areas of concern.

The zonal approach is designed as a bull’s eye target with the center circle or Zone 1 representing the most critical areas for cleaning and sanitizing- primarily direct food-contact surfaces. These areas include, but are not limited to, production equipment, utensils, and containers with direct contact with foods. The second circle (Zone 2) of the bull’s eye target includes the areas of concern for cleaning and sanitizing of indirect food-contact surfaces such as equipment parts or other surfaces that personnel may come in contact with near Zone 1. Examples of indirect contact surfaces include portions of the plant environment such as drains, utility pipes, heating ventilation, and air conditioning system equipment, etcetera. Zone 3 includes floors, walls, and other items in contact with floors, walls, cleaning equipment, and other items in the processing area that are not as

close to foods as in Zone 2. Zone 4 includes maintenance equipment and areas further away from production such as hallways, entrances, and welfare facilities. One of the most viable contamination sources is the food product itself. Waste products that are not handled in a sanitary way become contaminated and support microbial growth. Adenosine triphosphate (ATP) bioluminescence and protein tests are non-microbial tests that detect soil and debris that cannot be seen by the naked eye. ATP bioluminescence detects any cells that contain ATP; whereas, protein tests identify protein in soils, which is an indicator of contamination such as feces.

2.4.3.1 Red Meat Products

According to Shapton and Shapton (1991), the muscle tissues of healthy living animals are nearly free of microorganisms. Shapton and Shapton (1991) further assert that contamination of meat occurs from the external surface, such as hair, skin, and the gastrointestinal and respiratory tracts. The animal's white blood cells and the antibodies developed throughout their lives effectively control infectious agents in the living body (Anon, 1995). A study by Haas (1990) revealed that these internal defense mechanisms are destroyed when blood is removed during harvesting. Initial microbial inoculation of meat results from the introduction of microorganisms into the vascular system when contaminated knives are used for exsanguination. The vascular (circulatory) system rapidly disseminates these microorganisms throughout the body. Contamination subsequently occurs by the introduction of microorganisms on the meat surfaces in operations performed during slaughtering, cutting, processing, storage, and distribution of meat. Other contamination can occur by contact of the carcass with the hide, feet, manure,

dirt, and visceral contents from punctured digestive organisms.

2.4.3.2 Poultry Products

According to Marriott (1990) poultry is vulnerable to contamination especially *Salmonella* and *Campylobacter* organisms during processing. The processing of poultry, especially defeathering and evisceration, permits an opportunity for the distribution of microorganisms among carcasses. Contaminated hands and gloves and other tools of processing plant workers also contribute to the transmission of salmonellae.

2.4.3.3 Seafood Products

Seafoods are excellent substrates for microbial growth and are vulnerable to contamination during harvesting, processing, distribution, and marketing (Shapton and Shapton, 1991). They are excellent sources of proteins and amino acids, B vitamins, and a number of minerals required in bacterial nutrition. Seafoods are handled extensively from harvesting to consumption. Because they are frequently stored for long periods of time without prior refrigeration, contamination and growth of spoilage microorganisms and microbes of public health concern can occur.

2.4.3.4 Adjuncts

Anon (1995) notes that ingredients (especially spices) are potential vehicles of harmful or potentially harmful microorganisms and toxins. The amounts and types of these agents vary with place and method of harvesting, type of food ingredient, processing technique,

and handling. The food plant management team should be aware of the hazards connected with individual incoming ingredients. Only supplies and materials gathered in accordance with recognized good practices should be used. This requirement also applies to control of testing of critical materials, either by the manufacturing firm, receiving establishment, or both.

2.4.4 OTHER CONTAMINATION SOURCES

2.4.4.1 Equipment

According to Marriotti (1990) contamination of equipment occurs during production, as well as when the equipment is idle. Even with hygienic design features, equipment can collect microorganisms and other debris from the air, as well as from employees and materials. A recommended way of reducing contamination of equipment is through improved hygienic design and more effective cleaning (leach *et al.*, 2001).

2.4.4.2 Employees

Kassa *et al.* (2001) affirm that employees are the largest source of all the viable means of exposing microorganisms to food. Employees who do not follow sanitary practices contaminate food that they touch, with spoilage and pathogenic microorganisms that they come in contact with through work and other parts of the environment. The hands, hair, nose, and mouth harbor microorganisms that can be transferred to the food during processing, packaging, preparation, and service by touching, breathing, coughing, or sneezing (Bryan, 1979). Because the human body is warm, microorganisms proliferate rapidly, especially in the absence of hygienic practices. According to Norton (2002) the

spread of bacteria from one location to another can be prevented after the chain of infection is broken. Figure 2.5 highlights various ways through which humans and food handlers in particular can contaminate food.

Figure 2.5: Potential contamination of food by humans (*Adapted from Principles of Food Sanitation p78*)

Generally, the mishandling of food by people perpetuates the chain of infection until someone becomes ill or dies before corrective actions are taken to prevent additional

outbreaks (Chao, 2003). If every person that handles food could achieve appropriate personal hygiene, food contamination could be minimized. Every employee involved with food manufacturing can play a very important role in preventing food contamination by adhering to recommended food safety practices.

2.4.4.3 Air and Water

Rushing (1992) postulates that water serves as a cleaning medium during the cleaning operation and is an ingredient added in the formulation of various processed foods. It can also serve as a source of contamination. If excessive contamination exists, another water source should be obtained, or the existing source should be treated with chemicals (such as ultraviolet units) or other methods (WHO, 2008). Contamination can result from airborne microorganisms in food processing, packaging, storage, and preparation areas. This contamination can result from unclean air surrounding the food plant or from contamination through improper sanitary practices. The most effective methods of reducing air contamination are through sanitary practices, filtering of air entering the food processing and preparation areas, and protection from air by appropriate packaging techniques and materials (Haas, 1990).

2.4.4.4 Sewage

Raw, untreated sewage can contain pathogens that have been eliminated from the human body, as well as other materials of the environment. Examples are microorganisms causing typhoid and paratyphoid fevers, dysentery, and infectious hepatitis. Sewage may contaminate food and equipment through faulty plumbing (Haas, 1990). If raw sewage

drains or flows into potable water lines, wells, rivers, lakes, and ocean bays, the water and living organisms such as seafood are contaminated. Rushing (1992) opines that privies and septic tanks should be sufficiently separated from wells, streams, and other bodies of water in order to prevent this contamination,. In his study of use of municipal-treated sewage for irrigation purpose in Canada, Haas (1990) notes that raw sewage should not be applied to fields where fruits and vegetables are grown.

2.4.4.5 Insects and Rodents

Flies, rodents and cockroaches are associated with living quarters, eating establishments, and food processing facilities, as well as with toilets, garbage, and other filth. According to Feachem (1983) these pests transfer filth from contaminated areas to food through their waste products; mouth, feet, and other body parts; while the regurgitation of filth onto clean food during consumption. Mitchell *et al.* (2007) recommend that serving areas should be protected against the entry of in order to stop contamination.

2.5 PROTECTION AGAINST CONTAMINATION

2.5.1 The Environment

According to Paez *et al.* (2007) foods should not be touched by human hands when consumed uncooked or after cooking, if such contact can be avoided. If contact is necessary, workers should thoroughly wash their hands prior to and periodically during the time that contact is necessary. Contact with hands can be reduced by the use of disposable plastic gloves during food processing, preparation, and service (Mitchell *et al.*, 2007). Morriott (1990) recommends that processed or prepared food, either in storage or

ready for serving or holding, should be covered with a close-fitting clean cover that will not collect loose dust, lint, or other debris. If the nature of the food does not permit this method of protection, it should be placed in an enclosed, dust-free cabinet at the appropriate temperature (Anon, 1995). Foods in small modular wrappers or containers, such as milk and juice, should be disposed of directly from those wrappers or containers. If foods are served from a buffet, they should be presented on a steam table or ice tray, depending on temperature requirements, and should be protected during display by a transparent shield over and in front of the food. The shield will protect the food against contamination from the serving area (including ambient air), from handling by those being served, and from sneezes, coughs, or other employee- and customer-originated contamination. Any food that has touched any unclean surface should be cleaned thoroughly or discarded. Equipment and utensils for food processing, packaging, preparation, and service should be cleaned and sanitized between uses. Foodservice employees should be instructed to handle dishes and eating utensils in such a way that their hands do not touch any surface that will be in contact with food or the consumer's mouth.

2.5.2 Storage

According to Shapton and Shapton (1991) storage facilities should provide adequate space with appropriate control and protection against dust, insects, rodents, and other extraneous matter. Organized storage layouts with appropriate stock rotation can frequently reduce contamination and facilitate cleaning, and can contribute to a tidier operation. In addition, storage area floors can be swept or scrubbed and shelves and/or

racks cleaned with appropriate cleaning compounds and subsequent sanitizing. Trash and garbage should not be permitted to accumulate in a food storage area.

2.5.3 Litter and Garbage

The food industry generates a large volume of wastes: used packaging materials, containers, and waste products. Refuse should be placed in appropriate containers for removal from the food area so as to reduce contamination. The preferred disposal method (required by some regulatory agencies) is to use containers for garbage that are separated from those for disposal of litter and rubbish (Worsfold and Griffith, 2003). Clean, disinfected receptacles should be located in work areas to accommodate waste food particles and packaging materials. According to Jacob and Powell (2009) these receptacles should be seamless, with close-fitting lids that should be kept closed except when the receptacles are being filled and emptied. Plastic liners are inexpensive and provide added protection. Haas (1990) recommends that all receptacles be washed and disinfected regularly and frequently, usually daily. Containers in food processing and food preparation areas should not be used for garbage or litter, other than that produced in those areas.

2.5.4 Toxic Substances

Scott (2003) hints that poisons and toxic chemicals should not be stored near food products. In fact, only chemicals required for cleaning should be stored on the same premises. Cleaning compounds should be clearly labeled. Only cleaning compounds, supplies, utensils, and equipment approved by regulatory or other agencies should be used

in food handling, processing, and preparation.

2.5.5 Environmental Microbiological Monitoring

According to Olsen *et al.* (2000) organizations involved in food handling should employ environmental monitoring as a means of

- **Monitoring the general levels of hygiene within the environment in question.**

The monitoring of the general level of hygiene provides an overall impression of the level of cleanliness within the test environment – it measures the efficiency of the general cleaning and sanitation procedures in place and their ability to remove food residues and transient microorganisms. A variety of methods are available to achieve this task, including general physical inspections, ATP Monitoring Systems and the detection of the presence of food residues (generally protein).

- **Environmental microbiological monitoring for the presence of specific pathogens within the processing environment.**

The detection of specific pathogens serves two important roles:

- a. It highlights the presence of important food pathogens which may have been introduced into the food handling environment generally through human contact or from raw ingredients, but which may not have been eliminated by routine cleaning and sanitation procedures.
- b. Secondly, it highlights the sources of these pathogens that may be resident in the

environments being tested.

Microbiological environmental monitoring should be used to indicate either unacceptable conditions or practices which in turn should aid in controlling pathogenic bacteria such as *Salmonella* and *Listeria*. The presence of coliforms may also be valuable as they will provide an indication of the general levels of microbiological cleanliness within test environments.

2.6 FOOD HYGIENE AND SANITATION

When working conditions, personal hygiene and tools used by food handlers are not favorable, food poisoning occurs (Cruz *et al.*, 2001). The staff should pay attention to the surfaces of the tools used for food and beverages' preparation and of cooking and service fields, and to the cleanliness of their hands, body and clothing in order to prevent the transition of pathogen microorganisms to the food (Shapton and Shapton, 1991). Some of the worst habits the staff working in food and beverage sector have include touching prepared food with fingers, playing with his nose, scratching their head and their acnes, tasting food with unwashed and dirty spoons, not washing their hands after touching their nose and mouth, using food preparation sinks for washing hands, and touching the inside of plates and glasses with their hands (Jones and Angulo, 2006). It is obligatory, in terms of consumer health, that the kitchen staff working for hotels and holiday villages, wherein more than 1,000 people eat simultaneously, must know some hygiene and sanitation rules, and obey them in order to prevent consumers from being food poisoned. Food handler training is seen as one strategy whereby food safety can be increased, offering long-term benefit to the food industry and sector (Worsfold and Griffith, 2003).

According to Green and Selman (2005) there are four main ways of preventing food contamination: ensuring food areas are clean, ensuring that good standards of personal hygiene are maintained, cooking foods thoroughly, and keeping foods at the right temperature.

2.6.1 Personal hygiene

Food can be contaminated during the handling process. Green (2008) opines that it is important to wash hands during the following critical moments: before handling food; before eating, before feeding children; after touching raw food, especially raw meat, poultry and vegetables; after going to the toilet; after changing a baby's diaper

2.6.2 Temperature control

Feachem (1983) postulates that proper cooking kills food poisoning bacteria such as *salmonella*, *campylobacter*, *E.coli* O157, *Vibrio cholerae* and other *Vibrio* species. Good temperature control is essential to keep certain foods safe. Products such as prepared ready-to-eat foods, cooked foods, smoked meat or fish, and certain dairy products must, be kept hot or chilled until they are served. If they are not, harmful bacteria could grow or toxins (poison) could form in the food and make the consumer ill. According to Byan *et al.* (1971) chilled food must be kept at or below 8°C were as hot food must be kept above 63°C. When poultry, pork, minced/chopped meat and rolled joints are cooked, one should make sure that the centre of the meat reaches a temperature of at least 70°C for two minutes, or an equivalent time/temperature combination (Frean *et al.*, 2003). In the

absence of a thermometer, for cooked meats and poultry make sure that the juices are clear and no parts of the meat are red or pink. Patil *et al.* (2005) in their study on food safety practices in restaurants recommend that cooked food is consumed immediately warn consumers and food handlers against leaving food at room temperature longer than 2 hours, and thawing frozen food at room temperature.

2.6.3 Proper hand washing

Slade (2002) affirms that in order to wash hands properly, clean water and soap should be used. However, Slade (2002) advises on the alternative use other means such as wood ashes or dilute bleach in cleaning hands prior to handling food. Furthermore, alcohol hand rubs may be used to sanitize the hands where water is not readily available. Chao (2003) asserts that food handlers should work up a good lather and make sure they wash wrists, hands, fingers, thumbs, fingernails, and in between the fingers. According to Chao (2003) food handlers should then rinse the soap off their hands and dry them thoroughly using a clean disposable towels or papers.

2.7 CAUSATIVE AGENTS OF FOODBORNE DISEASES

A foodborne disease is considered to be any illness associated with or in which the causative agent is obtained by the ingestion of food where as food poisoning is considered to be an illness caused by the consumption of food containing microbial toxins or chemical poisons (Scott, 2003). Food poisoning caused by bacterial toxins is called *food intoxication*; whereas, that caused by chemicals that have gotten into food is referred to as *chemical poisoning*. Illnesses caused by microorganisms exceed those of chemical origin

(Frean *et al.*, 2003). Illnesses that are not caused by bacterial by-products, such as toxins, but through ingestion of infectious microorganisms, such as bacteria, rickettsia, viruses, or parasites, are referred to as *food infections*. Foodborne illnesses caused from a combination of food intoxication and food infection are called *food toxicoinfections*. Illness caused by the mind, due to one witnessing another human sick or to the sight of a foreign object, such as an insect or rodent, in a food product, is termed *psychosomatic food illness*. A *foodborne disease outbreak* is defined by Olsen *et al.* (2000) as two or more persons experiencing a similar illness, usually gastrointestinal, after eating a common food, if analysis identifies the food as the source of illness.

According to Bean *et al.* (1996) approximately 66% of all foodborne illness outbreaks are caused by bacterial pathogens. Bean *et al.* (1996) affirm that of the 200 foodborne outbreaks reported each year in the United States, approximately 60% are of undetermined etiology. Unidentified causes may be from the *Salmonella* and *Campylobacter* species, *Staphylococcus aureus*, *Clostridium perfringens*, *Clostridium botulinum*, *Listeria monocytogenes*, *Escherichia coli* O157, *Shigella*, *Vibrio*, and *Yersinia enterocolitica*, which are transmitted through foods. A wide variety of home-cooked and commercially prepared foods have been implicated in outbreaks, but they are most frequently related to foods of animal origin, such as poultry, eggs, red meat, seafood, and dairy products (Norton, 2002). Norton (2002) postulates that acute outbreaks are more often produced by toxins from bacteria such as *Staphylococcus* spp., *Clostridium perfringens*, *Salmonella* spp. and *Vibrio cholerae*. Food poisoning can also be caused by chemicals or heavy metals, such as copper, cadmium or zinc, or by shellfish toxins.

Manes *et al.* (2013) opine that to provide protection against foodborne illness, it is necessary to have up-to-date knowledge of production, harvesting, and storage techniques to accurately evaluate the quality and safety of raw materials. Thorough knowledge of design, construction, and operation of food equipment is essential to exercise control over processing, preservation, preparation, and packaging of food products. An understanding of the vulnerability of food products to contamination will help establish safeguards against food poisoning.

According to Frean *et al.* (2003) the following pathogenic bacteria are responsible for the vast majority of cases of food poisoning:

- *Campylobacter* is found in raw and undercooked poultry; other sources include red meat, unpasteurized milk and untreated water. Food can be contaminated by improper handling and poor hygiene.
- *Salmonella* - main sources are poultry, and red meat, unpasteurised milk and raw egg products. Food can be contaminated by improper handling and poor hygiene.
- *Clostridium perfringens* – a spore forming bacteria found in meat and poultry and their products. Contamination occurs due to inadequate cooking, reheating, cooling and lack of refrigeration. This allows surviving spores to develop and cause food poisoning.
- *E. coli* O157:H7 is often found on undercooked minced beef and unpasteurised milk. Outbreaks have also involved sprouted seeds, unpasteurised fruit juices,

- leafy greens and cheese. It particularly affects the very young and the very old.
- *Listeria monocytogenes* is widespread in the environment and so is commonly present in many raw foods and ingredients. It is ubiquitous and is associated with certain chilled ready-to-eat foods such as pates, soft cheeses and sliced cooked meats. It especially affects people over 60 and pregnant women.

2.7.1 Changes in Foodborne Pathogens

There have been many changes in the microorganisms that cause foodborne illnesses. Scientists have observed more virulent strains of organisms, where a few cells can cause severe illness. An example is *S. enteritidis* and *E. coli* 0157:H7. According to Mitchell *et al.* (2007) adaptive stress responses have also been observed where organisms have adapted to environmental conditions to survive and grow, such as psychrotropic pathogens that grow slowly at refrigerated temperatures. Organisms such as *Yersinia enterocolitica*, *L. monocytogenes*, and *Clostridium botulinum* type E are examples of bacteria capable of growing at refrigerator temperatures (Green and Salman, 2005). Jacob and Powell (2009) note that in recent years increased resistance to antibiotics has been observed in *Salmonella typhimurium* DT104. A number of outbreaks in produce and unpasteurized apple cider have been caused through the protozoan parasites *Cyclospora cayetanensis* and *Cryptosporidium parvum*.

2.8 AN OVERVIEW OF DIFFERENT RESTAURANT TYPES

Scott (2003) defines a **fast food restaurant**, also known as a **quick service restaurant (QSR)** within the industry, as a specific type of restaurant characterized both by its fast

food cuisine and by minimal [table service](#).

Fast food outlets have become popular with consumers for several reasons. One is that through economies of scale in purchasing and producing food, these companies can deliver food to consumers at a very low cost. In addition, although some people dislike fast food for its predictability, it can be reassuring to a hungry person in a hurry or far from home

There are many different restaurant types. New restaurants open all the time, and concepts vary from pizza chains to fine sushi restaurants to breakfast cafes and even restaurants that specialize in peanut butter and jelly sandwiches. Despite the broad range of restaurant concepts, most are classified by one of three major restaurant types, including full-service, fast-casual and quick-service (Marriott and Gravani, 2006).

2.8.1 Full-Service Restaurants

According to Scott (2003) full-service restaurants encapsulate the old-fashioned idea of going out to eat. These restaurants invite guests to be seated at tables, while servers take their full order and serve food and drink. Full-service restaurants are typically either fine dining establishments or casual eateries, and in addition to kitchen staff, they almost always employ hosts or hostesses, servers and bartenders (Marriott and Gravani, 2006). Two standard types of full-service operations include fine dining and casual dining restaurants, discussed below.

- **Fine Dining**

According to Scott (2003) fine dining restaurants are top the ladder when it comes to service and quality. Fine dining restaurants usually gain perceived value with unique and beautiful décor, renowned chefs and special dishes. Listed below are some of the features, challenges and advantages of running a fine dining restaurant.

Wilson *et al.* (1997) observe that service style for fine dining restaurants is top-notch. Well-trained and experienced servers and sommeliers attend guests, providing excellent knowledge of food and wines (Scott, 2003). The atmosphere in a fine dining establishment is one of the keys to its perceived value. The lights need to soften the mood, the music should reflect the concept yet not overpower the guests' conversations, and the décor should add an elegant and unique perspective. Fine dining establishments strive to create an overall exceptional dining experience for guests.

Norton (2002) highlights that one advantage of running a fine dining restaurant is that managers and servers are frequently experienced and committed to making their careers in fine dining establishments. For instance, managers typically require five to seven years of experience as well as immense knowledge of food and wine. Chefs need to be experienced as well, perhaps even requiring a culinary degree. Celebrated chefs will also give a fine dining restaurant the upper-hand when it comes to quality food and artistic presentation.

Fine dining restaurants probably face their biggest challenges in poor economic times. People who do not feel that they can afford to eat at upscale restaurants often cut them out

of the budget. Fine dining restaurants must constantly maintain an elevated level of service and quality in every aspect, from dinner service to food presentation to restroom cleanliness.

- **Casual Dining Restaurants**

This is another type of full service eatery is casual dining restaurants which according to Norton (2002) are typically more affordable and often geared toward families. Casual dining restaurants offer full table service but the décor, food and service is usually less remarkable than a fine dining establishment.

In casual dining restaurants, guests are seated by a host or hostess while servers help explain menu items and take orders. Service style for casual dining restaurants is usually not as formal as fine dining service. Servers may act more casually around diners, but guests still expect professionalism and service throughout the meal. The casual restaurant atmosphere is often family-friendly, with decorations adorning the walls, or themed posters and colorful paint and booths. Like fine dining restaurants, casual eateries can specialize in a certain regional cuisine or a fusion of several dishes. The menu and concept usually determine the atmosphere.

Casual dining restaurants have an advantage in that they are often able to attract a wider customer base than fine dining restaurants. Casual restaurants are especially appealing as they are more accessible for families with children.

Casual dining restaurants may find challenges in keeping up with competitors. They compete both with fine dining restaurants and fast-casual places, depending on subtleties

in menu pricing and atmosphere. Fast-casual restaurants do well to differentiate themselves from their competitors to try and attract customers. They should put their marketing efforts toward promoting the ways in which they are unique, special and better than the competition.

2.8.2 Fast-Casual Restaurants

According to Marriott and Gravani (2006) the term fast-casual is relatively modern terminology for a restaurant that falls between full-service and quick-service. Also called quick-casual and limited-service, these types of restaurants are typically distinguished by service type and food quality. Fast-casual restaurants are often perceived to offer better quality food and a more upscale dining area than quick-service restaurants, but with less expensive menu items than full-service restaurants. Fast-casual establishments try to settle within the \$7 to \$10 range, and usually specialize a few menu items or combination menu items, such as an overstuffed burrito for \$7 or a sandwich, side and drink for under \$10 (Jones and Angulo, 2006).

2.8.2.1 Service style in Fast-Casual Restaurants

Guests will often walk up to a service counter where they will choose menu items from a menu board and place their orders with a cashier. The guests may also choose their food first, perhaps walking along an assembly line for their sandwich or burrito, and then pay when they receive the food. Like quick-service, speed and convenience are important aspects of fast-casual restaurant concepts, although fast-casual restaurants arguably demonstrate better quality food and service than fast-casual restaurants.

2.8.2.2 Challenges in Fast-Casual Restaurants

Unlike full-service restaurants, fast-casual restaurants experience a good deal of turnover. Frequent management change can bring a restaurant's success crashing down, since workers do not see the level of commitment more often seen in full-service restaurants. According to studies during a three year period, sub shops and fast-casual pizza joints saw some of the most turnover of any other restaurant type.

2.8.2.3 Advantages of Fast-Casual Restaurants

The fast-casual concept as a whole has a lot of strong advantages over other restaurant types. For example, the idea of fast-casual has a lot of wiggle room. It can be a totally organic eatery, or showcase a certain regional fare, or even stick to the classics, all while attracting customers with affordable menu prices (Anon, 1995). Fast-casual restaurants are extremely versatile. Since many obtain liquor licenses, they attract a large portion of the adult clientele, but still cater to families and students. Many also believe fast-casual restaurants provide more healthful food than what quick-service restaurants have to offer.

2.8.3 Quick-Service Restaurants

Quick-service is the term for restaurants that capitalize on speed of service and convenience (Shapton and Shapton, 1991). Fast-food restaurants often fall under the umbrella of quick-service restaurants, but not all quick-service places serve fast-food. Quick-service restaurants are characterized by simple décor, inexpensive food items and speedy service.

2.8.3.1 Service style in Quick-Service Restaurants

According to Green (2008) service style at quick-service restaurants typically includes a service counter with one or more cashiers working to take orders. Customers order off a menu board hanging on the wall or from the ceiling. It is not unusual to see a drive-through at a quick-service restaurant. In comparison to full-service restaurants, quick-service establishments generally have simpler dining areas with fewer decorations (Anon, 1995). However, quick-service chains in particular often strive to achieve a very specific, individual "look and feel" in their restaurants. For example, Jamba Juice chains paint their walls and hang posters that comply with a very specific color palette and theme, and every store is required to play specific music every month.

2.8.3.2 Advantages of Quick-Service Restaurants

Quick-service restaurants often succeed in a big way because of speed of service and overall consistency (Marriott, 1990).

2.8.3.3 Challenges for Quick-Service Restaurants

Like fast-casual restaurants, quick-service restaurants experience a good deal of turnover. Frequent ownership and management change coupled with an overwhelmingly young workforce tend to increase general turnover rates. Coffee shops, which are popular quick-service restaurant concepts, are a good example. Statistics from a recent three-year study show that coffee shops experience a three-year cumulative ownership turnover rate of 70 percent (Leach et al., 2001).

2.9 FOOD CONTROL SYSTEMS

According to FAO (2005) food control refers to the systematic set of activities carried out by food producers, processors, retailers and national or local authorities in an effort to provide consumers protection against food poisoning and unscrupulous food traders. Food control ensures that all foods produced in or imported into the country conform to national food safety requirements. The food control system therefore consists of food legislation, a food inspection department, food analysis facilities (laboratories), and information dissemination and management (Marriott and Gravani, 2006).

Laboratories are the backbone of all food control systems. In order to meet the requirements prescribed by international standards, laboratories should have state-of-the-art equipment as well as qualified and well trained manpower to operate such equipment. Laboratories used for food control, especially those for export inspection and certification services, require accreditation as per international standards (FAO, 2005). Sufficient numbers of qualified personnel in food science, technology, biochemistry microbiology, chemistry etcetera. are also required.

Food control laboratories are required to communicate effectively with all stakeholders along the food chain, including government bodies, research and academic institutions, the food production and processing sector and consumers (Clayton *et al.*, 2002). An informed and active public and knowledgeable industry are cornerstones to effective risk management. Patil *et al.* (2005) aver that communication and knowledge are the only ways to deal effectively with consumer concerns and fears. Transparent systems and procedures are required to ensure that consumers and other stakeholders are properly informed on both sporadic cases of food-borne illness and food safety emergencies

(WHO, 2008). The procedures for managing such risks should involve all stakeholders. This also applies to routine food safety matters which will require easy-to-understand summaries on current matters for public distribution.

Scott (2003) postulates that an especially important role of the food industry is communication with consumers. The industry widely uses integrated communication including advertising, marketing and product promotion. Product labeling is another means of communication that allows the consumer to make informed decisions on products. Labels must therefore avoid making false and misleading health claims. Advertising and labeling must not only be used as one-way communication systems but must allow informed consumer feed-back to food producers and distributors.

Assuring food safety along the entire food chain requires partnerships and education at all levels especially consumer education (FAO, 2005). Training is an essential element of the implementation of Hazard Analysis and Critical Control Points (HACCP) and all other activities involved in producing safe food. In order to achieve this result, all those employed in food production must be thoroughly trained in their responsibilities (Worsfold and Griffith, 2003). In particular, the management should be conscious of the risks associated with the food business and must take adequate steps to mitigate such risks. The application of Good Hygienic Practices (GHPs) using the Codex Code of Principles of Food Hygiene as well as other Codex specific guidelines for certain foods must be applied (FAO, 2005).

2.9.1 Food control systems in Africa

According to WHO (2005) the informal food distribution sector in many African countries, often escapes formal inspection by regulatory authorities, mainly because most vendors operate without licenses and from un-designated places. Many of the vendors are itinerant, moving from one site to another. In some countries, such as Kenya, Malawi, Mozambique, Zambia and Zimbabwe, vendors operating from undesignated places are forcefully removed from the vending sites, mainly because their activities violate existing laws governing the sale of food (Mosupye and Von Holy, 1999). However, in many African countries, food control programmes still need to be strengthened.

The WHO Regional Office also recorded several outbreaks associated with contaminated food including: anthrax in Zimbabwe, typhoid fever and botulism in Uganda, chemical intoxication due to consumption of seed beans and maize in Nigeria, pesticide residues from cabbage and other vegetables in Senegal, konzo from bitter cassava in the Democratic Republic of Congo and food poisoning and diarrhoeal diseases in many other countries.

In 2002, WHO conducted an assessment of the status of food safety programmes in the African Region and collected data on the availability of food safety acts and their coverage, food inspection systems, mechanisms for monitoring of food exports and imports, surveillance systems for food-borne diseases and microbiological monitoring, manpower development and public education. The findings from 28 responding countries in the WHO African Region showed significant gaps in national food laws and inadequate linkages between strategies to ensure food safety. The study by Chi (2002) further showed that a limited number of countries had legislation that adequately tackled

current and emerging food safety problems in relation to pesticide residues, food additives, contaminants and biotoxins. Twenty-two of the responding countries had an Act or Ordinance governing food safety standards and regulations, however, only 12 countries found existing legislation satisfactory. Countries that had Food Acts and regulations often lacked complete and effective food control infrastructure, as well as institutional capacities to ensure compliance and to provide consumer protection. Existing laws were often outdated, traditionally prescriptive and fail to adequately address the whole range of food safety concerns. Studies by other international organizations identified similar problems associated with food legislation, regulations, laboratory, inspection and monitoring services, administration of food control, manpower development as well as funding of food safety programmes.

In Mozambique, the Food Safety Unit is under the Department of Environmental Health within the Ministry of Health and is responsible for regulation, standards etcetera (Mosupye and Von Holy, 1999). The main partners of the Ministry of Health in the area of food control are the Ministries of Agriculture, Commerce, Fisheries and the National Institute of Normalization and Quality. In Malawi, the Ministry of Health and Population, Ministry of Local Government, Malawi Bureau of Standards and Consumer Association of Malawi are responsible for the implementation of Food Laws (Mosupye and Von Holy, 1999). The Food Control Unit in Botswana is under the Community Health Services Division in the Ministry of Health while in the Comoros, the Ministry of Environment and Ministry of Agriculture are responsible for the implementation of food policy. In the Democratic Republic of Congo, through several decrees, the Ministry of Agriculture is

responsible for animal health, the Ministry of Health for food safety and hygiene at the borders, the Ministry of External Trade for export and import inspection and the Ministry of Justice for food regulation (Mosupye and Von Holy, 1999).

Maxwell et al.(1998) points out that the Ghana Food and Drugs Law (PNDC Law 305 B) and Amendment Act 523 seeks to ensure that only safe and wholesome food, drugs and other substances are made available for public consumption. The production and sale of food is governed by food standards established and promulgated by the Ghana Food and Drugs Board of the Ministry of Health (Maxwell *et al.*, 1998). There are regulations and by-laws to control food hygiene and the Metropolitan Medical Officer has the vested authority for their enforcement. The Ghana Standards Board, the Ministries of Agriculture and Trade as well as Customs and Excise are all involved in food safety. Identical systems are in operation in Benin, Central African Republic, Liberia, Nigeria, Tanzania and Zimbabwe.

According to Otto *et al.* (2011) activities for food safety and control in Uganda, as in many other countries, are uncoordinated and scattered in Ministries and are implemented by different agencies and authorities whose mandates are provided for under different laws and regulations. The Ministry of Health is the custodian of food legislation and has two agencies with food safety functions. The Department of Environmental Health coordinates food safety matters and supervises the semiautonomous Local Government Units, which employ health and food inspectors.

The Department of Health, the Department of Agriculture, and the South African Bureau

of Standards, are the key stakeholders in food control in South Africa. For day-to-day implementation, the food control system operates at the national, provincial and local levels. An evaluation of the system in 1995 revealed that it was impossible to determine which department represented the country in food control policy. The evaluation recommended the creation of a new modern, effective and internationally recognized food control system. There is general consensus on the way forward but high level acceptance and approval for implementation is still awaited.

In order to overcome the problems associated with fragmentation of food control systems and the lack of collaboration between sectors some countries have established modern and effective single food control agencies that are internationally recognized or national food control authorities with inter-ministerial and interdepartmental representation. The Kingdom of Morocco has established and transferred all food control functions to a single government department called l'Agence du contrôle de la qualité de la sécurité sanitaire des aliments (ACQSA). The establishment of ACQSA yielded several benefits including the modernization of the food control system, improvements in the efficacy of risk analysis, efficient use of material and financial resources as well as increased visibility and credibility.

Certain countries, for example Ethiopia, Senegal and the Gambia are in the process of establishing national food control authorities. In Ethiopia, the lead government institutions responsible for food safety include the Ministry of Health, Ministry of Agriculture and Rural Development, Quality and Standards Authority of Ethiopia, Ministry of Trade and Industry and the Ethiopian Manufacturing Industries Association

(Otto *et al.*, 2011). These institutions work together in organizing training workshops, standard setting and drafting regulations. Since 2002, these bodies have established a Technical Committee that implements food safety assurance systems in accordance with the international market requirements supported by the United Nations Industrial Development Organization (UNIDO). However, coordination of activities at the lower level of the hierarchy remains to be established and strengthened. Responsibilities and mandates are not clearly defined demarcated and streamlined, resulting in insufficient coordination of activities, duplication of efforts, misuse of human resource and wastage of meagre resources allocated to the sectors. In order to overcome these problems, the existing Ethiopian Technical Committee has established the National Food Safety Council whose members are drawn from regulatory bodies, research institutes, industry, consumers and higher learning institutes involved in food safety. Similarly in the Gambia, a Council on Nutrition was formed which embraces all the agencies involved in food safety and is directly under the Office of the President (Otto *et al.*, 2011). In Sierra Leone, the Bureau of Standards in the Ministry of Health is the National Codex Contact Point and works collaboratively with all food safety stakeholders through a number of technical committees, namely, Animal and Animal Products, Plant and Plant Products, General Purpose and Special Committees (Otto *et al.*, 2011). All the agencies involved in food safety work collaboratively with the police on a nation-wide campaign on expired products.

2.9.2 The food supply chain in Zimbabwe

According to Slade (2002) food may be a silent vehicle for microbial, chemical

and physical hazards. There is concern about transmission of multiple antimicrobial resistant bacteria via the food chain. Several devastating outbreaks of foodborne diseases have been reported in the African Region.

Ensuring food safety requires action and cooperation of all individuals involved in the food supply chain from suppliers of agricultural inputs to those preparing food at domestic level (FAO, 2005). This is aptly conveyed by the expressions, “from stable to table and from the field to the plate.” Figure 2.6 shows the food supply chain for Zimbabwe. According to FAO (2007) it is important that a country takes measure at each of the five stages of the food supply chain in order to have a holistic approach to the issue of food safety. However, in Zimbabwe like in most developing countries, there is less focus on food safety at stages 1 to stage 3. It is in stages 4 and 5 where most food borne diseases occur as a result of incorrect handling and preparation of foods (FAO, 2007). In Zimbabwe various organizations are involved in food safety at different levels of the food supply chain. A number of different pieces of legislation are used by different organizations to ensure food safety although the activities are fragmented. (FAO/WHO, 2005).

Food Supply Chain

- Supply of Agricultural Inputs:



Figure 2.6: The food supply chain in Zimbabwe adapted from FAO/WHO (2005).

2.9.3 Food Inspection in Zimbabwe

The Ministry of Health and Child Care and local authorities have environmental health officers (EHOs) who conduct food inspections in various parts of the country. They are empowered by the Public Health Act Chapter [15:09] and the Food and Food Standards

Act Chapter [15:04] to inspect premises where food is sold or prepared and to collect food samples (World Health Organization, 2009). They also monitor imported and exported food. The EHOs work under the Provincial Medical Directors (PMD) in provinces and under medical officers of health in towns.

Food samples are sent to the Government Analyst Laboratory where tests and analyses are carried out. According to WHO (2009), the Government Analyst Laboratory although under the Ministry of Health and Child Care (MoHCC) operates independent of the PMDs and City Health Departments. Health inspectors pay occasional visits to food industries for routine inspections. They collect samples of food and send them to the Government Analyst Laboratory for analysis to determine compliance with the Food and Food Standards Act. The prosecution chain is however a let down. Either it is very long and the penalty is negligible or such prosecutions are not publicized. Prosecutions if publicized will serve as deterrence to would be offenders. There is need to impose deterrent penalties on offending companies. The Ministry of Health and Child Care is in the process of drafting food hygiene legislation for all those involved in food manufacture and sale.

Recently, the food control authorities in Zimbabwe noted that their duties were being hampered by fragmentation of food laws and lack of coordination between food control departments. In addition, some of the laws and regulations are outdated and do not effectively address new trends, especially street food vending. Therefore, efforts to create a Food Control Authority that would administer the Zimbabwe Food Control Act are at

an advanced stage. Similar fragmentation was observed in South Africa and the creation of a food control agency has been investigated as a way of addressing such fragmentation.

2.9.4 Aspects of food legislation

Legislation exist the world over, to help prevent food poisoning and those who subject the consumer to risk can be punished. However, food poisoning continues to cause considerable illnesses even today. Unfortunately, most cases of food poisoning arise through carelessness and it is not easy to isolate the actual cause of sickness. It requires investigations to question the food handlers about their methods of operation from raw materials to finished products in order to trace the source of infection.

According to Mosupye and Von Holy (1999), in the African Region, basic food laws may not be incorporated into legislation, or they may be outdated, fragmented, or simply inadequate. Often, the legal structure can be confusing for the enforcement agents, producers, and distributors. There are many ministries or departments involved in food safety activities, causing overlap, duplication of efforts, and gaps in enforcement. Sometimes, it is impossible to determine which department represents the countries on food control policy. But progress is being made in that area. In 2004, for example, a unified food safety agency was created in Madagascar, the “Unité de Contrôle de Qualité des Denrées Alimentaires”. Food regulation systems in Africa are often based on laws adopted during colonial times. Those systems were introduced on an ad hoc basis to deal with problems of particular interest to the colonial administrators and have not been updated in many countries. Most African countries have made some attempts to revise

outdated food laws. For instance, in Mauritius, a new Food Act was passed in June 1998 (to replace the former act of 1940) and became operational in January 2000. But the act was criticized by the food industry for not meeting international norms.

2.9.5 Food Legislation in Zimbabwe

Recently, the food control authorities in Zimbabwe noted that their duties were being hampered by fragmentation of food laws and lack of coordination between food control departments. In addition, some of the laws and regulations are outdated and do not effectively address new trends, especially street food vending. Therefore, efforts to create a Food Control Authority that would administer the Zimbabwe Food Control Act are at an advanced stage. Similar fragmentation was observed in South Africa and the creation of a food control agency has been investigated as a way of addressing such fragmentation.

Table 2.0: Institutional and legal tools used to monitor food safety at different levels in Zimbabwe adapted from FAO/WHO (2005)

Stage of food supply	Potential hazard	Monitoring/ Regulatory body	Legislation used
– Agricultural inputs <ul style="list-style-type: none"> • Pesticides • Fertilizers • Veterinary drugs 	<ul style="list-style-type: none"> • Contaminated water, pastures, GM inputs • Banned pesticides • Residual drugs 	<ul style="list-style-type: none"> • Biosafety Board of Zimbabwe • R and SS Hazardous substances (MOHCC), GAL 	-Research Amendment Act 1998 - Public Health Act Ch 15:09
Primary Production	Biological in GM foods	Biosafety Board of Zimbabwe	Research Amendment Act

Primary food processing	Physical, biological, chemical	MOHCC (Environmental Health Dept), GAL, Local authorities	Public Health Act Ch 15:09
Secondary Food Processing	Physical, biological, chemical	Local authorities, MOHCC	Food and Food Standards Act
Food distribution	Physical, biological, chemical	MOHCC (Port Health Dept) Local authorities, GAL, Biosafety Board of Zimbabwe	<ul style="list-style-type: none"> • Public Health Act Ch15:09 • Food and Food Standards Act Ch 15:04 • Research Amendment Act
Retailing and catering	Physical, biological, chemical	MOHCC (Environmental Health Dept), Local Authorities, GAL	Public Health Act, Food Standards Act, By-Laws

GAL – Government Analyst Laboratory

GM – Genetically Modified

MOHCC – Ministry of Health and Child Care

R and SS – Research and Specialist Services

The table above shows that emphasis is placed on monitoring some primary food processing and most food distribution and catering of unprocessed and processed food.

2.9.6 Challenges to food control activities in Africa

A number of studies have revealed that food control activities in African countries have been hampered by a number of factors, including: inadequate or out of date food legislation, ill-equipped food inspectorates, inadequate laboratory facilities, poor management, and lack of coordination and cooperation among government food control agencies.

According to Otto et al. (2011) the Uganda Public Health Act, Section 109, (The Eating Houses Rules) establishes the minimum requirements for and practices in public eating places. It also empowers authorized officer(s) to license eating places and to revoke the license where a violation has taken place. On the other hand, the Food & Drug Act requires that every food vendor be registered and that food sold to the public is fit for human consumption. It also empowers the authorized officer to inspect premises and sample foods for analysis.

In West Africa, the situation regarding regulation and control of restaurant foods is not satisfactory. In countries such as Benin and Senegal, legislation and various regulations have been adopted to regulate the production and sale of restaurant foods (FAO, 2007). These regulations establish official requirements for an operator to be licensed, conditions and practices required for the production and sale of restaurant foods, penalties for fraud and other infractions, and institutions and staff in charge of food control. However, quality and safety standards required for restaurant foods have not been specifically defined in these regulations.

In many African countries, the lack of resources does not allow some institutions to carry out their control, education and enforcement tasks efficiently. This constraint has been cited in Benin, Burkina Faso and Togo (Chi, 2002). A similar situation has been reported in Malawi and Mozambique. In some countries such as Senegal and South Africa (Ethekewini Municipality), achievements in food control activities in the restaurant food sector have been significant. These achievements have been attributed to good

organization, availability of well trained staff and consumer awareness.

2.9.7 Conclusion

In conclusion, the global, regional and local perspective of food handling practices, legislation, food control systems and accompanying data on the epidemiology of foodborne diseases was given. The connection between unsafe food handling practices and resultant contamination of food was clearly outlined. However, there remains a gap in knowledge on comparative food handling practices employed in registered and unregistered restaurants around the world as most researchers focused on either of the two in their studies.

CHAPTER THREE

MATERIALS AND METHODS

3.0 INTRODUCTION

This section of the research outlines the work plan; the instruments used in carrying out investigations and a description of the activities necessary for objectives and research questions to be answered.

3.1 RESEARCH DESIGN

Finn and Jacobson (2008) define scientific research as systematic, controlled, empirical,

and critical investigation of natural phenomena guided by theory and hypotheses about the presumed relations among such phenomena. The researcher made use of employed qualitative and quantitative methods to gather and synthesize data on common food handling practices among food workers in Mutare (Creswell and Plano, 2007). A cross sectional study on the prevailing food handling practices employed in both registered and unregistered restaurants was conducted using both qualitative (inquiry) and quantitative (validation) data collection techniques in order to fulfill research objectives. The use of both qualitative and quantitative methods of collecting data (triangulation) helped in increasing validation of data and reliability of results as the researcher was able to cross check or compare facts obtained from sample units with the aid of diverse data collection techniques hence reducing bias in research.

3.2 Research Methods

Finn and Jacobson (2008) postulate that there are two basic methods used to collect information about the problem of hygiene factor connected with fast food restaurants namely primary method and secondary method. This project was executed in two phases, the first being the administration of structured questionnaire to food service workers and clientele in a bid to better understand their level of knowledge regarding implementation of safe food handling practices. More so, this initial stage of research was fundamental in determining food handlers' perceptions, attitudes and self-confessed practices related to

food safety. This phase included determination of food safety training needs of foodservice employees.

A food safety observation checklist covering many components to do with food handling was used in the second phase of the research. Restaurants were systematically observed for sanitation and hygiene within and around the premises. More so, food handlers were observed while carrying out their regular duties of preparing food and serving customers. Observations thus helped in the verification of data obtained from food handlers and their managers during the first phase of the research. The preceding activities were done to enhance validity and objectivity of results.

Phase 1:

In this phase, the researcher used the following protocol in executing phase 1 activities in order to gain understanding of the knowledge, attitudes and practices (KAP) of both food handlers and their managers/supervisors:

- Designing food handling questionnaires for clientele, food handlers and management.
- Pre-testing the questionnaires.
- Analyzing food workers 'knowledge, attitudes and practices (KAP) on food safety. Opinions of restaurant clientele were also taken into consideration
- Identifying loopholes in food handling practices and proposing corrective/preventive actions (major output of phase 1).

Phase 2:

The second stage helped identify food handling practices of foodservice employees. The following steps were followed:

- Designing food safety observation guide.
- Pilot-testing the food safety observation guide.
- On-site evaluation of food handling practices, sanitation and hygiene of selected restaurants.
- Recommending correction and improvement actions based on food safety observation exercise.

Food handlers, clientele and managers of restaurants excluded from the actual study were used during pre-testing of questionnaires and food safety observation guide in a bid to solicit their views on the appropriateness of clarity of instructions and questions used in the tools. The researcher then noted input from the exercise in adjusting or fine tuning the research tools before the main study resumed.

3.2.1 Primary data collection Method and Its Justification

In order to collect primary data, the research was carried out using questionnaires and observations. The reasons behind using questionnaires in order to carry out primary research are as follows:

1. The response can be gathered in a more effective way even more than interviews, because sometimes while taking interview one might forget to ask certain questions.
2. The response can be gathered from large proportion of people while in focus groups or

interviews one can get information only from certain number of people.

3.2.2 Secondary data collection Method and Its Justification

In order to collect secondary data internet journals, articles, restaurant registration books and books were used. The reasons of using secondary method in order to carry out research are as follows;

1. It is less time consuming and easy to access; one can find information very easily.
2. Generally the cost to acquire information through secondary data collection method is less.

3.3 DATA COLLECTION TECHNIQUES AND TOOLS EMPLOYED

3.3.1 Food handling questionnaires

Two questionnaires were designed as following:

- A self-administered questionnaire consisting of an assortment of 15 open and closed questions was prepared to assess the food handling practices of restaurants' shop floor staff. The researcher was keen to delve into prevailing transportation, receipt, storage, preparation and food serving practices in quick service restaurants. The questionnaire were left with restaurant supervisors or shop floor staff for completion and supervisors advised the researcher on the dates of collection, the design of questionnaires was such that individual and institutional confidentiality were upheld. Respondents were not required to write down their

names, company name or address in a bid to increase response rate.

The questionnaire was distributed to all food handlers of the selected operations. The questionnaire included sections examining employees' knowledge on food safety such as correct food holding and cooking temperature; receipt and storage of raw materials; management of food and other waste; handling food left overs and personal hygiene among the others. Another section of the questionnaire measured employees' self-reported food safety practices. Lastly, the instruments also included information on food safety training and induction as well as highest level of education attained by workers participating in the study. The questionnaire was then handed to food handlers working in the sampled restaurants through their management.

- Another self-administered questionnaire was designed to assess management's knowledge on best practices (Good Hygiene Practices, Good Manufacturing Practices, Good Storage Practices etcetera). Again this questionnaire had a mixture of open and closed questions and was made as short as possible in order to increase response rate. Clear instructions were written on the top page of the questionnaire. Questionnaires were collected from supervisors by the researcher on a dates proposed by the former and agreed by the latter.

3.3.2 Clientele Questionnaire

A questionnaire and accompanying interview checklist were used to determine clients'

opinions on the status of restaurants and associated food handling practices. This was done in a bid to balance the research by way of not only capturing data from food handlers and their management but also including input from customers which to a large extent will limit bias. Restaurant clients were conveniently sampled by way of targeting selected companies in which questionnaires were left out for completion and later followed up for collection. Interviews were conducted with willing clients right in the restaurants while they were having their meals or soon after. There was however informed consent from restaurant clientele and premise owners prior to conducting the interviews with clients. It was essential to capture data from restaurant clientele because they are in contact with restaurant staff and normally observe their food handling practices frequently. More so, soliciting the views of restaurant clientele was key in avoiding bias introduced when only the side of restaurant staff is heard.

3.3.3 Observations and food safety observation guide

A total of 10 registered and 10 unregistered quick service restaurants located in Mutare were visited and observed for adequacy and appropriateness of food handling practices. Food handlers were observed during their normal working hours. Furthermore, the researcher took note of the general sanitation and hygiene of restaurant kitchens and dining rooms. Kitchen equipment and utensils were observed for cleanliness. Methods of storing raw materials prior to use were also noted including the fate of food left overs. The Hawthorne Effect, where just the presence of observers affects the observees' performance, is a significant concern with any type of observational research (Clayton

and Griffith, 2004).

Observations on site helped verify data acquired through staff and clientele questionnaires and interviews thereby reducing bias in research. More so, observations permitted the collection of facts not mentioned in questionnaires and interviews. Observations give more detailed and context related first-hand information that enables the undertaking of tests of reliability of responses to questionnaires and interviews.

3.3.4 Document Review

Ethical considerations were prioritized prior to accessing classified documents especially from Mutare City Council. As such, written consent was sought from the City Health Department for the researcher to access their documents such as restaurants' licensing and registration details, inspection reports, fines and penalties, and City By-laws among the others. Some of the documents used were the source of sampling frame used to obtain samples. More so, food handling practices observed or recorded otherwise were matched with statutory requirements for compliance. Noncompliance with statutory or legal requirements normally serves as evidence of inadequate and inappropriate food handling practices. Epidemiological details of food poisoning cases were pointers to possible hot spots in terms of food handling practices. The researcher also made reference to several journals and internet articles in a bid to explore modern and more sophisticated techniques of sampling food-contact surfaces, collecting and transporting food samples to the laboratory for microbiological assessment.

3.3.5 Field Pretesting

In this study pilot testing was done with restaurant staff and clientele who would not participate in the main study in order to reinforce research tools based on the results of the exercise. Participants closely resembled those who took part in the actual study and were chosen conveniently with the help of Mutare City Health Department staff. As such, 20 participants each from food handlers, management and clientele took part in field pretesting. Pretests were conducted systematically, with the potential respondents and using the same method of administration. The researcher pre-tested the questionnaires with specialists in question construction, who helped pick up potential difficulties which might not have been revealed in a pretest with respondents. Identified problems in questionnaire pretesting enabled the researcher to redraft the questionnaires accordingly. If the problems are minor, the researcher may then proceed to administration of the questionnaire to the full sample.

A very important part of the questionnaire construction process is its piloting, known as pretesting. This involves testing research instruments in conditions as similar as possible to the research, but not in order to report results but rather to check for glitches in wording of questions, lack of clarity of instructions etc. - in fact, anything that could impede the instrument's ability to collect data in an economical and systematic fashion.

3.4 STUDY AREA

3.4.1 Location

Mutare is the third largest city in [Zimbabwe](#) by population numbers after Harare and

Bulawayo. It is the capital of [Manicaland](#) province. It is located 265 kilometers south east of the capital city. The City of Mutare is surrounded by mountains and is also home to the famous Christmas Pass. Resultantly, the city is also known as a gap town. North of the CBD lies the Vumba Mountains which are approximately 15 kilometers from the city centre. The city is home to important cultural and historical sites such as the rock paintings of Murahwa hills to the north-west of the CBD.

3.4.2 Population

The majority of Mutare residents are Shona people of the Manyika dialect. According to ZIMSTAT (2012) preliminary census data, Mutare urban has total population of 188 243; 88 957 being male and 99 286 females. However, the total population for Mutare rural stands at around 260,567. Mutare rural district lies within the sphere of influence of economic functions of the City of Mutare.

3.4.3 Suburbs

Residential areas in Mutare are classified according to the population density. As such, they are broadly grouped into low, medium and high density suburbs. The low density areas which are more affluent include Murambi, Greenside, Fairbridge Park, Darlington, Morningside and Palmerstone. Murambi and Morningside are located on the northern side of the city while Greenside, Darlington and Bordervale are sited on the eastern side near the border with Mozambique. Examples of medium density suburbs include Westlea, Yeovil, and Florida, all located to the west of the central business district

(CBD). Other high density suburbs namely Chikanga, Sakubva and Dangamvura are located on the extreme west of the CBD. Further west of Chikanga lies Hobhouse high density suburb.

Further to the south along the road to Masvingo and outside the city limits is the high-density town of Zimunya. Mutare's main industrial areas are south of the railway and west of [Sakubva](#), although there is also some light industry just east of the southern part of the city centre.

Table 3.0: Suburbs in Mutare.

Region	Suburbs
Northern (North of the railway line)	Fairbridge Park; Murambi; Morningside; Tiger's Kloof; Palmerston; Avenues; Utopia; Darlington; Greenside; Yeovil; Westlea; Florida; Chikanga; Toronto
Southern (South of the railway line)	Sakubva ; Dangamvura; Weirmouth; Fern valley; Zimunya.

3.5 STUDY POPULATION

According to Finn and Jacobson (2008) a population can be defined as including all people or items with the characteristic one wishes to understand. This research focused on all registered and unregistered restaurants under the jurisdiction of Mutare City Council whose numbers are summarized in table 3.2.

Table 3.1: Population of the study area

Population	Institution	Number
A	Registered	110
B	Unregistered	91

- **SAMPLING DESIGN**

3.6.1 Sampling Frame and Sample Size

A sample is a smaller but representative portion of a specific population of interest that is used to make generalizations on the entire population. A sample normally possesses certain attributes or characteristics defined by gender, race/ethnicity and socio-economic status. Sampling was done due to limited resources (time, money) and workload involved when studying the entire population. A sampling frame is an all-encompassing list of population units from which sample units used in the study are drawn

Samples were drawn from a comprehensive list of registered and unregistered restaurants in the City of Mutare obtained from the Health Department. A list consisting of 91 unregistered food outlets dotted across the city was used for sampling. Another list of 110

registered outlets captured during the statutory process of licensing and registration was also used for sampling purpose.

Table 3.2: Sample units used in the study.

Area	Number of unregistered food outlets sampled	Number of registered food outlets sampled
High Density Suburbs	10	5
Central Business District (CBD)	5	10
Low Density Suburbs	3	3
Medium Density Suburbs	3	3
Industry	2	2
Total Sampled	23	23

3.6.2 Sampling Methods

Both probability and non-probability sampling techniques were used in the research. Sampling is critical to external validation, which is the extent to which research findings can be generalized to people or situations other than those observed in the study.

3.6.2.1 Probability Sampling

A probability sampling implies that every element of a population has an equal and known chance of inclusion in the sample. In order for one to generalize the findings from the sample requires that the sample be drawn from a population according to one of the

several probability sampling plans. According to Shevelson (1988), all probability samples involve the idea of random sampling at some stage. Probability sampling includes random selection and random assignment of participants in the study

- **Multi-stage sampling**

Multistage sampling is a probability sampling method in which sampling is undertaken in a series of steps or stages and where sampling units become smaller as the researcher moves to the next stage of the process. In a two-stage sampling design, a sample of primary units is selected and then a sample of secondary units is selected within each primary unit. The simplest version of two-stage sampling is to use simple random sampling at each stage. The primary units do not need to be the same size and you do not need to select the same number of secondary units within each primary unit. This sampling method has been proven to be effective in the sense that it involves many randomizations. Multi-stage sampling procedure has its strength in that it does not make use of the entire sample units in clusters of interest thereby cutting down on sampling costs. This is a major advantage of the sampling technique over cluster sampling.

Sampling Procedure

Fig 3.1: Multi-stage sampling for both registered and unregistered restaurants in Mutare Quick service restaurants were grouped into 3 clusters that is central business district (CBD), high density and medium density suburbs according to registration status. Simple random sampling was then used to select an equivalent of 10% of both registered and unregistered restaurants (samples) from each cluster.

3.6.2.2 Non-probability Sampling

Non-probability sampling is any sampling method where some elements of population have no chance of selection. In other words, non-probability sampling occurs when a sample is drawn from a population out of convenience and taking to account certain assumptions about the target population.

- **Purposive (judgmental) sampling** – according to Chapman *et al.* (2007) this sampling method is premised on the researcher making assumptions that certain elements of a population such as experts of certain departments or fields will provide useful data essential in answering specific research questions. Examples of experts that can be drawn using purposive sampling include managers, doctors, and Purposive sampling technique was employed in administering questionnaires to supervisors or management and shop floor workers involved in food handling. The rationale behind its use was the limited number of supervisors and shop floor workers whose number averaged 4.
- **Convenience sampling**- this sampling method is also referred to as grab or opportunity or accidental sampling. This sampling technique was used when conducting interviews with restaurant clientele. Clientele questionnaires were also administered using the same sampling technique. More so, convenience sampling was employed during pilot testing of food handling and clientele questionnaires.
- **SAMPLE COLLECTION**

3.7.1 Food Sampling

Langree and Armbruster (1996) define food sampling as a food control procedure in which food is systematically checked for compliance to prescribed safety standards in a bid to safeguard public health. During food sampling, food is assessed for presence of harmful chemical, physical or microbiological contaminants in accordance to legal thresholds. Food samples are normally taken to an accredited laboratory for physico-chemical analysis by qualified laboratory scientists.

The objective of food sampling was to select a certain portion or number of containers, or production units that is most representative of the lot. The purpose of food sampling was to determine any adulteration in foodstuffs and to identify widespread problems (if any) in quick service restaurants. According to Kassa *et al.* (2001) different methods of sampling are employed depending on the types of food to be analysed, and the sampling thereof can be done at any point of production depending on the goal of the exercise. Some forms of sampling include microbiological contamination of pathogens, total plate count and other indicator organisms; pesticide residues; chemical and heavy metal contamination; toxins including aflatoxins and mycotoxins.

Food samples including beef, chicken, and gravy were collected while surface samples were taken from food preparation tables and from hands of food handlers. Food samples were taken to the laboratory at near-freezing temperatures below 4°C for total bacteria count (TBC), coliform count and specific biochemical tests. Sterile equipment (dry, leak-proof, wide-mouthed, sterile, and of a size suitable for samples of the product) was used

in storing and transporting samples to the lab. For dry materials, sterile cans with suitable closures were be used.. The glass jars used to transport food samples from restaurants were first autoclaved at 121 degrees Celsius for 15 minutes in an autoclave machine prior to use so as to eliminate any microbes that may be present before sampling.

Each sample unit was identified with a properly marked strip of masking tape and samples delivered to the laboratory promptly in a cooler box containing ice, and sent to Midlands laboratories for microbial tests.

A record for all samples of the times and dates of collection and of arrival at the laboratory was made. Refrigerated samples were analyzed within 36 hours of collection. Food samples were mainly taken for assessment of contamination by *Salmonella*, *Shigella* and coliforms using various growth media. Violet Red Bile Agar (VRBA) was used to isolate coliforms, MRS Agar for detecting lactobacilli, and Xylose Deoxycholate (XLD) Agar for identification of *Salmonella* and *Shigella spp.* in food.

3.7.2 Microbiological Environmental Monitoring through Restaurant Work Surface Sampling

Elements of ISO 18593 standard were used as benchmarks for environmental hygiene monitoring using hygiene swabs. ISO 18593 standard requires that hygiene swabs be moisturized first in media with detergent neutralizing properties. This is done to avoid compromising the integrity of harvested microorganisms prior to analysis in the laboratory. The researcher also took cognizance of the clause on using a surface sampling size of not more than 100cm² whenever it is practical to do so.

3.7.2.1 Collecting Swab Samples for Microbiological Testing

Swab testing is meant to ascertain the effectiveness of hygiene and sanitation procedures that may be in place within a particular establishment frequented by members of the public. Swab testing involves application of a sterile cotton swab over a defined surface area for a defined period of time in a bid to determine the presence of pathogenic microorganisms. The swab is then transferred to a sterile diluent and shaken thoroughly to separate adhering cell/spores. The diluent is then membrane filtered and the membrane transferred to appropriate agar media for growth. In some instances, the swab is directly rolled or streaked across the agar surface (Chao, 2003).

Sterile swabs were used to test the level of microbial contamination on various surfaces such as kitchen hand washing basins, tables, cutting boards, cooking utensils or any other suitable place. Swab samples can be analyzed for specific indicator organisms for food spoilage or sewage contamination.

3.7.2.2 Procedure for Collecting Swab Samples

3.7.2.3 Surface Sampling Procedure

1. Gloves were worn first and hygiene swab taken out by means of tearing its packaging as per written user instructions.

2. Each cotton swab was moistened in Amies transport medium.
3. The hygiene swab was held at an approximate angle of 30° with respect to the surface to be sampled.
4. The swab was then rubbed slowly and thoroughly using horizontal strokes in the palms of workers' hands, on table or other restaurant surfaces. The swab was then put in a tube containing Amies medium where it was rotated several times so to immerse the entire swab surface in the medium.
5. The hygiene swabs were then taken to the laboratory in a cooler box with ice where they were analyzed within 48 hours.

3.8 TRANSPORT AND GROWTH MEDIA USED IN MICROBIOLOGICAL ASSESSMENT

3.8.1 Transport medium

Amies transport medium which is semi-solid was used to harvest, transport and maintain the integrity of harvested microorganisms. Amies transport media contain charcoal which helps neutralize surface detergents and sanitizers as well as other compounds that can be toxic to harvested microorganism. This semi-solid medium contains ingredients to prevent the over-growth of commensals and ensure the survival of pathogens when specimens cannot be cultured immediately. Generally, transport media are not enriched with mineral substances like nitrogen so that the growth of harvested microorganisms is kept minimal.

3.8.2 Differential/Indicator Media

This refers to media in which dyes or chemicals are added in order to differentiate microorganisms. Differential media thus help differentiate one microorganism from another. X-gal agar Mannitol salt agar (MSA) plates and were used in the study. MSA is known to be selective for Gram positive bacteria. MacConkey agar which easily allows the identification of lactose fermenting coliforms such as *Klebsiella* was also used. The aforementioned agar plates possess special characteristics that favour the growth and identification of specific microorganisms. The introduction of dyes such as phenol red helps identify microbial colonies in agar plates.

3.8.3 Selective Media

According to Shapton and Shapton (1991) selective media are used in the laboratory in order to harvest targeted microbes. Eosin methylene blue (EMB) was the specific selective medium that was used in isolating coliforms. Feachen (1983) highlights that EMB contains chemical toxicants which eliminate Gram positive bacteria than are not coliforms. EMB also contains bile salts that destroy Gram negative bacteria that are not coliforms.

3.8.3.1 Xylose Lysine Deoxycholate (XLD) Agar

XLD agar was used to isolate *Salmonella* and *Shigella* species from food.

3.8.4 Enrichment Media

Selenite broth was used as enrichment media for microbial growth. Enrichment media are support the growth of a broad spectrum of microorganisms. Shapton and Shapton (1991) postulate that enrichment media help in growing as many different types of microbes as are present in the specimen. Selenite broth is normally used as a selective enrichment for isolating Salmonella species (in food samples) that may be present in small numbers and competing with intestinal flora (Shapton and Shapton, 1991). It is buffered Lactose Peptone Broth to which sodium biselenite is added as a selective agent. The medium is not supposed to be autoclaved. Once prepared, it is steamed for 100°C for 30 minutes. Selenite Broth contains peptone, mannitol and sodium selenite (Bowling, 2000).

3.8.5 General purpose media (GPM)

It is media that provide enough nutrients in which most microbes will utilize for growth. The medium allows for a wide variety of microbes to grow. Blood agar base which is supplemented expired human blood from the National Blood Transfusion Service (NBTS) was used to culture as many pathogenic microorganisms that were present in swab specimens.

3.8.6 Violet Red Bile Agar (VRBA)

This is a special medium that was used for detecting the presence of lactose fermenting bacteria in collected samples. The presence of bile salts in the media helps in isolating and promoting growth of lactose fermenters.

3.8.7 MRS Agar

This is a clear brown bacterial growth medium designed to support the growth of *Lactobacilli* (Kassa *et al.*, 2001). It contains sodium acetate, which suppresses the growth of many competing bacteria. The yeast and meat extracts and peptone provide sources of carbon, nitrogen and vitamins for general bacterial growth.

3.9 INCUBATION OF INOCULATED AGAR PLATES

This was done immediately after inoculation. Cultured plates were put in an incubator for a period of 24 hours at 37°C. Incubating inoculated plates allows for the growth of microorganisms through provision of optimum growth temperature for a wide range of microbes

Agar plates need to be kept properly when being used to grow cell cultures. Agar plates can be kept in a special incubator to maintain the right temperature. However, they must be incubated upside down. This is because water evaporating from the plate may condense on the lid of the container and fall back into the culture, thus interfering with the experiment (Jacobson *et al.*, 2009).

According to FDA (2000) plates are normally incubated at 37°C because it is the ideal growth temperature for most bacteria. However, not all bacteria grow best at this

temperature. Certain human pathogens, such as *Mycobacterium leprae* barely grow at all at 37°C (Shapton and Shapton, 1991). However, Mitchell *et al.* (2007) maintain that when working with bacteria that live on or in the human body, regardless of whether they cause diseases, 37°C is the optimal temperature for bacterial growth. Growth at other temperatures will normally slow growth of good bacteria and increase growth of harmful bacteria.

3.9.1 Identifying microbes through colony appearance/morphology on growth media

Paez *et al.* (2007) recommends the following set of parameters used to identify pathogens using colony appearance after incubation:

- **The shape of microbial colony** - this ranges from an oval to irregular shape which sometimes appear like roots
- **Size of colony** - can vary either be very large or too small in size (less than 1mm)).
- **Pigmentation of colony** – colonies may appear on agar plates in different colours that include red, black, cream and purple.
- **Opacity of colony** - refers to the extent to which a colony is transparent clear.
- **Colony elevation** - refers to the extent to which colonies rise above the level surface of agar medium.
- **Surface of the colony** - refers to the general appearance of the colony in the plate. It is related in a slight way to colony elevation.
- **Texture** – this has to do with how colonies feel when rubbed in between fingers.

3.10 DATA ANALYSIS AND PRESENTATION

The questionnaires were sorted and tallied by the researcher and coding was done to ensure the confidentiality of the eating places. The questionnaire responses were analyzed using SPSS version 11.0 software. The values were converted into percentages and presented as tables. Data from the microbial count test was also presented in a table. Overall the researcher used tables, pie charts, descriptive statements, and column graphs to present data. Each data presentation tool was entitled and given a heading. Hypothesis testing was conducted using the Chi square test.

3.11 ETHICAL ISSUES

Creswell and Plano, 2007 postulate that adherence to ethical principles is essential in all branches of research. Only ethically sound can achieve public acceptance and demonstrate the integrity required of researchers and their international colleagues.

3.12 Informed Consent

According to Creswell and Plano (2007) participation in research must be voluntary and it is the researcher's duty to ensure that research participants understand the scope and the details of the project. As such, the researcher gave information to potential participants included: purpose and duration of the research, identity of the researcher, benefits of the research to the food industry, information on data protection, privacy and data retention, the right not to take part, the right to withdraw, and contact details for questions.

3.13 Data Protection and Privacy

The right to privacy and data protection is a fundamental aspect of research ethics. In order to respect this right, the researcher complied with the legislation on data protection and obtained written permission on accessing documents belonging to Mutare City Council.

3.14 Confidentiality

This was assured to all participants who consented to taking part in the study. This researcher incorporated clearly worded instruction on the cover page of questionnaires that informed them to exclude their names, addresses and name of institution.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 INTRODUCTION

The purpose of this chapter is to present the findings of research work, to analyse and to

discuss the data. Tables, pie charts, descriptive statements and column graphs are going to be employed in representing research data. Numerical data is going to be expressed in the form of percentages (%) and frequencies (n) to facilitate easy comparison of the data. Most of the data is going to be expressed in the form of descriptive statements derived from the respondents. A discussion of the findings is going to follow in correlation with the objectives and the hypothesis stated in Chapter One.

4.1 Questionnaire Response Rate

A simple way of calculating questionnaire response rate for a particular group of respondents is by dividing the number of questionnaires returned by the total number administered. A number of factors are known to influence questionnaire response rate. These include the design and layout of questionnaire, provision of incentives as well as perceived participant benefits likely to be derived from the study. Questionnaire response rate can rise above 70 percent provided that study subjects are furnished with full details about the purpose and significance of the exercise. Well motivated participants are also likely to yield a high response rate. Overall the response rates as illustrated in Table 4.0 are above 85 percent. In fact the average response rate was 89.4%. Table 4.0 also shows that registered restaurants had a higher average response rate of 93.7% compared to 87.3% of participants in unregistered restaurants.

Table 4.0: Questionnaire response rate.

Restaurant	Category	Number Administered	Number Returned	Response Rate (%)
Registered	Food Handlers	105	98	93.3

Unregistered	Food Handlers	103	93	90.3
Registered	Management	69	65	94.2
Unregistered	Management	64	54	84.4
Registered&Unregistered	Clientele	150	127	84.7

4.2 Demographic characteristics of respondents

The respondents were drawn from both registered and unregistered quick service restaurants in the city of Mutare. The respondents ranged from food handlers, managers, supervisors and clientele. Table 4.2 shows the profile of these respondents by gender, age, and highest level of education attained.

Table 4.1: Demographic characteristics of respondents from registered and unregistered restaurants in Mutare

Respondents and their characteristics	Frequency	Frequency (%)
Registered restaurants		
Managers/supervisors (n=65)		
Highest level of education		
‘O’ Level	37	56.9
‘A’ Level	17	26.2
Diploma	5	7.7
Degreed	6	9.2

Registered restaurants		
Food handlers (n=98)		
Highest level of education		
'O' Level	67	68.4
'A' Level	20	20.4
Diploma	9	9.2
Degreed	2	2.0
Registered restaurants		
Clientele (n=67)		
Gender		
Male	30	44.8
Female	37	55.2
Age, years		
18-25	15	22.4
26-33	20	29.9
34-41	23	34.3
42 and over	9	13.4
Unregistered restaurants		
Managers/supervisors (n=64)		
Highest level of education		
'O' Level	42	65.6
'A' Level	21	32.8
Diploma	1	1.6
Degreed	0	0
Unregistered restaurants		
Food handlers (n=93)		
Highest level of education		
'O' Level	57	61.3
'A' Level	32	34.4
Diploma	4	4.3
Degreed	0	0

Unregistered restaurants		
Clientele (n=60)		
Gender		
Male	38	63.3
Female	22	26.7
Age, years		
18-25	14	23.3
26-33	21	35.0
34-41	15	25.0
42 and over	10	16.7

4.3 QUESTIONNAIRE RESPONSES FROM MANAGERS AND SUPERVISORS

The data obtained from the responses given by managers and supervisors was expressed in descriptive statements and tables.

4.3.1 Waste disposal zones

Waste can be regarded to as material or products that are no longer to a particular individual or group of people. However, it is important to note that what becomes waste to one person may in actual fact be a raw material to the next person. This is why the issue of waste management has to be tackled under the framework of sustainable waste management. This concept of introducing sustainability in solid waste management entails reusing, recycling and reducing waste. In the context of the food industry, food waste can be reduced through composting and feeds for animals or pets. Sustainable solid waste management seeks to incorporate environmentally friendly methods of collecting, storing, sorting, transporting and treating waste. Thus it is a good practice for restaurants to have waste management procedures for their facilities as part of prerequisite program.

According to Mitchell *et al.* (2007) a food outlets is supposed to have sufficient number of bins with lids. More so, bins are required to be regularly emptied of their content in order to minimize the problem of bad odour and flies. All respondents from both registered and unregistered restaurants pointed out that they put different kinds of waste in a single bin. However, 70% of supervisors/managers in registered restaurants said they put bin liners first before disposing waste. On the contrary, only 20% of supervisors/managers in unregistered restaurants make use of bin liners. 60% of management responses for registered restaurants hinted that they have a common practice of emptying bins after work and starting the day with empty bins. 75% of management in unregistered restaurants said they empty the bin when full. On the distance traveled to dispose waste 70% of registered restaurants' management highlighted that the approximate distance from kitchen was at least 20 meters. The remaining 30% responded that the distance was near 10 meters. Overall there is minimal sorting of waste at source prior to disposal in both registered and unregistered restaurants.

4.3.2 Location of ablution facilities (toilets)

Restaurants are supposed to have staff and customer toilets that are kept clean. Toilets should be easily accessible and be of a size and number suited to the available staff and clientele served. More so, toilets must have hand washing basins, liquid soap and disposable hand drying papers. The use of warm air hand-drying machines is now being discouraged as research as associated them with the spread of pathogens (Norton, 2002). All the respondents working in registered restaurants reported that the ablution facilities (toilets) are in the same building with the kitchen while 80% of respondent in

unregistered restaurants confirmed the availability of toilets within their establishments.

4.3.3 Availability of running water basins and soap dispensers in staff and consumers' toilets

100% of managers and supervisors working in the selected restaurants indicated that they had at least one functional toilet used by either staff or clients or both. However, 60% of the managers highlighted that they do not have toilets for clientele. This was a cause for concern as best hygiene practices require that clientele be provided with a decent toilet facility. None of the respondents from the unregistered sector of restaurants indicated the availability of clientele toilets.

4.3.4 Swab tests

20% of supervisors/managers for registered restaurants acknowledged that they periodically do swab tests as part of their hygiene monitoring of food contact surfaces and equipment. The researcher noted that many of the restaurants who do swab tests have prerequisite programmes for food safety management. 30% of management in the same category highlighted that they sometimes do swab tests and 50% said they do not swab their premises as part of routine hygiene monitoring. On the other hand, 95% of supervisors/managers in unregistered restaurants said they do not do swab tests. The remaining 5% responded that they sometimes do swabbing. It appears that management in both sectors regard swab tests as a prerogative of the City Health Department Inspectorate.

4.3.5 Availability of cabinets for keeping brushes, mops and wiping cloths

Marriott (1990), postulates that equipment used in cleaning and sanitizing the kitchen and dining rooms must be confined to lockers or cupboards away from food in order to prevent cross contamination. 60% of supervisors/managers working in registered restaurants pointed out that they have separate compartments for storing brushes, mops and other cleaning equipment. The remaining 49% said they have no separate rooms/compartments for storing material used for cleaning. On the contrary, 70% of supervisors/managers in unregistered restaurants said they had reserved space for storing cleaning materials like mops and brushes.

4.3.6 Availability of a separate room(s) for employee baggage and possessions

Mutare City Council Hygiene by-laws (1978) require that owners food establishments or premises have allocated change rooms for employees in which their baggage are also kept. Again this is a food safety measure that seeks to prevent cross contamination of pathogens from the clothes and personal possessions of restaurant staff. 90% of management respondents for registered restaurants highlighted that they had separate rooms used as dressing/change rooms for staff were as 65% of the supervisors/management working in unregistered food outlets said they do not have change rooms or lockers for keeping baggage for staff.

4.3.7 Pest and pathogen control management

In any facility where food is handled and stored, proper pest management is critical to operating a safe, clean and regulatory-compliant business. According to Cruz *et al.* (2001) restaurants face four chief pest concerns: cockroaches, flies, stored product pests and rodents which can transmit pathogens (disease causing organisms) to food. If there is food, there is a risk of infestation, and restaurant employees need to be aware of these risks and their options for prevention and treatment. Only 10% of supervisors and managers in registered restaurants highlighted that they use both electric and non-electric fly trappers which are regularly serviced and emptied. A further 90% affirmed the use of spray chemicals (fumigation) to control pests. However all respondents using spray chemicals informed the researcher that both supervisors and shop floor staff are involved in the application of pest control chemicals. There was no mention of pest control contractors being involved in controlling pests. On the other hand 55% of management in unregistered confirmed fumigating their premises to control pests. The remaining 45% did not respond to the question involving methods of pest control they employ.

4.3.8 Employee health and hygiene

Public Health (Medical Examinations) (Food Handlers) Order (1994) employees who are responsible for serving and handling food should go for medical examinations. They should be deemed competent to be able to work in a food service facility. Statutory Instrument 41 (1994) requires that all the food handlers in Zimbabwe go for medical examinations yearly. A positive confirmation was given that management programs for health and hygiene practices are in place to minimize the risk of contamination from food, employees and equipment. All ill employees are excluded from direct contact with food. According to Public Health Act, food handlers must notify the manager or shift

supervisor on duty of the following:

- running stomach (diarrhea), nausea, vomiting and stomach cramps or pain
- fever, chest problems, and persistent coughing
- infections of the skin especially rash, boils and septic wound or septic skin ulcer
- discharge from the eyes, ears, nose or mouth

90% of management respondents working in registered restaurants highlighted that they have valid medical examination certificates for food handlers working in their establishments. The remaining 10% hinted that they were still in the process of having their staff undergo medical examinations for the year 2013. A totally opposite scenario was noted in unregistered as 90% responded that they do not medical examination certificates for food handlers working for them. The remaining 10% that said they were in possession of valid medical examination certificates gave the researcher an extra task of verifying their presence on site. In terms of management programs for employee health and hygiene, 70% of registered players admitted that they did not have them in place were as 20% hinted that they have them The remaining 10% did not give any response on this one. As for the unregistered restaurants, none of the managers/supervisors said they had such programs in place.

4.3.9 Employee training program

It has been found out that the enactment of stringent food laws and standards for safety will have to be supported by sound training programs targeting food service employees.

Food consumer awareness programs have to be implemented at both central and local government levels since food safety start from the farm right through to the table (final consumer). 80% of management working in registered restaurants outlined that they conduct induction training on new employees. 50% of their counterparts in unregistered restaurants highlighted that they do food hygiene inductions with new employees. However 70% of management falling under registered restaurants revealed that they do not have reviewed documents for employee food safety program while 95% of supervisors/managers in unregistered restaurants said they had no written program in place available for review. Only 25% in registered restaurants highlighted that they conduct monthly food hygiene talks as per set internal procedure. A cause for concern was the silence on both groups on the training of subcontractors on aspects of food safety.

4.3.10 Purchasing, warehousing and storage

According to Leach *et al.* (2001) all food must be stored correctly on storage racking or shelves must be kept 150mm clear of the floor. Food should be stored in a manner which it does not get contaminated. Warehouses and cold storage facilities should be constructed in a way which prevents rodents, birds and insects from accessing inside.

40% of management in registered restaurants informed the researcher that they receive some of their perishable raw materials in refrigerated vehicles/trucks. 60% said the bulk of their raw materials (including meat) is transported from suppliers in open trucks. 70% of managers in registered restaurants highlighted that they purchase fruits and vegetables from local vegetable markets including Sakubva vegetable market. The remaining 30% informed the researcher that they buy vegetables from individuals (vendors) who move

around the town with their produce.

90% of managers in unregistered restaurants informed the researcher that they receive their food raw materials from suppliers in open trucks. The remaining 10% affirmed the use of own transport to ferry raw materials from producers. None of them mentioned aerated and refrigerated trucks being used in transporting food raw materials from suppliers. However a greater percentage (65%) of management falling under unregistered food outlets responded that they buy meat and vegetables from individuals. This implies that the bulk of meat prepared in these restaurants is neither slaughtered in registered abattoirs nor inspected.

Figure 4.1: Management responses for both registered and unregistered restaurants

4.3.11 General history on foodborne diseases

None of the managers in the two categories of restaurants mentioned the occurrence of foodborne disease outbreaks or illnesses in the history of their operations. However 30% and 40% in registered and unregistered restaurants respectively, professed ignorance pertaining past occurrence of foodborne disease outbreaks. 20% of registered restaurants confirmed receiving clientele reports of suspected illness after buying fast food. However, only 10% of unregistered restaurants confirmed receiving formal reports from clientele who fell sick after eating their food.

4.4 QUESTIONNAIRE RESPONSES FROM FOOD HANDLERS

4.4.1 Food Handlers hand washing practices

All food establishments must have hand washing facilities designed to effectively wipe away dirt and pathogens from hands of food handlers. As such, liquid soap and both hot and cold water should be made available to food service workers. Workers are supposed to wash hands after using the toilet, after handling money or cleaning equipment, after scratching and after handling raw vegetables or meat products. Figure 4.2 summarizes hand washing responses from workers in registered restaurants

Figure 4.2: Food handlers' hand washing practices in registered restaurants

Figure 4.2 illustrates that 70% of food handlers have a common practice of washing their hands after handling raw food. On the contrary, a significant number of food handlers working in registered restaurants (70%) do not always wash their hands after handling delivery packaging possibly because of the low risk perception regarding packaging material. Similarly, 60% and 70% of food handlers pointed out that they sometimes wash hands after scratching and coughing or sneezing respectively. . It can be concluded from facts in Figure 4.2 that there is no consistency in hand washing as none of the respondents affirmed washing their hands after exposure to contaminants.

Coming to food handlers in unregistered restaurants, it was noted that 60% of workers always wash hands after handling refuse (Figure 4.3). On the contrary, 65% of

respondents highlighted that they sometimes wash hands after coughing and sneezing. Furthermore, 50% said they sometimes wash hands after handling dirty equipment as well as cleaning kitchen surfaces.

Figure 4.3: Food handlers' hand washing practices in unregistered restaurants

4.4.2 Handling of food left overs

Three main categories on the use of food left overs were drawn up following an analysis of responses obtained from food handlers in both registered and unregistered restaurants. Figure 4.4 shows that discarding left overs and donation to staff were the most common practices of managing food left overs in registered restaurants. On the other hand, half of respondents from unregistered restaurants cited the use of food left overs the next day as the most common practice followed by discarding of left overs (40%).

Figure 4.4: Handling of food left overs

4.4.3 Methods of cleaning equipment and food contact surfaces

A three tier sink system sink is becoming very common in many food establishments as it has been proved to effectively wash kitchen utensils and equipment. The three tier system involves soaking, washing and rinsing utensils in a systematic way. It is recommended that hot water of at least 60°C be used in washing kitchen equipment. Cold water should be available too. Sinks are needed for the washing of food and equipment. These must be

of a sufficient number and capacity. Figure 4.5 illustrates that the most common method of sanitizing kitchen equipment as well as food contact surfaces is the use warm water and soap. 60% of food handlers working in registered food outlets highlighted that they use warm water and soap during cleaning were as half of the respondents in unregistered restaurants employ the same method. Very low number (5%) of shop floor staff in the registered sector use cold water and soap as shown in Figure 4.5. On the other hand, a relatively lower percentage (20%) of respondents from unregistered sector hinted on the use of hot water and soap in cleaning kitchen equipment and work surfaces.

Figure 4.5: Methods of cleaning restaurant equipment

Table 4.3 illustrates a comparative outline of numerical facts on food hand washing practices employed in both registered and unregistered restaurants in the city of Mutare. A closer look at the numbers shown in table 4.3 shows that there is a greater number of respondents in unregistered restaurants who do not consistently wash hands before starting work, after taking breaks and after handling dirty equipment. The same is true for a number of food handlers in registered restaurants who do not consistently wash hands after coughing, sneezing and touching delivery packaging.

Table 4.2: Actions when food handlers wash their hands

	Registered (n=98)			Unregistered (n=93)		
	Yes	No	Sometimes	Yes	No	Sometimes

Before starting work and after any break, after visiting the toilet	58	10	30	37	14	42
After handling raw food (meat, fish, eggs and vegetables)	69	5	24	47	9	37
After handling dirty equipment including money	44	15	39	37	9	47
After handling delivery packaging	30	10	58	47	9	37
After handling refuse	54	2	42	56	5	32
After cleaning surfaces or equipment	34	30	34	37	9	47
After coughing/sneezing	30	15	53	19	14	60
After scratching or touching your hair	39	10	49	42	5	46

4.4.4 Use of a calibrated food thermometer when checking food temperatures

A kitchen thermometer designed to check internal temperature of food during preparation is expected to be used by food workers as violations in cooking and holding temperatures can result in food poisoning. Table 4.4 indicates that most of the food handlers at both institutions do not use a calibrated food thermometer when checking food temperatures. In fact, there was no evidence of use of calibrated thermometers in unregistered restaurants. A small percentage (5%) registered restaurants use calibrated thermometers when checking food temperatures.

Table 4.3: Responses regarding use of a calibrated food thermometer.

Institution	Yes (%)	No (%)
Registered (n=98)	5	95
Unregistered (n=93)	0	100

4.5 QUESTIONNAIRE RESPONSES FROM RESTAURANT CLIENTELE

4.5.1 Common undesirable food handling practices observed by clientele

Restaurant clientele's opinions regarding food safety and the general hygiene of restaurants from which they buy food were captured. Clientele normally report on what they honestly see and experience in the restaurants since they have a greater contact time with food handlers.

Figure 4.6 illustrates that the most prevalent (62%) bad habit observed in several cases by clientele is sneezing and coughing directly on food to be served. Clientele opined that in many cases, food handlers do not cover their nose and mouth when sneezing or coughing. A further 20% of clientele highlighted that some food workers worked without hair nets or any other form of covering in their head. However, the wearing of dirty uniforms as well as cases of eye discharge were not significantly reported by clientele.

Figure 4.6: Undesirable food handling practices observed by clientele

4.5.2 Food handlers' cleanliness according to clientele

Figure 4.7 shows that the greatest percentage (40%) of clientele indicated that the cleanliness of food handlers was satisfactory against the 10% and 20% that regard general cleanliness of food workers in restaurants as excellent and good respectively. 30% of clientele maintained that they were unhappy with the general cleanliness of food handlers working in restaurants across the city.

Figure 4.7: Clientele rating of food handlers' cleanliness

4.5.3 Clientele knowledge and perceptions about food safety

According to Figure 4.8, 70% of clientele were acquainted with the general meaning of food safety. This suggests a knowledge gap among most clientele that has to be bridged through various avenues of consumer education and awareness campaigns on food safety. This is confirmed by the fact that 58% of respondents clearly admitted that they had never received any information or education regarding food safety.

The bulk of food service consumers (55%) highlighted that they were not pleased with the hygiene status of restaurant ablutions (toilets) as well as hand washing basins provided therein. 72% of clientele confirmed having previously fallen ill due to suspected food poisoning linked to restaurant food. However, upon being quizzed on whether or not they reported their alleged illness to authorities, 80% of the clientele who previously fell ill informed the researcher that they did not report since most of the cases resulted in non-hospitalization.

Figure 4.8: Clientele responses

4.5.4 Clientele overall rating of food handling practices in registered restaurants

Table 4.4: Clientele responses on rating of food safety practices in registered restaurants

Food safety practices	Excellent (Frequency=n)	Good (Frequency=n)	Satisfactory (Frequency=n)	Undesirable (Frequency=n)
Sanitation and hygiene of the whole food service facility	7	12	35	13
Employee health	3	26	30	6
Employee hygiene	18	24	21	3
Availability of handwashing facilities	25	23	11	8
Equipment, containers, facility sanitation and equipment	21	17	19	10
Toilet facility sanitation, hygiene and maintenance	15	25	18	7
Proper hand washing facilities for food handling and adequate employee training	20	22	17	8

Table 4.5 indicates that the data fluctuated in all ratings, however a more clear analysis of the data, refer to the statistical analysis, where a Chi square test was conducted. (See

Appendix 2 for raw data calculation).

4.5.4.1 Hypothesis testing for effectiveness of food handling practices in registered restaurants

A chi square test was done to test the relationship between status of registration of restaurants and the effectiveness of food handling practices employed. Clientele responses were used in testing the hypothesis since their opinions were regarded less biased than those of food service employees.

4.5.5 Clientele overall rating of food handling practices in unregistered restaurants

Restaurant clientele were asked to complete structured questionnaires expressing their opinions on food handling practices prevalent in unregistered restaurants. Table 4.5 highlights major food safety practices which clientele used in rating sanitation and hygiene of these establishments. The scale used in rating food safety practices ranged from excellent to undesirable. In table 4.5, the frequency (n) represents the number of food service consumers who rated a particular practice.

Table 4.5: Responses on rating of food safety practices in unregistered restaurants

Food safety practices	Excellent (Frequency=n)	Good (Frequency=n)	Satisfactory (Frequency=n)	Undesirable (Frequency=n)
Sanitation and hygiene of the whole food service facility	2	7	35	16
Employee health	6	9	15	30

Employee hygiene	0	4	22	34
Availability of handwashing facilities	0	12	19	29
Equipment, containers, facility sanitation and equipment	3	13	21	23
Toilet facility sanitation, hygiene and maintenance	0	12	32	10
Proper hand washing facilities for food handling and adequate employee training	0	0	25	35

The Chi square calculated ($X^2_{calculated}$) value for registered restaurants is 57.769 against the Chi square tabulated ($Chi-square_{tabulated}$) value of 28.869. The procedure followed in calculating the Chi square tabulated value is shown in detail in Appendix

Decision: Reject H_0

Conclusion: The results revealed significant p value > 0.05 indicating that there was no significant relationship between the registration status of restaurants and effectiveness of

food handling practices employed therein.

4.5.5.1 Hypothesis testing for effectiveness of food handling practices in unregistered quick service restaurants

A chi square test was done to test the relationship between status of registration of restaurants and the effectiveness of food handling practices employed. Again, clientele responses were used in testing the hypothesis since their opinions were regarded less biased than those of food service employees.

The Chi square calculated ($X^2_{calculated}$) value for unregistered restaurants was 77.72 against the Chi square tabulated ($Chi-square_{tabulated}$) value of 28.869. The procedure followed in calculating the Chi square tabulated value is shown in detail in Appendix

Decision: Reject H_0

Conclusion: The results revealed significant p value > 0.05 indicating that there was no significant relationship between the registration status of restaurants and effectiveness of food handling practices employed.

4.6 Researcher's observation results and discussion on restaurant food handling practices

4.6.1 Food safety

One of the most common food safety flaw observed during the course of the study is cross contamination. In both registered and unregistered restaurants the researcher had

equal number of observations of service staff ignoring food and drink that had been spilled. The researcher noted that in several cases clientele would have to follow up with kitchen staff in order to have dirty tables and floors cleaned up. The presence of flies was a common nuisance in 50% of unregistered outlets and in about 30% of the sampled registered restaurants. In 40% of restaurants, it was observed that kitchen implements such knives and cutting boards could be used without first sanitizing them. In 50% of the events where this was observed, the researcher noted that kitchen staff were working under pressure to meet high clientele demand. The remaining 50% was attributed to negligence on the part of food handlers who probably have low risk perception on the dangers of cross contamination. 30% of registered restaurants observed were stacking meat with dripping blood on top of cabbages, tomatoes and other vegetables. On the other hand, the situation was dire in unregistered restaurants where 60% of restaurants visited did not separate cooked food from uncooked food. More so, dirty cleaning cloths and mops were found scattered all over the working rooms, thus posing danger of cross contamination.

4.6.2 Personal hygiene

A significant percentage of food safety violations involved aspects to do with personal hygiene of food workers. Overall 60% of sampled restaurants had workers who played a dual role of handling money and at the same time serving food to clientele. This practice was more common (65%) in unregistered restaurants than in registered restaurants (35%). In most instances, they work under immense pressure such that they concentrate more on serving customers than washing hands before handling food. In 20% of unregistered restaurants, the researcher observed that some food handlers were working in the kitchen

and dining without complete protective clothing. Some workers were not putting on aprons and hair nets were as some had nail polish applied on their fingers. Another notable flaw was the use of dirty uniforms. 40% of registered restaurants were implicated were as 60% of unregistered restaurants observed had workers putting on dirty uniforms. Although employees seemed to know more about proper personal hygiene practices as indicated by their questionnaire responses, a number of them seemed reluctant to put into practice what they know.

4.6.3 Cooking

Another notable food safety violation of concern was the keeping of food under potentially unsafe temperature. Some restaurants display ready-to-eat food in ovens with faulty elements. In fact, none of the restaurants observed made use of a food thermometer to check internal temperature of prepared food. This confirms the responses from food handlers to the effect that they do not at any given time use the thermometers. Another common violation was employees improperly tasting food while cooking it; however, this was a much bigger problem in unregistered restaurants than registered ones. In 30% of unregistered restaurants observed, food handlers were using their fingers take food for tasting.

4.6.4 Food holding temperature violations

This was a common violation in 60% of unregistered restaurants where ovens are not used to maintain safe holding temperature of food. In fact, the most common practice observed was storing cooked food in metal and plastic jars prior to serving when the customer wants to buy food. In some instances (50%) of the cases, food holding

containers used were visibly dirty, more so, the equipment used to serve the food to consumers were exposed to environmental contaminants like flies and dust and were seldom washed.

4.6.5 Equipment

The researchers observed significantly more equipment violations in unregistered restaurants. Only 30% registered restaurants observed employ a three-compartment sink to wash kitchen utensils. However, only 10% of unregistered restaurants employ the same system to wash kitchen utensils. Thus based on the preceding observations, it was more difficult for the restaurant staff at these restaurants to properly clean/sanitize their equipment. Methods of washing utensils were observed and it was noted that most food handlers washed their utensils in cold water (70%). In most unregistered restaurants (60%) the utensils were washed single buckets with water that was not regularly replaced even though the water had become visibly dirty.

4.6.6 Miscellaneous violations

As shown in Figure 4.6, all unregistered restaurants observed were not in possession of medical examination certificates for food handlers working therein. On the other hand, only 10% of registered restaurants had no valid medical examination certificates for employees probably because observations were done at the beginning of the year when renewal of certificates will be underway.

None of the unregistered restaurants under observation had documented procedures for cleaning and sanitizing equipment, staff training and development on food safety, just to

mention but a few. There was no evidence suggesting that employee inductions are done to new employees. On the other hand, 60% of registered food outlets observed had no similar food safety procedures available for periodic review. Food posters and charts were however available in some restaurants.

Some bad food handling habits observed as include chewing gums while cooking or serving food, blowing air into polythene bag used for serving food and coughing/sneezing directly on food being cooked or meant to be served to customers (Figure4.6). Coughing/sneezing on food was prevalent in almost 50% of restaurants observed. In instances when food handlers covered their mouth or nose with hands while sneezing or coughing, no evidence of hand washing thereafter was observed.

4.6.7 Environmental surrounding of restaurants

75% of the food handlers observed in unregistered restaurants prepared their foods in unhygienic environment characterized by food waste, used packaging and flies. The researcher also noted with shock that one unregistered restaurant was using a disused toilet apartment to store their daily supplies of raw materials. Thirty percent of restaurant staff observed did not always place litter in the bins available, preferring to throw waste on the floor or corners of the kitchen.

Table 4.6: Observation results on food handling practices and hygiene in both restaurants

Parameter	Registered (N=10)				Unregistered (N=10)			
	Frequency		Percentage		Frequency		Percentage	
	Yes	No	Yes	No	Yes	No	Yes	No

General (N=20)								
Medical examination before commencement of work	9	1	90	10	0	10	0	100
Coughing, sneezing, septic boils while handling food	4	6	40	60	5	5	50	50
Hygiene of premises (N=20)								
Clean premises	6	4	60	40	3	7	30	70
Presence of stagnant water	2	8	20	80	7	3	70	30
Presence of flies	4	6	40	60	7	3	70	30
Possession of waste bin	10	0	100	0	6	4	60	40
Personal Hygiene (N=20)								
Cover hair in net/cap	8	2	80	20	4	6	40	60
Wear apron	7	3	70	30	5	5	50	50
Wash hands after handling money	2	8	20	80	1	9	10	90
Wash hands with cold water only	6	4	60	40	8	2	80	20
Wash hands with cold water and soap	2	8	20	80	2	8	20	80
Wash hands with hot water only	0	10	0	100	0	10	0	100
Wash hands with hot water and soap	2	8	20	80	0	10	0	100
Food Hygiene (N=20)								
Exposure of food to flies/dust	2	8	20	80	4	6	40	60
Dishing of food with bare hand	1	9	10	90	4	6	40	60

Serve food with ladle/spatula/tongs	9	1	90	10	6	4	60	40
Eat during food service	2	8	20	80	4	6	40	60
Taste food with fingers	1	9	10	90	3	7	30	70
Taste food with clean spoon	9	1	90	10	7	3	70	30
Blows air into polythene bag used for serving food	1	9	10	90	4	6	40	60

4.7 Laboratory Results

In order to achieve objective three of the research, samples of hand and surface swabs; and food samples were systematically collected from restaurants and taken to the laboratory for microbiological assessment. This way, environmental microbial monitoring of food establishment was done and the quality of fat food sold in restaurants ascertained. Figure 4.7 summarizes the number of samples collected and outlines the number or percentage of collected samples that were microbiologically unsatisfactory. A total of 96 samples were taken to the laboratory for microbiological tests. Of the 96 samples, 34 were found to be unsatisfactory, implying that they were contaminated with pathogenic microorganism (Figure 4.7).

Table 4.7: Samples taken for microbiological assessment

Institution	Total Number of Samples	Number of Unsatisfactory Samples (%)
Registered	48	11 (22.9%)
Unregistered	48	23 (47.9%)

4.7.1 Criteria for identification of microorganisms in the laboratory

Microbiological tests conducted in the laboratory on restaurant samples was guided by a protocol developed by Kassa *et al.* (2001) as indicated below:

1 *E. coli* – appears as smooth circular and convex colonies with distinct edges. On MacConkey colonies appear pink and yellow on CLED

2 *Klebsiella spp.* – appear as very viscous large mucoid colonies which tend to coalesce with prolonged incubation (lactose fermenters).

3 *Staphylococci* – *S. aureas* forms smooth, solid and raised colonies which are pink on McConkey and appear as deep golden yellow colonies of uniform size on blood agar.

- *Salmonella spp.* – exhibits itself through formulation of cream colonies on XLD. Sometimes, smooth singular colonies with black dots appear due to production of hydrogen sulfide.

4.7.2 Surface swab results

Table 4.8 summarizes laboratory finding of samples taken from both registered and unregistered restaurants in Mutare. The table shows the pathogenic microbes detected per category of samples. There were four categories to which samples were grouped namely hands, surfaces of tables, utensils and equipment and restaurant food. Table 4.8 illustrates that *E coli*, *Klesiella spp*, *S aureas*, *Salmonella* and *Bacillus* were the most prevalent

pathogenic microorganisms detected in the laboratory. *Bacillus* was detected in both cooked and raw vegetables used in the preparation of salads. The presence of *Klebsiella* and *E coli* in samples signifies very low standards of personal hygiene and inadequate cleaning and sanitization of kitchen surfaces and equipment. *Klebsiella* is a lactose fermenting coliform that is normally found in the respiratory tract of humans and is introduced into the environment through coughing, sneezing or sneezing.

Table 4.8: Laboratory Swab results for registered and unregistered restaurants

Restaurant category	Source of swabs	Microorganisms obtained
Registered	Hands	<i>E coli, Klebsiella spp.,</i>
Unregistered	Hands	<i>E coli, Klebsiella spp., S aureas</i>
Registered	Table surfaces	<i>E coli, S aureas</i>
Unregistered	Table Surfaces	<i>E coli, Klebsiella spp</i>
Registered	Utensils and equipment	<i>S aureas</i>
Unregistered	Utensils and equipment	<i>E coli, Klebsiella spp</i>
Registered	Food samples	<i>E coli, Klebsiella, Salmonella and Bacillus</i>
Unregistered	Food samples	<i>E coli, Salmonella, Klebsiella</i>

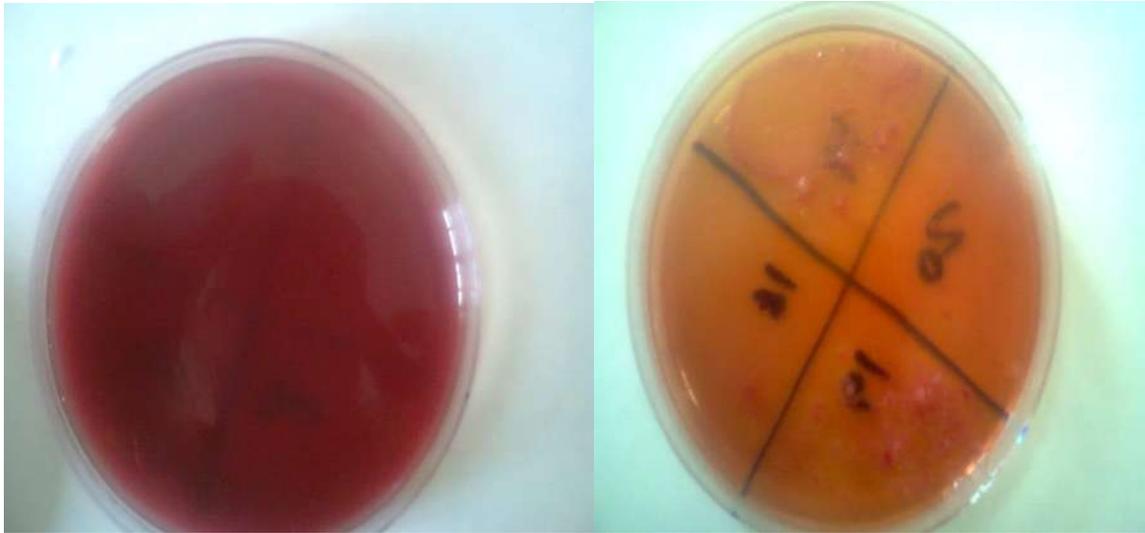
Table 4.9: Combined laboratory results of microbiological assessment

Restaurant category	Sample category	No of samples contaminated	No of samples uncontaminated	Isolated pathogen(s)
Registered	Hand swabs	3	15	<i>E coli, Klebsiella</i>

Unregistered	Hand swabs	9	9	<i>E coli,</i> <i>Klebsiella,</i> <i>Staphylococcus</i>
Registered	Food contact surface & equipment swabs	2	8	<i>E coli,</i> <i>Klebsiella,</i> <i>Salmonella,</i> <i>Bacillus</i>
Unregistered	Food contact surface & equipment swabs	4	6	<i>E coli,</i> <i>Klebsiella,</i> <i>Bacillus</i>
Registered	Food samples	6	14	<i>E coli,</i> <i>Staphylococcus</i>
Unregistered	Food samples	12	8	<i>E coli, Klebsiella</i>

The yellow band in Table 4.9 represents laboratory results for hand swabs in both registered and unregistered restaurants. The green band illustrates swab sample results taken from food contact surfaces such as tables and cutting boards as well as kitchen utensils. The blue band shows laboratory results for soup, vegetables, salad, meat and other food samples taken from both registered and unregistered restaurants.

The presence of *Staphylococcus aureus* on surfaces and dishcloths indicates unhygienic handling and acts as a reminder of the need for good hygiene practices in the kitchen. Transmission of *Salmonella* takes place via food contaminated with faeces of animals as well as eating contaminated raw food products like eggs. The presence of *Salmonella* in some food samples as shown in Table 4.9 suggests undercooking of meat products or inadequate washing of fruits and vegetables used in preparing salads. Transmission of *Salmonella* can also be attributed to cross contamination and inadequate hand washing.



Control

Plate with colonies

Figure 4.9: Agar plates used to grow microorganisms

4.8 DISCUSSION

The food safety and hygiene knowledge demonstrated by food handlers and management was quite satisfactory. However, there seems to be a strong association linking between knowledge to good food handling practices. In the same vein, the study demonstrates that there needs to be a transformation in the risky behaviour observed by clientele and the

researcher. In addition to imparting knowledge or information about food safety, the researcher noted that food handlers and management need to be equipped with skills to increase their food safety risk perception. Most of the registered restaurant observed seem only to observe minimal food safety requirement as stipulated in by-laws and other legal instruments. There seems to lack motivation for the food handlers to go an extra mile by adopting sound documentation procedures for food safety and putting in place prerequisite programs for maintaining high standards of hygiene at their establishments. The little but significant effort being put by the registered players in meeting legal requirements should be doubled through the involvement of the city council, sectorial ministries and other players. There has to be a multi-sectorial approach in tackling food safety in Zimbabwe that should culminate in a culture of prioritizing public health ahead of profit.

The study proved no association between registration status and subsequent food handling practices. Laboratory results also confirmed violations in food safety have nothing more to do with the registration of food outlets as both registered and unregistered were implicated. However, it is of concern significant unregistered restaurants do not meet minimum legal requirements for operating public eating places. The status quo implies that the City of Mutare is sitting on a health 'time bomb' that is capable of 'exploding' to unprecedented magnitude if authorities do not move with speed to regularize operations of unregistered restaurants. The continual operation of restaurants in the city without inspection and monitoring due to lack of registration is not sustainable at all and should be addressed through inclusion of various stakeholders. Another aspect of importance is

failure to revise outdated pre-colonial hygiene and food premises by-laws by the City of Mutare. It is in the interest of the local authority and the public at large to engage specialist consultant services in order to align legal provisions with modern trends in food safety. More so, the local authority should take advantage of its relationships with donor organizations that have traditionally partnered with them in solid waste management and water treatment.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter gives a summary and conclusion based on the results which were drawn from this research. Recommendations concerning the areas which need attention in terms of food safety are proposed in a bid to increase the food safety record of food outlets in the City of Mutare. Recommendations also detail possible ways of transforming the city's' food service facilities into modernized and better establishments which meet today's food safety standards.

5.1 Summary

The research was carried out to achieve the following objectives: to identify prevailing

food handling practices; to assess the food safety knowledge of food handlers; and to analyze food samples, work surfaces and equipment for pathogenic microorganisms in quick service restaurants in the City of Mutare. Food handling and clientele questionnaires were distributed to food handlers, managers, supervisors and the clientele to obtain data on knowledge, attitudes, practices and perceptions about food safety. A detailed food safety observation guide was used in order to have first-hand information about the prevailing food safety practices in both registered and unregistered restaurants. Food safety observations also helped verify the authenticity of data gathered through questionnaires. By involving both registered and unregistered restaurants in the study, the researcher sought to present a bigger and more holistic picture of general food handling practices in the city.

The managerial staff in the two categories of restaurants generally demonstrated better understanding of food safety principles. They also had an appreciation of their legal obligations with respect to food safety. However, it was noted that a significant number of restaurants in both categories were failing to translate their knowledge into good hygiene practices. More so, it was noted that food safety/handling procedures were not documented thus making it difficult to verify or track the food safety performance of restaurants. The general unavailability of food safety procedures is attributed to the absence of mandatory clauses on documentation and record keeping in food legislation including city by-law. There is therefore need for a review of outdated food regulations both at local and central government levels. The revision of food regulations will be an enabling step towards improving investigation procedures of foodborne illnesses and outbreaks. Currently, epidemiology of foodborne diseases and outbreaks is in shambles as

there is a tendency by health officials to generalize every suspected case of food poisoning as common diarrhea. Epidemiologic investigations are difficult to undertake without enough documentation and samples of cooked food that are supposed to be kept for a specified period after preparation.

The major area of concern with respect to unregistered food players in the City of Mutare was the preparation of food at premises that do not meet minimum requirements for food establishments. More so, workers in these restaurants have no medical examination certificates yet they continue to prepare food eaten by members of the public. The situation however is rather tricky since operators of such restaurants are getting a livelihood out of it. More so, the weak state of the economy and the indigenization and economic empowerment drive further complicate the situation as it appear to protect locals venturing in SMEs. It is the opinion of the researcher to have the local authority engaging caterers and other stakeholders to find a sustainable solution that does not impinge on public health.

It was also noted that most food handlers work while wearing appropriate personal protective clothing. Restaurants are also applauded for thoroughly cooking meat products as evidenced by the minimal number of meat samples that were unsatisfactory. However, omissions in form of lack of or inappropriate soap dispensers, personal lockers for staff street clothing and possessions were a major concern. There seems to be an unjustified excuse among managers and supervisors working in restaurants of failure to adequately implement food safety measures due to financial constraints. Some of the violations noted which include bad worker habits; inadequate cleaning of surfaces and cutting boards do

not necessarily require much money to prevent.

The clientele food safety ratings however revealed that both categories of restaurants are employing effective food safety practices. However, just as (Aycicek *et al.*, 2006) observed that visual assessments are not entirely reliable, laboratory results showed pathogenic contamination of a number of food handlers' hands; kitchen equipment and utensils such as cutting boards and plates as well as cooked or raw food like salads. This demonstrates that both registered and unregistered restaurants need to improve on their workers' personal hygiene and sanitation of kitchens and eating areas.

5.2 Conclusion

The objectives of the research were all met, however from observations made; the researcher concluded that food workers in both registered and unregistered restaurants need to improve on food safety practices, some of which are no longer modern. The study proved that registration of restaurants alone is not associated with best food safety practices. It is possible for registration to be done as a fulfillment of legal requirements yet failing to pass the microbiological hygiene test as shown by the laboratory results. Although restaurant clientele overall applaud the food handling practices employed by restaurants, laboratory finding prove that much needs to be done to improve sanitation and hygiene in order to win the battle against the “invisible enemy” – pathogens.

5.3 Recommendations

Having conducted research on both registered and unregistered restaurants in the City of

Mutare, the researcher seeks to make the following recommendations based on the findings of the study:

1. Minimizing exposure of food to unsafe temperature zone (5– 60°C). This can be done through the following:

- Hot food should be displayed at temperatures above 60°C. This can be achieved if food is displayed immediately after cooking

2. Keeping high risk food like salads and eggs safe through the following:

- Purchasing vegetables, eggs, fish and meat from registered suppliers whose activities are regulated by public health officials.
- The storage of eggs in the refrigerator until they are prepared.
- Thoroughly cooking vegetables, eggs and other high risk foods.

3. Avoid cross contamination through the following measures:

- This can be achieved by way of cleaning and sanitizing knives, and cutting boards especially after preparing raw food like vegetables and meat. If possible, colour coded cutting board should be used for specific food items in order to reduce the number of errors made by food handlers.
- Juices from raw meat products should never be permitted to drip onto cooked food. This can be achieved through separate storage of raw and cooked food using the system of food compartments. Where shelves are using to store food, cooked food must always be on top.

- Washing hands thoroughly after handling raw foods. Use clean kitchen implements to handle ready-to-eat foods.
- Educating food workers on best practices in food safety including ways of preventing cross contamination of food.
- Bins and other waste receptacles should be colour coded. Each colour should represent a food waste material. The food waste material should be disposed off in the relevant colour coded bin e.g. red can represent meat products waste materials, blue can represent sadza waste material, yellow can represent rice waste material, green can represent fruit and vegetable waste material and black can be used for disposing all non biodegradable waste such as plastic, metal, paper and glass. This is important to facilitate easy dumping of waste.

4. Ensure high standards of personal hygiene:

- Regular and thorough hand washing is essential. Food handlers must wash your hands after using the toilet, handling raw food, touching your face, nose or hair or using a handkerchief.
- Commercial kitchens must have a hand basin in the toilet and a dedicated hand basin adjacent to food preparation areas. Soap or cleanser and single-use paper towels are preferred for drying hands.
- Avoiding hand contact with ready-to-eat foods.

5. Ensure food processing equipment is clean and free of food residues:

- Kitchen staff should regularly remove food scraps, and clean and sanitize bench tops and food preparation areas.
- Kitchen equipment should be thoroughly cleaned. Workers in restaurants should disassemble the equipment to ensure all food residues are removed. Cleaning is to be done in a multi-step process—involving removing food residues, rinsing, cleaning using a good quality detergent, rinsing and drying. A food grade sanitizer should also be used in a commercial kitchen.
- A three sink system for cleaning, washing and rinsing food stuffs and utensils must be installed to minimize cross contamination.
- All food contact surfaces must be cleaned and sanitized with hot water of at least 76.6°C.

6. Purchasing food from a safe source:

- Restaurants should buy food raw materials from traceable and reputable suppliers. Milk must also be purchased from trusted suppliers. Restaurants should avoid buying raw unpasteurized milk sold by individuals.
- Improvements in farm animal hygiene, in slaughter plant practices, and in vegetable and fruit harvesting and packing operations may help prevent foodborne diseases like salmonellosis caused by contaminated foods.

7 Food Safety Supervisors must ensure staff know how to handle food safely

through:

- induction and orientation
- training - personal hygiene training should be provided to all food handling personnel, including information on how they may act as a potential source of pathogenic bacteria.
- team meetings such as weekly and monthly food safety talks
- group and one on one training sessions
- correcting individual behaviour
- monitoring staff performance to ensure they follow hygiene procedures.

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APPENDICES

APPENDIX 1

MIDLANDS STATE UNIVERSITY

RELEASE FORM

NAME OF AUTHOR: FORICHI TENDAI

PROJECT TITLE: COMPARATIVE ANALYSIS OF FOOD HANDLING PRACTICES EMPLOYED BY REGISTERED AND UNREGISTERED QUICK SERVICE RESTAURANTS: THE CASE OF CITY OF MUTARE, ZIMBABWE

PROGRAMME FOR WHICH PROJECT

WAS PRESENTED: Master of Science in Safety, Health and Environmental Management

YEAR GRANTED: 2014

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SIGNED:

PERMANENT ADDRESS: NHF 21, Gaza Township, Chipinge

DATE: May 2014

APPENDIX 2

Raw data and method of calculation for hypothesis testing for registered restaurants

7	12	35	13	67
3	26	30	6	65
18	24	21	3	66
25	23	11	8	67
21	17	19	10	67
15	25	18	7	65
20	22	17	8	67
109	149	151	55	464

Column Totals

Observed (O) Value
Row Totals

Grand Total

Expected (E) Value = (Row Total) (Column Total) / Grand Total

degrees of freedom (df) = (c-1)(r-1) ; (4-1)(7-1) = 18

O=7 E= 15.74	O= 12 E= 21.52	O= 35 E= 21.8	O= 13 E= 7.94
O= 3 E= 15.27	O= 26 E=20.87	O=30 E=21.15	O=6 E=7.7
O=18 E=15.5	O=24 E=21.19	O= 21 E=21.48	O=3 E=7.82
O=25 E=15.74	O=23 E=21.56	O=11 E=21.8	O=8 E=7.94
O=21 E=15.74	O= 17 E= 21.52	O= 19 E= 21.8	O= 10 E= 7.94
O=15 E= 15.27	O=25 E= 20.87	O=18 E=21.15	O=7 E=7.7
O=20 E=15.74	O=22 E=21.52	O=17 E=21.8	O=8 E=7.94

Chi square value (X^2) =

Where: O is the observed value

E is the expected value

If X^2 value is greater than the tabulated value, reject null hypothesis (H_0)

If X^2 value is smaller than tabulated value, accept null hypothesis (H_0)

H₀₁: Registered Quick Service Restaurants in Mutare employ ineffective food safety practices

Observed (O)	Expected (E)	(O-E)	(O-E) ²	(O-E) ² /E
7	15.74	-8.74	76.39	4.85

12	21.52	-9.52	90.63	4.21
35	21.8	13.2	174.24	7.99
13	7.94	5.06	25.6	3.22
3	15.26	-12.27	150.55	9.9
26	20.87	5.13	26.32	1.26
30	21.15	8.85	78.32	3.7
6	7.7	-1.7	2.89	0.38
18	15.5	2.5	6.25	0.4
24	21.19	2.81	7.9	0.37
21	21.48	-0.48	0.23	0.01
3	7.82	-4.82	23.23	2.97
25	15.74	9.26	85.75	5.45
23	21.56	1.48	2.19	0.1
11	21.8	-10.8	116.64	5.35
8	7.94	0.06	0.0036	0.00045
21	15.74	5.26	27.67	1.76
17	21.52	-4.52	20.43	0.95
19	21.8	-2.8	7.84	0.36
10	7.94	2.06	4.24	0.53
15	15.27	-0.27	0.07	0.0046
25	20.87	4.13	17.06	0.82
18	21.15	-3.15	9.92	0.47
7	7.7	-0.7	0.49	0.06
20	15.74	4.26	18.15	1.15
22	21.52	0.48	0.23	0.01
17	21.8	-4.8	23.04	1.06
8	7.94	0.06	0.0036	0.00045
Totals 464	464	0.03	996.28	57.769=X²

TABLE OF CRITICAL χ^2 VALUES UP TO 20 DEGREES OF FREEDOM

Df	$\alpha = 0.10$	$\alpha = 0.05$	$\alpha = 0.01$
1	2.706	3.841	6.635
2	4.605	5.991	9.210
3	6.251	7.815	11.345
4	7.779	9.488	13.277
5	9.236	11.070	15.086
6	10.645	12.592	16.812
7	12.017	14.067	18.475
8	13.362	15.507	20.090
9	14.684	16.919	21.666
10	15.987	18.307	23.209
11	17.275	19.675	24.725
12	18.549	21.026	26.217
13	19.812	22.362	27.688
14	21.064	23.685	29.141
15	22.307	24.996	30.578
16	23.542	26.296	32.000
17	24.769	27.587	33.409
18	25.989	28.869	34.805
19	27.204	30.144	36.191
20	28.412	31.410	37.566

APPENDIX 3

Raw data and method of calculation for hypothesis testing for unregistered restaurants

2	7	35	16	60
6	9	15	30	60
0	4	22	34	60
0	12	19	29	60
3	13	21	23	60

0	12	32	10	54
0	0	25	35	60
11	57	169	177	414

Column totals

Observed (O) value
totals

Row

Grand Total

Expected (E) Value = (Row Total) (Column Total) / Grand Total

degrees of freedom (df) = (c-1) (r-1); (4-1) (7-1) = 18

O=2 E= 1.59	O = 7 E = 8.26	O= 35 E = 29.49	O= 16 E = 25.65
O = 6 E = 1.59	O = 9 E = 8.26	O= 15 E = 29.49	O= 30 E = 25.65
O= 0 E = 1.59	O= 4 E = 8.26	O= 22 E= 29.49	O= 34 E= 25.65
O= 0 E= 1.59	O= 12 E= 8.26	O= 19 E=29.49	O=29 E=25.65
O=3 E= 1.59	O=13 E=8.26	O=21 E=29.49	O= 23 E= 25.65
O= 0 E=1.43	O=12 E=7.43	O= 32 E= 22.04	O=10 E= 123,09
O= 0 E=1.59	O= 0 E= 8.26	O= 25 E=29.49	O= 35 E= 25.65

Chi square value (X^2) =

Where: O is the observed value

E is the expected value

If X^2 value is greater than the tabulated value, reject null hypothesis (H_0)

If X^2 value is smaller than tabulated value, accept null hypothesis (H_0)

H₀2: Unregistered Quick Service Restaurants in Mutare employ ineffective food safety practices

Observed (O)	Expected (E)	(O-E)	(O-E) ²	(O-E) ² /E
2	1.59	0.41	0.17	0.11
7	8.26	-1.26	1.59	0.19
35	29.49	5.51	3.36	1.03
16	25.65	-9.65	93.12	3.63
6	1.59	4.41	19.45	12.23
9	8.26	0.74	0.55	0.07
15	29.49	-14.49	209.96	7.12
30	25.65	4.35	18.92	0.74
0	1.59	-1.59	2.53	1.59
4	8.26	-4.26	18.15	2.2
22	29.49	-7.49	56.1	1.9
34	25.65	8.35	69.72	2.72
0	1.59	-1.59	2.53	1.59
12	8.26	3.74	13.99	1.69
19	29.49	-10.49	110.04	3.73
29	25.65	3.35	11.22	0.44
3	1.59	1.41	1.99	1.25
13	8.26	4.74	22.47	2.72
21	29.49	-8.49	72.08	2.44
23	25.65	-2.65	7.02	0.27
0	1.43	-1.43	2.04	1.43

12	7.43	4.57	20.88	2.81
32	22.04	9.96	99.2	4.46
10	23.09	-13.09	171.35	7.42
0	1.59	-1.59	2.53	1.59
0	8.26	-8.26	68.23	8.26
25	29.49	-4.49	20.16	0.68
35	25.65	9.35	87.42	3.41
Totals 414	443.93	-29.93	1206.77	77.72=X²

TABLE OF CRITICAL X² VALUES UP TO 20 DEGREES OF FREEDOM

Df	$\alpha = 0.10$	$\alpha = 0.05$	$\alpha = 0.01$
1	2.706	3.841	6.635
2	4.605	5.991	9.210
3	6.251	7.815	11.345
4	7.779	9.488	13.277
5	9.236	11.070	15.086
6	10.645	12.592	16.812
7	12.017	14.067	18.475
8	13.362	15.507	20.090
9	14.684	16.919	21.666
10	15.987	18.307	23.209
11	17.275	19.675	24.725
12	18.549	21.026	26.217
13	19.812	22.362	27.688
14	21.064	23.685	29.141
15	22.307	24.996	30.578
16	23.542	26.296	32.000
17	24.769	27.587	33.409
18	25.989	28.869	34.805
19	27.204	30.144	36.191
20	28.412	31.410	37.566

APPENDIX 4

Questionnaire for managers/supervisors

Introduction

My name is **Tendai Forichi** (Registration number **R131007X**). I am currently a **2nd year student** at the **Midlands State University (MSU), Gweru** studying towards a **Master's Degree in Safety, Health and Environmental Management**. I am carrying out a research project to compare and assess food safety practices employed by food outlets in Mutare. Please assist me by responding to the questions below. Your cooperation will be greatly appreciated.

Notes to assist in completing the questionnaire:

This survey questionnaire should be completed with the understanding that:

- Organization identity and any information obtained from you will remain confidential and will not be released without advanced approval by the organization.
- The results of study will be used solely for academic reasons and will not be published without your consent.
- The questions are designed to evaluate your company's food handling operations. There are no right or wrong answers. Some components of this questionnaire may or may not be applicable to all operations

The questionnaire comprises 8 sections

I kindly ask that you indicate the statements which you feel are particularly important to you and your business **by ticking** (√) the relevant box.

It is estimated that the questionnaire will take 15 minutes to complete, and will be collected from you upon completing.

Thank you for your time and effort in this

General questions

- Current position at present institution.

Manager Supervisor

- Highest level of education attained.

‘O’ Level ‘A’ Level Degreed

Potential sources of contamination

- Is there a management program in place that identifies potential sources of contamination? Yes No

- Are there specified zones where waste is disposed at your institution? Yes
No

- If yes, how further is the waste disposal zone(s) from the kitchen(s)?.....
.....

- Are the ablution facilities (toilets) in the same building with the kitchen? Yes
No

- Are there running water basins and soap dispensers in both staff toilets and consumer’s toilets? Yes No

- What measures do you implement to prevent cross contamination at your food service facility (specify)
.....
.....
.....

- Are swab tests conducted periodically to food handlers? Yes No
sometimes
- Do you have separate cabinets where brushes, mops and wiping cloths are kept?
Yes

No
- Is there a separate room or lockers from the food preparation area where employees have their baggage and possessions kept? Yes No

Pest and pathogen control management

- Please state any practice(s) you use to control pests at your facility.....
.....
.....
- Does your institution comply with all relevant regulations regarding pest control in food service system? Yes No
- Is an independent party used to assure/inspect pest control compliance at your institution?

Yes No
- Are the records available for review? Yes No

Employee Health and Hygiene

- How often do food handlers go for medical examinations? Monthly Yearly

Do not go

Specify.....

- Are management programs for health and hygiene practices in place to minimize the risk of contamination from food, employees, and equipment? Yes No
N/A

- How do you handle ill employees at your company?

.....
.....
.....

- Are employees given medical certificates as proof that they do not have health problems which affects the safety of the food? Yes No

- Are employee health and hygiene management documents available for review?
Yes No N/A

Employee Training Programme

- Is there a reviewed document for employee food safety programme? Yes No

- Do you conduct awareness training on associated practices for food handling employees?

Yes

No

- How often do you conduct personnel hygiene training with employees at your facility?

.....
.....

- Do you address the following training programmes for food handlers at your

institution? (please tick the appropriate practice)

Sanitation programmes	
Employee health	
Hand washing and sanitizing	
Employee hygiene	
Appropriate use of protective and sanitary clothing and supplies	

Warehousing and cold storage

- Are your warehouse(s), storeroom(s) and refrigerators(s) proof against rodents and insects? Yes No

- Is there a reviewed documented system which ensures that purchased materials and ingredients are safe from contamination while under storage ?Yes No

- Are there any practices which ensure that food is stored at the proper temperature/storage conditions? If there are please specify.....
.....
.....

- Does your food service facility have documented procedures for warehousing, storage of materials, ingredients and prepared food? Yes No

General history on foodborne diseases

- Has there been any occurrence of a food borne disease outbreak or illness in the history of the institution? Yes No I do not know

- Has there been any case which was reported of a client or staff member to have had a foodborne illness in the history of the institution?

Yes No I do not know

Transport and Procurement

Please state your suppliers of raw food stuffs including ingredients used in preparing food

.....
.....
.....
.....

Describe the mode of transport used by suppliers in transporting raw food including meat and meat products to you

.....
.....
.....
.....

Describe the steps and practices involved in receiving raw food from suppliers up to the point of food preparation

.....
.....
.....
.....
.....
.....

• **Do you have any comment regarding food safety at your food outlet?** No Yes
Comment:.....

.....
.....
.....

.....*******THANK YOU FOR YOUR
COOPERATION*******

APPENDIX 5

Questionnaire for food handlers

Introduction

My name is **Tendai Forichi** (Registration number **R131007X**). I am currently a **2nd year student** at the **Midlands State University (MSU), Gweru** studying towards a **Master's Degree in Safety, Health and Environmental Management**. I am carrying out a research project to compare and assess food safety practices employed by food outlets in Mutare. Please assist me by responding to the questions below. Your cooperation will be greatly appreciated.

Notes to assist in completing the questionnaire:

This survey questionnaire should be completed with the understanding that:

- Organization identity and any information obtained from you will remain confidential and will not be released without advanced approval by the organization.
- The results of study will be used solely for academic reasons and will not be published without your consent.
- The questions are designed to evaluate your company's food handling operations. There are no right or wrong answers. Some components of this questionnaire may or may not be applicable to all operations

The questionnaire comprises 17 questions

I kindly ask that you indicate the statements which you feel are particularly important to you and your business **by ticking** (√) the relevant box.

It is estimated that the questionnaire will take 15 minutes to complete, and will be collected from you upon completing.

Thank you for your time and effort in this

1. Gender. Male Female

2. Age (years)

- 25-33 34-41 42 and over

3 Highest level of education attained.

'O' Level 'A' Level Degreed

- Do you clean and sanitize cutting surfaces after cutting up raw meat? Yes
No

5 How do you clean your equipment?

Using cold water and soap using warm water and soap using hot water and soap

- How do you handle food left overs?

.....

- Do you wash fruits and vegetables thoroughly under running water to remove dirt and other contaminants? Yes No

- Do you clean and sanitize cooking utensils after each use or when there is a chance that they have been contaminated? Yes No Sometimes

- Do you wash your hands after the following action:

	Yes	No	Sometimes	N/A
Before starting work and after any break , after visiting the toilet				
After handling raw food (meat, fish, eggs and vegetables)				
After handling dirty equipment including money				

After handling delivery packaging				
After handling refuse				
After cleaning surfaces or equipment				
After coughing/sneezing				
After scratching or touching your hair				

- Do you use a calibrated food thermometer when checking food temperatures?
Yes No

- Do you divide large quantities of food into smaller containers to cool the food more quickly? Yes No Sometimes

- Do you cover and correctly label prepared food before storage and serving?
Yes No Sometimes

- Do you use the leftover food first? Yes No

- Where do you store leftover foods? (Tick the appropriate box)

In the refrigerator	
In the oven	
On the kitchen counter	
On the stove	
In the cupboard	
None of the above (specify)	

- Do you separate raw and cooked foods to prevent contaminating the cooked

foods?

Yes No

16 Do you store raw meat in the refrigerator below a separate from ready- to-eat or prepared foods? Yes No

17.Do you have any comments regarding food safety at your organization? Yes
No

.....
.....
.....
.....
.....

*******THANK YOU FOR YOUR
COOPERATION*******

18-25 25-33 34-41 42 and over

7. Do you have hand washing basins with running water and soap dispensers in the dining halls? Yes No

8. Are you pleased with the daily appearance and maintenance of your ablution facilities (toilets) in terms of sanitation and hygiene? Yes No

9. How do you rate food handler’s cleanliness, hygiene and appearance at your institution?

Excellent Good Satisfactory Unacceptable

10. Are you pleased with the hygiene in your dining hall(s)? Yes No

11. Are your dining hall(s) well ventilated? Yes No

12. Have you ever noticed undesirable food safety practices being exhibited by food handlers at your institution? Yes No

If yes, state them.....

13. What do you think your food service department should do to improve the food safety standards of your institution?.....

14. Have you ever suffered from a suspected food borne illness after consuming a meal from your dining hall? YesNo.....

15. If yes, did you communicate/report the illness? Yes.....No.....

16. If you were a Food Safety Inspector, how would you rate the following food safety practices at your institution? (Tick the appropriate box)

Practice	Excellent	Good	Satisfactory	Undesirable
Sanitation and hygiene of the whole food service facility				
Employee health				

Employee hygiene				
Availability of hand washing facilities				
Equipment, containers, facility sanitation and equipment				
Toilet facility sanitation, hygiene and maintenance.				
Proper hand washing facilities for food handlers and adequate employee training.				

17. If you are a student what programme are you studying?.....

18. If you are a staff member what is your expertise at the institution?.....

*****THANK YOU FOR YOUR
 COOPERATION*****

APPENDIX 7

FOOD SAFETY OBSERVATION GUIDE FOR FOOD SERVICE OUTLETS

Name of institution.....

	Yes	No	N/A
<ul style="list-style-type: none">Handwashing			
Is there supply of hot and cold running water, liquid soap and disposable towels on hand wash basins?			
Are hands washed frequently, in particular on the following occasions:			
<ul style="list-style-type: none">Before starting work			

• After visiting ablutions			
• After handling raw food (meat, fish, pastry, eggs, vegetables)			
• After handling dirty equipment (including money)			
• After handling delivery packaging			
• After handling refuse			
After cleaning surfaces or equipment			

	Yes	No	N/A
• Personal habits			
Is direct handling instead of using implements such as tongs and spoons evident?			
Are the following bad habits evident which include:			
-Use of tobacco			
- Tasting food by dipping fingers or reusing an unwashed spoon			
-Scratching			
-Coughing/sneezing over food			
-Taking breaks in food rooms			

-Washing hands in a food equipment sink sitting or sitting on food preparation surfaces			
-Touching hair			

• Temperature control	Yes	No	N/A
Are food storage areas and equipment kept within the following specification;			
-Ambient stores (e.g. dry goods, produce, bread) to be within 10 to 23°C			
-Freezers to operate at or below 18°C			
-Do all refrigeration equipment have a temperature display on the casing, or have an internal thermometer?			
-Are all 'high risk' food (e.g. cooked food, soft cheeses, and prepared salads) and those not stable at ambient temperature (e.g. raw meat, uncooked dough and fresh pasta products) stored under refrigeration?			
-Are doors of refrigeration equipment opened only when necessary and closed immediately after use (not propped open for convenience)?			

-Are fridges overloaded and is air circulation adequate?			
-Any food found to be fully or partially thawed must not be refrozen?			

	Yes	No	N/A
• Refuse disposal			
Are bins taken to the external refuse store when full and at the end of each session?			
Are bins taken to the external refuse store when full and at the end of each session?			
Are contents of internal refuse stores removed outside at the end of each day?			

	Yes	No	N/A
• Staff facilities			
Do you have facilities separate from food rooms where they can change and store their street clothes and personal effects?			
Are toilet facilities separately provided for staff?			
Are all facilities kept in a good state and cleaned daily?			

Are lockers for staff clothing and other belongings provided and located in the changing room?			
Do toilets have a wash hand basin, with liquid soap and paper towels and a sign stating “Now wash your hands” on display?			
Are warm air hand dryers and paper towels available?			

	Yes	No	N/A
• Documents			
Is a current food handling license displayed or present?			

APPENDIX 8

APPROVAL FORM

The undersigned certify that they have read and recommended to the Midlands State University for acceptance a dissertation entitled: **Comparative analysis of food handling practices employed by registered and unregistered quick service restaurants: The case of City of Mutare**

By

.....

Submitted in partial fulfilment of the requirements of MSc Degree in Safety, Health and Environmental Management.

STUDENT.....**DATE**.....

SUPERVISOR..... **DATE**.....

CHAIRPERSON.....**DATE**.....

EXTERNAL EXAMINER.....**DATE**.....