

**HYGIENIC PRACTICES OF THE STREET FOOD
VENDORS AND MICROBIOLOGICAL QUALITY OF
SELECTED COOKED STREET FOODS IN MOMBASA
ISLAND, KENYA**

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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE
DEGREE OF MASTERS OF SCIENCE IN HOSPITALITY AND
TOURISM MANAGEMENT OF KENYATTA UNIVERSITY.**

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*Hygienic practices of
the street food*

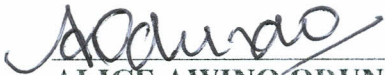


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DECLARATION

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



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DEDICATION

This thesis is dedicated to the creator, the Almighty God, who gave me the wisdom and strength to accomplish it despite the many challenges.

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Writing of a thesis calls for cooperative efforts from a number of key individuals and institutions. While it might not be possible to acknowledge all those who assisted me individually, some minimum crediting is inevitable.

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ABSTRACT

The street food sector has experienced significant growth in the past few decades due to rapid urbanisation. Despite the economic benefits of the sector, it has been recognized as a potential hazard to public health when food is not prepared and handled hygienically. The objective of this study was to assess the hygienic practices of the street food vendors, isolate and identify food pathogens in particular, *Escherichia coli* and *Salmonella* strains. The potential link between food contamination and the risk factors in some selected cooked street vended foods namely, *mahamri*, *beef samosas* and *mbaazi* in Mombasa Island was established. The study adopted a descriptive survey and experimental design. It was carried out in three locations in Mombasa Island namely, Old Town, Mwembe Tayari and Majengo. One hundred vendors were selected using purposive and systematic random sampling. Representative samples of the food items were randomly collected from five vendors in each of the three locations for microbiological analysis. Standard methods from the Bacteriological Analytical Manual of Foods were used to determine coliform counts, total plate counts, and isolate *E.coli* and *Salmonella* strains. Data on the hygienic practises and the risk factors were collected using questionnaires, focus group discussions and an observation checklist. Data collected were analysed using Statistical Package of Social Sciences (SPSS) computer software. The techniques used to analyse data were one-way analysis of variance (ANOVA) at 95% level of confidence interval (CI), t- tests and chi-square (X^2). The main findings were that, poor hygienic practises was observed among vendors, which were in contrast to the guidelines from the Kenya Foods, Drugs and Chemical Substance Act. These poor hygienic practices were mainly due to lack of basic training in food hygiene. *E. coli* was isolated in all the 45 food samples tested, though the counts were within the acceptable limits of 10 per g. *Salmonella* was detected in 8.9% out of the 45 samples tested, which were *beef samosas*, and this was considered a risk to consumers. Total plate counts and coliform counts were within the acceptable limits. The most notable risk factors that could have led to food contamination were, poor hygienic practices, in particular, use of bare hands to serve food, poor sanitary environment such as waste water sewage and lack of formal education. There was a statistical significant association between these factors and contamination of food ($P < 0.05$). *Mahamri* and *mbaazi* presently sold on the streets in Mombasa Island are safe for consumption, in relation to the pathogens *E. coli* and *Salmonella*. *Beef samosas* are a risk to consumers given the percentage that tested positive for *Salmonella*. The study concluded that production of relatively safe street vended foods that have low bacterial counts could be possible if appropriate measures such as education of the street vendors in food safety risks and food-handling practices are used. Based on these findings, it was recommended that street food vendors should be officially recognised, licensed and included in the urban development programme.

TABLE OF CONTENTS

Title page	
Declaration	i
Dedication	ii
Acknowledgements	iii
Abstract	iv
Table of Contents	v
List of Tables	viii
List of Figures	ix
List of Acronyms and Abbreviations	x
CHAPTER 1: INTRODUCTION	1
1.1.0 Background Information	1
1.1.1 Economic Importance	2
1.1.2 Burden of Food-Borne Diseases	3
1.1.3 Socio-economic Consequences of Street Food Contamination	4
1.2.0 Problem Statement and Justification	5
1.3.0 Research Questions	7
1.4.0 Null Hypotheses	7
1.5.0 General Objectives	7
1.5.1 Specific Objectives	7
1.6.0 Significance of the Study	7
1.7.0 Limitation of the Study	8
1.8.0 Operational Definitions of Terms	8

CHAPTER 2: LITERATURE REVIEW	10
2.1.0 Socio-economic Contribution of Street Vended Foods	10
2.2.0 Food Safety in Street Vended Foods	13
2.3.0 Food-Borne Illnesses as Challenges to Food Safety	15
2.4.0 Major Food- Borne Diseases from Microorganisms	17
2.5.0 Microbial Contamination in Street Vended Foods	20
2.6.0 Factors Contributing to Contamination of Street Vended Foods	24
CHAPTER 3: METHODOLOGY	26
3.1.0 Research Design	26
3.2.0 Study Location	26
3.3.0 Target Population and Sample Selection	28
3.4.0 Data Collection Instruments	28
3.5.0 Pre-testing of Instruments	29
3.6.0 Data Collection Procedures	29
3.6.1 Sample Collection and Transportation	29
3.7.0 Microbiological Analysis	30
3.7.1 Sample Preparation	30
3.7.2 Test for Total Plate Count	30
3.7.3 Test for Coliform Group	31
3.7.4 Test for <i>Escherichia coli</i>	31
3.7.5 Test for <i>Salmonella</i>	31
3.8.0 Data Analysis	32

CHAPTER 4 RESULTS	33
CHAPTER 5 DISCUSSIONS	51
CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS	63
REFERENCES	67
APPENDICES	
7.1 Appendix A: Questionnaire and Observation Guide	72
7.2 Appendix B: Focus Group Discussions	79

LIST OF TABLES

Table 1:	The characteristics of the street food vendors	34
Table 2A:	Basic food hygiene training and hygienic practises between trained and untrained vendors in relation to protective clothing and medical examination	36
Table 2B:	Basic food hygiene training and hygienic practises between trained and untrained vendors in relation to jewellery, fingernails and handling of food and money	37
Table 2C:	Basic food hygiene training and hygienic practises between trained and untrained vendors in relation to smoking and covering of food items	38
Table 3:	Mean bacterial counts in the sampled food items	39
Table 4:	ANOVA test for total plate counts and coliform counts	40
Table 5:	ANOVA test for <i>E.coli</i>	41
Table 6A:	Basic training in food hygiene, food preparation and level of education in relation to food contamination	43
Table 6B:	Food display and place of sale in relation to food contamination	44
Table 6C:	Environment of food sales in relation to food contamination	45
Table 6D:	Food covering and materials used in relation to food contamination	46
Table 6E:	Nature of the roads and water sewage in relation to food contamination	47
Table 6F:	Hygienic practices of the vendors in relation to food contamination	48
Table 6G:	Items used for service and food handling in relation to food contamination	49
Table 6H:	Place of food preparation and left-over foods in relation to food contamination	50

LIST OF FIGURES

Figure 1:	Map of Mombasa Island	27
Figure 2:	Hygienic practices of the street food vendors	35

ACRONYMS AND ABBREVIATIONS

- CDCP Centers for Disease Control and Prevention.
- FAO Food and Agriculture Organization.
- NRI Natural Research Institute.
- WHO World Health Organization
- EPOC Equity Policy Centre
- NIAID National Institute of Allergy and Infectious Diseases
- FGD Focus Group Discussions
- ICMSF International Commission of Microbiological Specification of Food.

CHAPTER 1

INTRODUCTION

1.1.0 Background Information

Street foods are ready to eat foods and beverages prepared or sold by vendors or hawkers especially in streets and other public places (FAO, 1989). The characteristic of street foods is their retail location, that is "on the street": from pushcarts, baskets, trays or basins with few having permanent structures. According to Draper (1996), they are an extremely heterogeneous food category encompassing, meals, drinks, and snacks. They show variation in terms of ingredients, methods of retail, processing and consumption. Street vended foods differ greatly between countries and cultures. The street food trade is a growing sector in many developing countries today. Its expansion is linked to urbanization and the need of urban populations for both employment and food. Urbanisation is characterised with considerable distance between home and workplace, tight time schedules and long working hours (Mwangi, 2002). Other factors include, small housing conditions not conducive for cooking and lack of knowledge of cooking by migrants without families. Data available on the consumption of street foods show that they are inexpensive and readily available (Draper, 1996). In many countries, the foods form an integral part of the diet. They are consumed with regularity and consistency across all income groups, particularly by the urban poor and in some countries, children.

The street food trade is a necessary part of the urban modern day life, especially in a developing country like Kenya. This trade however, is seen as a

problem, a challenge, and an opportunity for development (WHO and Ministry of Health, Kenya, 1994). The problem is control of quality and safety of foods offered for sale while the opportunity is the strengthening of traditional and local food habits, and development of small industries and cooperative marketing structure. The challenge is to provide government, local authorities and municipalities with the means to ensure the safety and quality of street food, while at the same time encouraging the formal development of the sector.

1.1.1 Economic Importance

Street vended foods are an ancient, almost universal phenomenon in both developing and industrialised countries (Garin *et al.*, 2002). With the growth of urbanization, there has been a corresponding development of the informal sectors of the economy and more specifically, of street vended foods. These foods contribute significantly to the economy of many countries and, an estimated two and half billion people worldwide consume them (FAO, 2001a). Projects by Equity Policy Centre (EPOC), Bogor and FAO studies have shown that, the street food trade generates a large volume of business and money (Draper, 1996). It also provides a competitive source of employment and income to millions of people. For instance, FAO estimated that approximately 100,000 vendors in Malaysia had a collective total annual sales amounting to \$2 billion. The EPOC studies found that, the annual volume of trade ranged from \$67 million in Bogor, a city of 250,000 people, to \$2 million in Manikganj, a small provincial town of 38,000 people. The trade provides employment to a large number of workers (FAO, 2001b). Women are often owners or employees of the street food business (WHO, 1992). For example, in

Benin, Ghana, and Togo, it was estimated that women represented 70 to 90 percent of vendors (Natural Research Institute, UK, 2000). They did this primarily to improve the food security of their households and to have some degree of financial independence. A study in Uganda found that, most vendors earned more than the minimum government civil service wage (Draper, 1996). In Accra, Ghana, a one-year preliminary survey indicated that the street food sector employed over 60,000 people (Natural Research Institute, UK, 2000). It had an estimated annual turnover and a profit of US\$100 million and US\$24 million respectively. In the EPOC project, the street food trade comprised from about six percent of the total labour force in Zinguichor, Senegal and Manikganj, Bangladesh to 15 percent and 25 percent in Iloila city, the Philippines and Bogor, Indonesia respectively (Draper, 1996).

1.1.2 Burden of Food-Borne Diseases

The burden of food-borne diseases is significant in all parts of the world (FAO, 2001b). For some notable food-borne hazards, the reported incidence of diseases has increased over the last decades. While cooked street foods provide an essential service to a large population and a source of income for a large number of sellers, they are recognized as a possible hazard to public health (Garin *et al.*, 2002). In recent years, there has been an increased outbreak of food-borne diseases (Natural Resources Institute, UK, 2003). This has imposed a heavy social and economic burden on communities and their health systems. An estimated 9 million cases of food-borne illnesses occur in the United States every year, amounting to a cost of around \$8.4 billion (Klontz *et al.*, 1995). In developing countries, diseases caused by contaminated food constitute one of

the most widespread health problems and is a major cause of reduced economic activity (FAO/WHO, 1984; Motarjemi *et al.*, 1995; FAO/WHO, 1986). In the past decades, the epidemiology of food-borne diseases has changed with several new microorganisms and re-emerging pathogens (Angelillo *et al.*, 2000). These pathogens include *E.coli* 0157:H7 and *Shigella boydii*, which are life threatening to most individuals (CDCP 2002).

Microbiological agents such as, bacteria, viruses, and parasites are the cause of the food-borne diseases (FAO/WHO, 1984). They are manifested with gastrointestinal symptoms such as diarrhoea, abdominal pain, nausea, and vomiting (FAO/WHO, 1986). Pesticides, use of unpermitted chemical additives and environmental contamination have also been identified as possible hazards (Draper, 1996). Approximately 1,500 million global episodes of diarrhoea that occur annually result in three million deaths among children under five (mainly from developing countries). Of these, 70 percent are caused by biologically contaminated foods, substantially contributing to malnutrition (WHO, 2002a; FAO/WHO, 1986). Bacterial infections caused by *Salmonella*, *Escherichia coli* 057:H7, *Campylobacter*, *Shigella* and *Vibrio cholera* are the most prevalent (CDCP, 2002). These infections are characterized by diarrhoea and vomiting.

1.1.3 Socio-economic Consequences of Street Food Contamination

The social and economic impact of food contaminants is of serious consequence to many countries. Food-borne diseases are very costly in terms of loss of income, manpower and medical care (Motarjemi *et al.*, 1995). For example, the cost of treating *Salmonellosis* was estimated to be US\$1000

million in 1987 in the United States of America. According to Altekruse *et al.*, (1995), over 10 percent of the United States population experience food borne illness each year, at an annual cost of \$10 billion.

Against the above background, if street vended foods are going to play an increasingly important role in national economy, current information on such aspects as food-borne health risks and constraints to compliance with the Codex Alimentarius standards is required. Other considerations would include, cultural eating habits and awareness of the vendors regarding food safety, hygiene and quality assurance. The findings of this study are useful in designing more strategies and policies, to improve the quality and safety of street vended foods in Kenya.

1.2.0 Problem Statement and Justification

In many developing countries, street vended foods are an increasingly important part of daily life. However, the livelihoods of those in this informal food business and the health of consumers could be jeopardized if problems of food safety and hygiene are not addressed. The hygienic aspect of vending operations is a major concern. Stands are often located in areas where running potable water is not readily available and sanitation is poor. Safe food storage temperatures are difficult to maintain, as food is often displayed for long periods. Some foods may not be adequately reheated before being served, thus leading to contamination by microorganisms such as *Salmonella*. In addition, adequate washing facilities are rarely available, and the washing of hands, utensils and dishes are often done in buckets or bowls. Some vendors operate a few meters away from garbage dumps and discard wastewater in the streets.

These practices attract insects and rodents to food service points, and pose the risk of contamination especially to the inadequately covered food items. In many cases, toilets are not available, thus forcing the vendors to dispose of body wastes in nearby areas, and return to their vending sites without washing their hands. These poor sanitary conditions with the pollutants are likely to contaminate food with all kinds of pathogenic organisms. The majority of consumers, who are not aware or concerned about safety, are also exposed to substantial health risks.

Despite the adverse socio-economic and health consequences of contaminated foods and beverages, food-borne diseases have not been adequately investigated in order to develop quality control measures and policy formulation. Presently, application of the general principles of food hygiene, in accordance with the Codex Alimentarius Commission standards and codes of practice, is central to global efforts to prevent food contamination and ensure food safety in the food chain. Unfortunately, the application of such standards and principles is limited and difficult to be met by street foods vendors in developing countries. This study was planned to identify the level of microbial contaminants in the selected cooked street vended foods. The hygienic practises of the street food vendors and the predisposing factors that led to contamination was assessed. The information obtained will help fill in the information gap regarding food safety and quality of some street vended foods in Mombasa Island.

1.3.0 Research Questions

1. Are cooked foods sold on the streets in Mombasa Island safe for consumption?
2. What are the risk factors involved in the contamination of the street vended foods?
3. How are the hygienic practices of the street food vendors?
4. What is the bacterial load in the street vended foods?

1.4.0 Null- Hypothesis

There are no bacterial risks posed by cooked street vended foods in Mombasa Island

1.5.0 General Objective

To establish the safety and microbiological quality of some cooked street vended foods in Mombasa Island.

1.5.1 Specific Objectives

1. To assess the hygienic practices of the street food vendors.
2. To isolate and identify bacterial contaminants particularly, *Escherichia coli* and *Salmonella*, in selected cooked street foods on Mombasa Island.
3. To establish the potential link between food contamination and the risk factors.

1.6.0 Significance of The Study

This study assessed the hygienic practices of street food vendors and identified the bacterial contaminants in some cooked street vended foods in Mombasa Island. Presently, very little data concerning the incidence of food-borne diseases and information related to the quality and safety of the street foods is

available in Mombasa, Kenya. The results obtained from this study, will give the Ministry of Health, specific and quantitative information, on existing public health risks of these foods in Mombasa. The findings are also helpful in the potential interventions necessary to promote the safety and hygiene of the street vended foods, thereby reducing health risks to the public.

1.7.0 Limitation of Study

The street food vendors in the study, and the samples analysed are from Mombasa Island. Since these types of foods are mainly in Mombasa, and the prevailing conditions of Mombasa differ from other areas (as they have different characteristics), the results obtained can only be generalised with caution.

1.8.0 Operational Definitions of Terms

For the purpose of this study:

Street Food Vendor - A person who sells food on the streets.

Mobile Vendor - A person moving around selling food on basins, baskets, trays or pushcarts.

Stationary Vendor - A person selling foods from a permanent place, either on a makeshift stall or down on the pavement. For example, in front of shops or along the road.

Hygiene - All conditions and measures necessary to ensure the safety and suitability of food.

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

- Mahamri* - Deep-fried leavened wheat bun somewhat similar to doughnuts
- Mbaazi* - Pigeon peas cooked in coconut milk
- Beef samosas* - Deep fried pies filled with spiced beef.
- Sufuria* - An aluminium cooking pot
- Lessos* - Rectangular cotton cloth used for wrapping around the waist and shoulders.
- Githeri* - Dish made from beans and maize

Food-borne Disease - Any disease of an infectious or toxic nature caused by consumption of contaminated food or water.

In this study, the level of bacterial load in the street vended foods will depend on the safety measures and hygienic practises of the street food vendors.

CHAPTER 2

LITERATURE REVIEW

Literature was reviewed in line with the area of study under the following sub-topics: Socio-economic contribution of street vended foods; food safety in street vended foods; food-borne illnesses as challenges to food safety; major food-borne diseases from microorganisms; microbial contamination in street vended foods and factors contributing to contamination of street vended foods.

2.1.0 Socio-economic Contribution of Street Vended Foods

Street food vending is a global business, and the trade makes substantial contribution to urban economies (WHO, 1996). The street food sector has experienced substantial growth due to the socio-economic changes in many countries (Kishwar, 2001). It is estimated that, two and a half billion people worldwide consume street foods (FAO, 2001b). It provides employment for a large number of people especially women. In Kenya, the majority of vendors are women who balance the income generating opportunities of street vending, with traditional household and child-care duties (Mwangi, 2002). School children depend on street foods (FAO, 1997). For example, school canteens in Chonburi, Thailand and Iloilo, Philippines used local street food vendors to supply them with a daily light meal. In addition, in Ile-ife, Nigeria, 96 percent of elementary school children typically buy their breakfast from street vendors. Studies on street foods conducted across Asia found that street foods are not only cheaper than restaurant or fast foods, but are more cost effective than home prepared foods (Kishwar, 2001; Tinker, 1997). This is possible, especially if factors like time spent on shopping and cooking is taken into

account.

The street food trade is large and complex, providing both an important means of income generation and an affordable source of food for many millions of people (Draper, 1996). In Calcutta, 130,000 street vendors made an estimated annual profit of nearly US\$100 million, while in Malaysia approximately 100,000 vendors collected an annual sale amounting to over \$2 million (Draper, 1996). In 1994, an estimated R44, 7 million was spent on street food outlets in Gauteng South Africa. Blacks in the Durban metropolitan area spent R16, 7 million, and Asians R2, 1 million at these food outlets in 1998 (Martins and Anelich, 2000). An increase in employment in this sector was noted in Kenya (WHO and MOH, Kenya 1994). The earnings of this group per month was almost ten times the basic salary of a person in formal employment or more. Mwangi (2002), in her study found that street foods in Nairobi, Kenya, provided a substantial amount of income for most vendors, with most of them earning an income above the official minimum wage. Some of them, earned twice or more above the minimum wage.

According to Escalante (2001), the street food trade is vital for the providence of income to the small farmers. These farmers supply the food vendors with the local produce, thus stimulating and generating employment in the agricultural sector. Street food vendors/hawkers use fresh, unpackaged, and locally sourced ingredients for their foods, thereby providing income for the local farmers. If they are eliminated, these small-scale farmers would lose to the large-scale producers who are able to sell to formalised sectors of major retail and distribution networks.

The consumers of street vended foods find them to be easily accessible, relatively safe, affordable, nutritious and delicious (FAO, 2001a). They also play a major role in the nutritional intake of the urban and peri-urban dwellers. For example, in Bangkok, Thailand, the 20,000 street food vendors provide for 40 percent of the city residents' overall energy intake. In Bogor, Indonesia, a study showed that, it was possible to obtain almost half the recommended daily allowance of protein, iron and vitamins A and C from a meal costing about US \$ 0.25 (FAO, 1997). Street foods may be the least expensive and best method of obtaining a nutritionally balanced meal outside the home, if the consumer is informed and able to choose the proper combination of food. In Kenya, vast majority of vending households feed from the street food pot on a daily basis (Mwangi, 2002). These foods are able to provide more than adequate protein, iron, and substantial amounts of daily energy requirements.

Another important aspect of street vended foods is the crucial role it plays in the preservation of traditional and local culture (Escalante, 2001). Some traditional snacks or foods only appeal to consumers by the way the vendors prepare them on the streets. Preparation of some traditional foods (like *githeri*) is usually time and fuel consuming for the urbanite (Mwangi, 2002). Hence, people tend to buy traditional ready to eat foods from sources such as street food vendors. Street foods are sometimes considered "fast foods" with a traditional twist, given the great variety that could be procured easily and cheaply. In certain countries like Thailand, Malaysia, and China, street vended foods are so prevalent, that they are considered as part of the local culture (Chakravarty and Canet, 1996). There being many ethnic groups in Calcutta,

the street foods represent a mixed cuisine including foods from the different Indian states as well as international fare. More than 50 items of pre-cooked or instantly cooked foods are available at food stalls in India.

2.2.0 Food Safety in Street Vended Foods

Food can be exposed to pathogenic agents, both chemical and biological (viruses, parasites and bacteria), from which no one in either developing or developed countries are spared (WHO, 2003). The safety of foods is therefore a serious consideration, which deserves considerable attention, as it is the first step in reducing food borne illness. WHO, (2002a), states that, food safety is a basic human right and safe food contributes to economic growth and poverty alleviation. Losses in public confidence in the street foods do not only jeopardize incomes of vendors, but also their employees, producers and traders. The status of food safety programmes vary from country to country. Many countries have yet to formulate a national food safety policy responding appropriately to their health situations and economy (WHO, 1989). In countries where these policies have been formulated however, they do not reflect appropriately the true nature and extent of the current or emerging food safety problems. According to Mensah *et al.*, (2002), the problems of food safety in the industrialised world differ considerably from those of developing countries. Whereas traditional methods are used for marketing fresh produce in the developing countries, food processing and packaging are the norm in the industrialized countries. In the developing countries, a large proportion of ready-to-eat foods are sold on the streets.

Due to the significance of food safety, a Joint FAO and WHO experts

committee on food safety met in Geneva in 1983 (WHO, 1996). They recommended that efforts should be made to educate the personnel involved in the street food trade, and improve the environmental conditions in which the trade is practiced. Further, in 2002, WHO drew up a global food safety strategy including surveillance and capacity building (WHO, 2002a). As a result, the Joint FAO and WHO Codex Alimentarius Commission (Codex) elaborated many international standards on food safety (WHO, 2002a). International agreements managed by World Trade Organization put even further emphasis on the importance of Codex standards to protect public health, and ensure fair practices in the food trade (WHO, 2003). Loss of foreign exchange caused by importing countries rejecting food containing unacceptable levels of contaminants, is a problem for many exporting countries. Particularly affected are the developing ones with agriculture-based economies (WHO, 2003). The tourism industry is vulnerable, if the reputation of the country regarding food safety is compromised.

If any community is to have the full benefits of street vended foods with minimal risk of food-borne diseases, government intervention is required. This will ensure that the standard of the safety for such foods is attained in the context of the prevailing situation. Everyone, including farmers, growers, manufacturers, processors, food handlers and consumers, have a responsibility to ensure that food is safe, produced under sanitary conditions and suitable for consumption (FAO/WHO, 2001).

2.3.0 Food-Borne Illnesses as Challenges to Food Safety

Food-borne illnesses are a major international health problem and an important cause of reduced economic growth (Mensah *et al.*, 2002). Outbreaks of food-borne illness can damage trade and tourism (FAO/WHO, 2001). This eventually leads to loss of earnings, unemployment, and litigation. Diseases caused by contaminated foods or drinks are still one of the leading causes of morbidity in several countries (Angelillo *et al.*, 2000). Under certain circumstances, they can lead to serious consequences. In industrialized countries, while diseases such as cancer and cardiovascular disorders are the major causes of death, food-borne diseases though less newsworthy, make an enormous contribution (WHO, 1989). The WHO regional office estimated that food-borne diseases might have been the second largest cause of illnesses in Europe during the period 1986 to 1989 (WHO, 1989). This is second in importance only to respiratory tract infections. In Kenya, a report on the East African Medical Journal reported that, 37 major food poisoning outbreaks were reported to the Ministry of health between 1970 and 1993 (Kimani, 2001). This gave an incidence of nearly two outbreaks every year. However, in countries where street food vending is prevalent, there is little information on the incidence of food-borne diseases related to street food vending (Mosupye and Holy, 1999).

Food-borne illness can be caused by microbiological, chemical or physical hazards (WHO Information, 2002). Food contamination by biological agents is now recognized as a public health problem all over the world (WHO, 1989). Most countries with systems for reporting cases of the illness, have

documented significant increase over the past few decades in the incidence of diseases caused by pathogens such as, *Salmonella*, entero-haemorrhagic *Esherichia coli* and *Camphylobacter jejune* (WHO Information, 2002, CDCP, 2002). In 1997, diseases caused by these pathogens were estimated to cost up to US\$35 billion in medical cost in the United States of America (WHO Information, 2002). In Germany, the reported incidence of infectious enteritis rose to 193 per 100,000 in 1990 from 11 per 100,000 in 1965 (WHO, 2003).

In the USA, the estimated incidence for *Salmonellosis* alone was 20 cases per 100,000, with an estimated 7,000 deaths per year. WHO reported that, *Salmonellae* was the major causal agent of food-borne diseases in many countries (WHO, 1989). In addition, the number of cases in man has increased significantly in various countries over the last 30 years. Research in various countries, particularly in the industrialized world has demonstrated that poultry and red meat plays a major causative role in human *Salmonellosis*. Epidemiological studies showed that due to the permanent presence of *Salmonellae* in so many foods, secondary contamination during production, processing and culinary preparation of foods play a greater role. Primary contamination of foods may occur as a result of consuming raw or insufficiently heated foods such as, mince beef, hamburgers, and fresh pork sausages.

Food exposure to agriculture and environmental chemicals is a concern to public health officials in most countries (WHO, 2003). In developing countries, where an overwhelming majority of acute toxicosis occurs, the little published information indicates that there is significant exposure of the general

population to pesticide residues in food. Mycotoxins and other naturally occurring toxins are also known to present acute and chronic health hazards and are a worldwide problem (WHO, 2003).

2.4.0 Major Food-Borne Diseases from Microorganisms

Infectious diseases spread through food or beverages are a common, distressing and sometimes life-threatening problem for millions of people around the world (NIAID, 2002). The U.S. Centres for Diseases Control and Prevention (CDCP) estimated that, 76 million people suffer from food-borne illnesses each year in the United States (CDCP, 2002). This accounts for the 325,000 hospitalisations and more than 5,000 deaths. Kenya recorded one of the highest ever numbers of food poisoning cases in 1990 (Kimani, 2001). A total number of more than 200,000 outpatients were treated at government hospitals. Food-borne diseases especially those caused by pathogenic organisms, remain a serious problem in all countries and are extremely costly to treat (Adams *et al.*, 1999). Health experts estimates that the yearly cost of all food-borne diseases in the United States is \$5 to \$6 billion in direct medical expenses and lost productivity (NIAID, 2002). In developing countries, where the problem of diarrhoeal disease is far greater, the effect on economical activity and development can only be far more severe (Adams, *et al.*, 1999).

Diarrhoea is a feature of most of the food-borne diseases and up to 70 percent of all episodes of diarrhoea may result from ingestion of contaminated food and water (Adams *et al.*, 1999). In most cases, food is not contaminated intentionally, but rather due to carelessness or insufficient education or training in food safety.

Salmonellosis is a major problem in most countries, with *Salmonella* spp. being the causative agent (WHO Information, 2002). Symptoms are fever, headache, nausea, vomiting, abdominal pain, and diarrhoea. Foods that are involved in outbreaks of *Salmonellosis* are, eggs, poultry and other meats, raw milk and sometimes, unwashed fruits. *Salmonellosis* may occur in small, contained outbreaks in the general population or in large outbreaks in hospitals, restaurants, or institutions for the children or the elderly (NIAID, 2002). While the disease is found world wide, health experts have most often reported cases in North America and Europe (Adams *et al.*, 1999). In Latin America and the Caribbean, between 1995 and 1997, the percentage of cases involved in the outbreak of *Salmonella* infections was 43.1 percent (NIAID, 2002). Symptoms are most severe in the elderly, infants and people with chronic conditions. People with AIDS are particularly vulnerable and suffer from recurring episodes.

Campylobacteriosis is a widespread infection and is caused by certain species of *Campylobacter* (WHO Information, 2002). In some countries, the reported number of cases surpasses the incidence of *Salmonellosis*. According to CDCP, *Campylobacter jejuni* is the leading cause of bacterial diarrhoea in the United States (CDCP, 2002). An estimated 2.4 million people every year are affected, and the bacteria causes between 5 and 14 percent of all diarrhoeal illness worldwide (NIAID, 2002). Food-borne cases are mainly caused by foods such as, raw milk, raw or uncooked poultry, infected animal and human faeces and non-chlorinated water (WHO Information, 2002). Infections are accompanied by diarrhoea, abdominal pain, fever, nausea and foul smelling faeces (NIAD,

2002). In 2 to 10 percent of cases, the infection may lead to chronic health problems including, reactive arthritis and neurological disorder (WHO Information, 2002).

Certain types of *Escherichia coli* can cause food borne illness (NIAID, 2002). Harmless strains can be found widely in nature, including the intestinal tracts of humans and warm-blooded animals. The disease causing strains are a frequent cause of both intestinal and urinary-genital tract infection. An enterohemorrhagic strain of *E.coli* emerged in the United States known as *E.coli* 0157:H7 (WHO Information, 2002). It is transmitted in food, and produces one or more related powerful toxins, which causes sever damage to the lining of the intestine (NIAID, 2002). Although their incidence is relatively low, their severity and sometimes fatal health consequences, particularly among infants, children and the elderly, make them among the most serious food-borne infections (WHO Information, 2002). In 1996, *E.coli* 0157:H7 infection from contaminated radish sprouts served in school lunches, caused illness and some deaths among 8,000 children in Japan (WHO Information, 2002). An *E.coli* outbreak infection in the United States of America in 1997 resulted in the recall of 11 million kilograms of ground beef (NIAID, 2002). *E.coli* bacteria have been found in raw or under cooked meats, unpasteurised milk, contaminated water, lettuce and some apple juices. In Kenya, most incidents of food-borne diseases are due to the *E.coli* bacteria (Kimani, 2001).

Cholera, a disease caused by the bacterium *Vibrio cholerae*, is a major public health problem in the developing countries, and causes enormous economic losses (WHO Information, 2002). Water and contaminated foods such as, rice,

vegetables, millet gruel, and various types of seafoods can be the vehicle for infection. Cholera is particularly prevalent in Asia (NIAID, 2002). The symptoms include abdominal pains, vomiting and profuse watery diarrhoea. These symptoms may lead to severe dehydration and possible death, unless fluids and salt is replaced. In Peru, the re-emergence of cholera in 1991 resulted in the loss of US \$500 million in fish and fishery product exports (WHO, 2002b).

Shigellosis, also known as bacillary dysentery, is an infectious disease caused by *Shigella sonnei* (WHO Information, 2002). CDCP estimates that more than 400,000 cases occur every year in the United States (NIAID, 2002). *Shigella* is found in contaminated food and beverages infected by food handlers, who do not wash their hands properly after using the bathroom (CDCP, 2002). Eating vegetables grown in fields containing sewage is a risk factor. Outbreaks of *Shigellosis* frequently occur in tropical or temperate climate, especially in areas with severe crowding and/ or poor hygiene, which sometimes occur in day care and institutional settings (NIAID, 2002).

2.5.0 Microbial Contamination in Street Vended Food

The potential for contamination of street foods with pathogenic microorganisms has been documented. Several outbreaks of diseases including cholera have been reported (Draper, 1996). Studies on street vended foods in America, Asia and African countries have revealed high bacterial counts and a high incidence of food-borne pathogens in food (Mosupye and Holy, 1999). For example, in Italy over 26,000 food-borne illnesses were reported (Angelillo *et al.*, 2000). *Salmonella* spp. and hepatitis A accounted for over 90 percent of

all the cases.

In the mountain region of Pakistan, tourists who bought snacks or prepared meals from vendors in the region complained of diarrhoea during or following travel (Mosupye and Holy, 1999). Calcutta Municipal Corporation and FAO Technical Cooperation Programmes carried a two-year study to improve the conditions in the street food trade. They found that, street foods were prone to microbiological contamination (Chakravarty and Canet, 1996). Samples tested of sweetened and sometimes flavoured buttermilk had high plate counts. *E. coli*, used mainly as an indicator of faecal contamination was detected in 55 percent of the samples tested. This confirmed improper food handling practices.

In the state of Perak, Malaysia, 14 people died because of eating rice noodles that they bought from a street vendor (Mosupye and Holy, 1999). While in Western Cuba, 14 people died and 49 were hospitalised for food poisoning after eating fried food from a street vendor, who was among those who died.

The Bangkok Street Foods Project indicated that, ice stored in boxes containing dirty soft drink bottles and unclean plastic bags of food ingredients led to widespread cross contamination (Dawson *et al.*, 1996). Coliform bacteria were found in more than 50 percent of the food samples, while some areas had 87 percent of their samples contaminated.

Another study by FAO in Bangkok revealed that, the positive tests for *Salmonella* in meals ranged from 0 to 10 percent while positive tests for *Clostridium perfringens* and *Staphylococcus aureus* ranged from 0 to 33.3 percent and 0 to 30 percent respectively (Hutabarat and FAO, 1994). High

bacterial counts, aflatoxins and lead in excess of permitted levels, were also found in foods and drinks. During cholera outbreaks in 1991, officials in Peru and Bolivia found the *vibrio cholera* in certain street foods such as *cevich*, an uncooked fish dish (FAO, 2001a). Likewise, in Puna City, India, cholera outbreak was related to street vended sugarcane juice containing ice that was contaminated with the infective agent (Mosupye and Holy, 1999).

Studies carried out in Africa revealed that street foods sold to school children in Nigeria, showed unacceptable levels of bacteria (Mensah *et al.*, 2002). *E.coli* was also isolated from some samples. The research findings indicated that, there was need for stricter implementation of the food sanitation code and the licensing of street food vendors. In Senegal, over 200 cases of food poisoning were traced to street foods made from dairy products (Mosupye and Holy, 1999).

The Natural Resources Institute, (UK), conducted a one-year preliminary study in Ghana. The aim was to enhance the food security of the peri-urban and urban poor, through improvements on the quality, safety, and economics of street vended foods (Natural Resources Institute, UK, 2003). Bacteriological counts of *E.coli*, *S. aureus*, *Bacillus cereus*, and *Cl. perfringens* were found in 96 street vended food samples analysed for contaminants. This number was higher than in the ones in the previous surveys. *Salmonella* was not detected in any samples.

Although, street foods have been found to be prone to microbial contamination, two studies conducted in India (Pune and Calcutta), found that the microbial quality of street foods was equivalent to, if not better, than that of foods bought

from hotels and restaurants (Draper, 1996). Female vendors were found to have better hygienic practices than their male counterparts. In Kenya, female vendors were able to sell food of better nutritional quality than their male counterparts (Mwangi, 2002).

In Accra, Ghana, a research carried out indicated that despite poor environmental hygiene, street vended foods were in general microbiologically safe (Mensah *et al.*, 2002). Similar findings were reported for salads and gravies in Johannesburg. A project on improving street foods in South Africa showed that they had relatively low microbiological counts and low incidences of pathogens. *Salmonella* was absent in all cases tested (Martins and Anelich, 2000). It appeared that, the street vendors from the regions tested in the Gauteng province of South Africa, observed good hygienic practices for the preparation of safe foods. Many recent studies have shown that foods sold in streets are generally not more contaminated than foods sold in local restaurants (Tinker, 1997). However, levels of contamination in both establishments are clearly potentially harmful to the health of the consumer.

Based on the findings on the study carried out by Mosupye and Holy, (1999), the quality and safety of the street foods sampled from the typical vendors in Johannesburg City, was acceptable. The study highlighted the fact that, production of relatively safe street-vended foods with low bacterial counts was possible, even under poor conditions (including those characterised by poor environment, personal hygiene and lack of sanitary facilities), provided that attention was paid to the relevant critical control points.

2.6.0 Factors Contributing to Contamination of Street Vended Foods

Mensah *et al.*, (2002), identified key factors that contributed to contamination of foods. They included: preparation of food long before consumption; storage at ambient temperatures; inadequate cooling and reheating; contaminated processed food; undercooking; exposure of food to flies and working with food at ground level.

Personal hygiene of vendors, lack of adequate sanitation and refuse disposal were other factors implicated in causing microbial contamination in street vended foods Draper, (1996). In a study undertaken by WHO in 1993 of its member states, contamination was from raw foods, dirty water, infected handlers and inadequately cleaned equipment (WHO, 1996). The Bangkok street food project noted that contamination of vendors hands and utensils ranged from 18 to 69 percent depending on the area (Dawson *et al.*, 1996). Where tap water was available, the contamination of the utensils was significantly low. This project demonstrated that food safety in street food operations could be improved, through the implementation of risk-based corrective action, even if such improvements could not immediately reduce the risks to the levels that could be fully controlled. Availability of running potable water could play a major role in the production of safe and quality food.

According to the WHO report of 1989, in most well documented outbreaks, contaminated surfaces, kitchen utensils and human hands played a significant role in cross contamination. These factors were identified particularly in already cooked and ready to eat foods such as poultry, meat, and meat products. Other sources of contamination of street foods were poor quality

ingredients, exposure to environmental contamination, lack of sanitation, defective hygienic practices and lack of knowledge concerning food safety (Garin et al., 2002).

Against the above background, if street vended foods are going to play an increasing important role in the national economy, current information on such aspects as potential health risks and constraints to compliance with the Codex Alimentarius standards is required.

CHAPTER 3

METHODOLOGY

3.1.0 Research Design

The study adopted a descriptive survey and experimental design. The descriptive design was used to assess the hygienic practices of the street food vendors and the potential link between food contamination and the risk factors. Descriptive survey designs are used in preliminary and exploratory studies (Orodho, 2004). This enables the researcher to gather information, summarize, present and interpret for the purpose of clarification. Standard methods for microbiological analysis were used for the enumeration, isolation and identification of *E.coli* and *Salmonella* strains in the three most commonly sold foods on the streets namely, *beef samosas*, *mbaazi* and *mahamri*.

3.2.0 Study Location

The study was carried out in Mombasa Island in Mombasa City. Mombasa is the second largest city in Kenya, and a major tourist centre. It has a population of 2,487,264 and a size of 10-15 miles (16-24 kilometres) wide (Population and Housing Census, 1999). Mombasa Island division is the smallest with a population of 146,344, but is the most developed and is almost entirely built up (Population and Housing Census, 1999). There are three locations in the Mombasa Island division namely, Old Town, Majengo and Mwembe Tayari which were studied (Figure 1). These three locations have characteristics such as major bus stops, markets, shopping areas, construction sites and commercial areas, which favour street food vending.

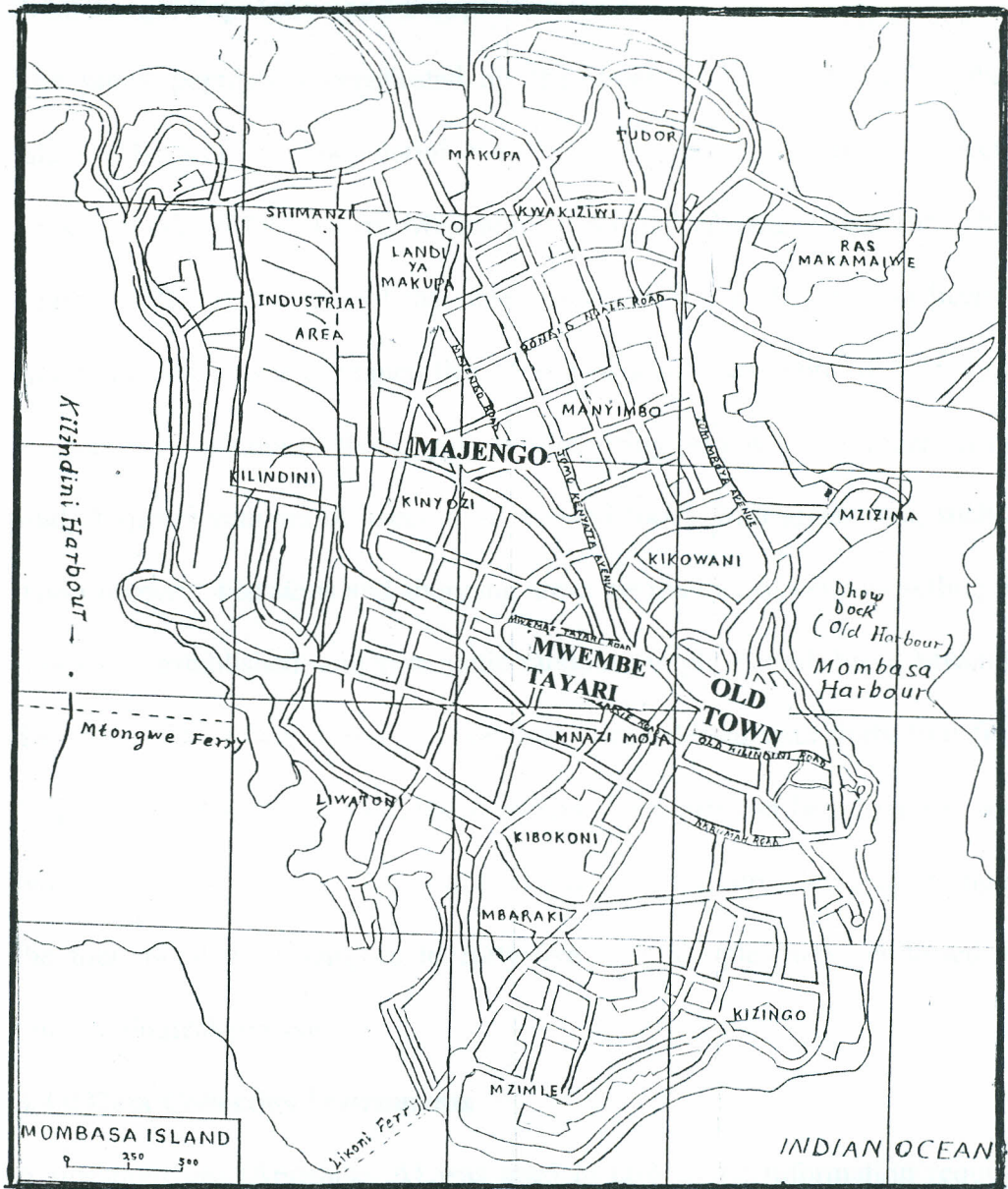


Figure 1: Map of Mombasa Island

Key: Study Area

- **Majengo**
- **Mwembe Tayari**
- **Old Town**

3.3.0 Target Population and Sample Selection

The target population constituted all the street food vendors in Mombasa Island. The accessible population was the street vendors selling the selected cooked foods in Old Town, Mwembe Tayari and Majengo locations. There being no official statistics of the street food vendors, as they are not licensed and registered, it was estimated that Mombasa Island has approximately 1,000 vendors. Ten percent of them were selected using purposive sampling, as this study targeted vendors of specific or selected foods. In a given area, such as major markets, bus stops and shopping areas the number of vendors selling the foods was established, and systematic random sampling used. From Mwembe Tayari and Old town, thirty-three vendors were selected with thirty-four from Majengo. Representative samples of *mahamri*, *mbaazi* and *beef samosas* were randomly collected from five vendors in each of the three locations bringing the total number of samples to forty-five. The samples were collected for microbiological analysis.

3.4.0 Data Collection Instruments

A questionnaire (Appendix A) was used to collect the information required from the population. This information included, level of education, training in basic food hygiene, acquisition of cooking skills and preservation of food items being sold. The questionnaire constituted of closed-ended questions to provide more structural responses and open-ended questions to provide for more in-depth information. The hygienic practices, food handling and service procedures and environmental surroundings of the street vendors during the trade were observed and recorded in an observation checklist. Focus group

discussions (Appendix B) were held to get more in-depth information that was not easily obtained through the questionnaire.

3.5.0 Pre-testing of Instruments

The research instruments were pretested on six street food vendors from one location of the Mombasa Island, which was not included in the study. This was important, as it enlightened the researcher on issues such as, ease in administration of the questionnaire, length of time needed for data collection, analysis of the samples and areas where more information was required.

3.6.0 Data Collection Procedures

Before starting the fieldwork, a research permit was obtained from the Ministry of Education. Consent to carry out the research was obtained from the office of the District Commissioner Mombasa. The vendors were briefed on the purpose and importance of the study. Confidentiality and anonymity of response was assured. Questionnaires were administered to vendors with the help of two assistants. They were filled together openly as most of the vendors did not have permanent structures and locating them would have been difficult. Focus group discussions were held with a group of five vendors at any given time. Observation checklist was used to gather information on the current situation of the vendors and the vending sites. Observation was carried out at the same time as the questionnaire was being administered.

3.6.1 Sample Collection and Transportation

Fifteen samples each of *mahamri*, *mbaazi* and *beef samosas* were bought from the vendors in the three locations. Samples of *mbaazi* and *mahamri* were collected in the morning from 7am, while those of *beef samosas* were collected

from 8am. Each food item was collected using the vendors serving utensils and put in sterile containers. The samples were then labelled according to location, date and sample number. They were placed immediately into a cooler box containing ice cubes with temperatures not exceeding 10°C and transported to the laboratory. The samples were refrigerated at 4°C and analysed within 24 h of arrival at the laboratory

3.7.0 Microbiological Analysis

The methods used for the microbiological analysis was adopted from the Bacteriological Analytical Manual for Foods (Andrews *et al.*, 1998).

3.7.1 Sample Preparation

Twenty-five grams of the food sample was weighed aseptically into a sterile blender jar and 225ml of the phosphate buffer diluent added to it and blended for 2 minutes. Decimal dilution in the range of, 1:10, 1:100 and 1:1000 were prepared by adding 10mls of the previous dilution to 90mls of the sterile diluent and blended in a vortex mixer for 7seconds.

3.7.2 Test for Total Plate Count (TPC)

1 ml of each dilution from the initial diluents was added to a sterile petri dish and Tryptone Soya Agar (kept at 45° C in a water bath) added and mixed thoroughly. The sample dilution and the agar medium were uniformly mixed and allowed to solidify at room temperature on a cool horizontal surface. The dishes were inverted and incubated, for 48 h at 35°C. Distinct colonies for each dilution plate with between 30-300 colonies were counted using a colony counter and magnifying glass. Average counts obtained were multiplied with the dilution factor and expressed as colony forming units per g (CFU/g) of

food.

3.7.3 Test for Coliform Group (Most Probable Number, MPN)

Three replicate tubes of MacConkey broth (containing inverted Durham tubes) were inoculated with 1ml each of the previously prepared dilutions of 1:10, 1:100, 1:1000 of the sample and incubated for 24h at 37°C. All tubes were observed for acid and gas production in the inverted vial or by effervescence produced when the tubes were gently shaken. The negative tubes were reincubated further for 24h, and the tubes showing acid and gas production recorded as positive for coliform. The most probable number (MPN) were estimated from the MPN table.

3.7.4 Test for *Escherichia coli*

All positive MacConkey broth tubes showing acid and gas within 48h were sub cultured in Tryptone broth for indole reaction test and incubated for 24h at 44°C. They were tested for indole by adding 0.3mls of Kovac's reagent. An appearance of a red ring on the surface of the mixture was taken as a positive indication of the presence of *E. coli*. The MPN table was used to estimate the counts.

3.7.5 Test for *Salmonella*

For the detection of *Salmonella*, 10g of the sample was put into 90mls of Bacteriological Peptone (High Media Laboratory, India) for 24h at 37°C. After incubation, 1ml of the suspension was added to each of the 9 mls of Selenite Cystein and Tetrathionate Broths (High Media Laboratory, India) respectively. They were incubated at 37°C for 48h. They were then streaked on previously prepared sterile plates of Brilliant Green Agar (High Media Laboratory, India),

using a sterile wire loop. The plates were incubated for 24h at 37°C. Characteristic colonies of *Salmonella* on the Brilliant Green Agar were examined and the pink ones considered positive. Replicate tests were carried out and the averages recorded.

3.8.0 Data Analysis.

Data were analysed using Statistical Package of Social Sciences (SPSS) computer software. One way Analysis of Variance (ANOVA), at 95% level of confidence interval (CI) was done to determine any significant differences in the bacterial counts in the three locations. One sample t-test was carried out to establish any statistical differences between the hypothesized mean and the sampled mean. Descriptive statistics such as means, percentages, and frequencies were used to present the findings. Chi-square tests were carried out to establish any significant relationship between the variables.

The qualitative data was organized and transcribed into patterns and themes (thematic analysis) that addressed the study objectives. The observations made were triangulated with the rest of the data for comprehensiveness.

CHAPTER 4

RESULTS

The results of the study are presented in line with the objectives. The characteristics of the vendors were established to give an overview of their nature. The hygienic practices of the vendors were observed and the bacterial counts in the food samples established. Potential links between food contamination and the risk factors were identified.

4.1.0 Characteristics of The Vendors

Female vendors were the majority in this study (Table 1), as they comprised of 60% of the total population of 100 vendors. Chi-square test was carried out to establish any statistical association between certain characteristics such as food preparation training, level of education and age as regards to gender. The majority (81%) of the vendors were not trained in food preparation. Of those trained (19%) in food preparation, 13% were females and 6% were males. Vendors were educated at primary, secondary, certificate or diploma level, with females being 51% and males 33%. The predominant age group of the vendors was 19-28 years, with 28 % females and 21% males. From the results above, there was no statistical significant association between food preparation training, level of education and age as regards to gender ($P > 0.05$). The population studied was uniform with regard to the baseline variable even though the females were the majority.

Table 1: The characteristics of the street food vendors

Characteristic	Gender		Total	X ²	P-value
	Male	Female			
Food Preparation Training					
Yes	6(6%)	13(13%)	19(19%)	0.69	0.405
No	34(34%)	47(47%)	81(81%)		
Level of Education					
No formal education	7(7%)	9(9%)	16(16%)	0.816	0.94
Primary education	15(15%)	24(24%)	39(39%)		
Secondary education	16(16%)	23(23%)	39(39%)		
Certificate & above	2(2%)	4(4%)	6(6%)		
Age Distribution					
≤ 18	3(3%)	3(3%)	6(6%)	0.79	0.68
19 – 28	21(21%)	28(28%)	49(49%)		
29 – 38	16(16%)	29(29%)	45(45%)		

4.2.0 Hygienic Practices of the Street Food Vendors

Poor hygienic practices were observed among the vendors examined (Fig. 2). Regarding personal hygiene, 11% were smoking, 25% were coughing over the food items and 26 % had a skin rash. Smoking was the observed among the male vendors in all the three study sites. Handling of food and money without washing hands in between and not having short and clean fingernails, were both relatively commonly seen in 91% and 54% of the vendors respectively. Vendors who had no protective clothing and those wearing jewellery (finger rings, bangles and bracelets) accounted for 48% and 51% respectively. In addition to the hygienic practices, 70% had not gone for routine medical examination during the study period. All the hygienic practices seen in this study, were in contrast to the standard by WHO (1996), Codex Alimentarius General Requirements for Food Hygiene (FAO/WHO, 2001) and the

guidelines in The Foods, Drugs and Chemical Substance Act, Kenya (1992).

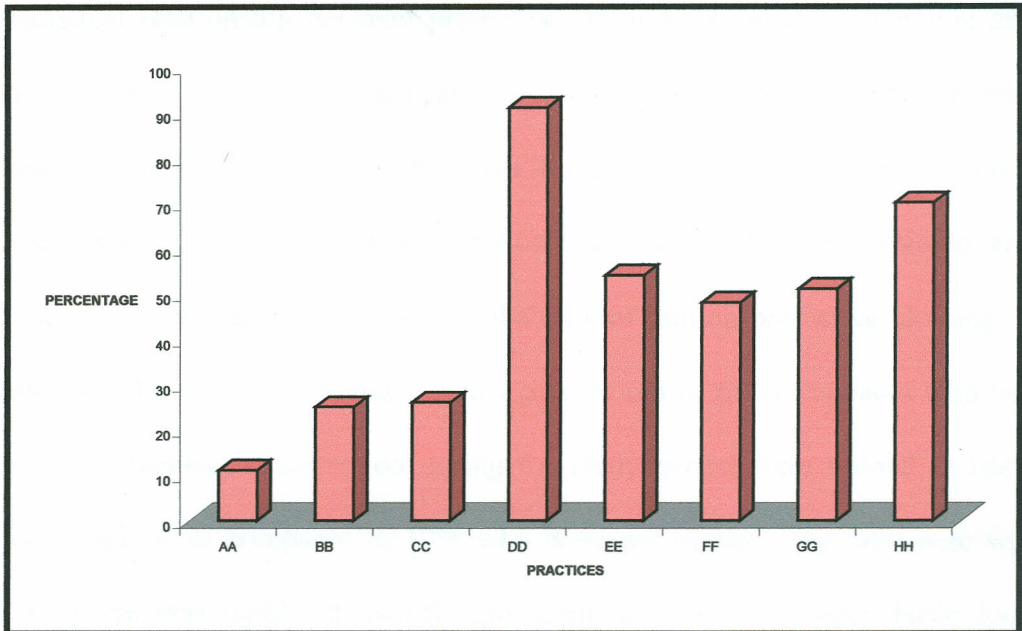


Figure 2: Hygienic Practices of The Street Food Vendors

KEY: PRACTICES

- AA - Smoking
- BB - Coughing over food
- CC - Having skin rash
- DD - Handling food and money without washing hands
- EE - Not having short and clean finger nails
- FF - No protective clothing
- GG - Wearing jewellery
- HH - Not gone for medical examination

4.2.1 Training in Relation to The Hygienic Practises

Training of the vendors was linked together with the hygienic practices, as these practises may be acquired through factors related to training. Statistical relationships were found in some instances, between the trained and the

untrained groups (Table 2A-2C). Chi-square tests were done to establish any statistical relationship between protective clothing, medical examination and basic training in food hygiene (Table 2A). Out of the 48% of the vendors who had no protective clothing, 12% were trained while 36% were not trained. There was a highly statistical significant association between training and protective clothing ($P < 0.05$). The probability of putting protective clothing, if not trained was very minimal. Twenty percent out of the 30 vendors who had gone for medical examination during the study period were trained in basic food hygiene as compared to 10% who were not trained. The ratio here was 2:1. There was highly statistical significant association between basic food hygiene training and medical examination ($P < 0.05$).

Table 2A: Basic food hygienic training between trained and untrained vendors in relation to protective clothing and medical examination

	Basic food hygiene training		Total	X ²	P- value
	Trained	Untrained			
Protective Clothing					
Aprons	15(15%)	5(5%)	20(20%)	20.48	<0.001
Dustcoats	4(4%)	1(1%)	5(5%)		
Lessos	7(7%)	20(20%)	27(27%)		
None	12(12%)	36(36%)	48(48%)		
Medical Examination					
Yes	20(20%)	10(10%)	30(30%)	15.78	<0.001
No	17(17%)	53(53%)	70(70%)		

Statistical significant association was found between the trained and untrained vendors in basic food hygiene, regarding wearing of jewellery, having short clean finger nails and handling food and money without washing hands in-

between (Table 2B). Out of 51% of the vendors who had jewellery, 14% had basic training in hygiene compared to 37% who had no training. There was a statistically significant association between wearing of jewellery and training ($P < 0.05$). Trained vendors who had short and clean nails were 25% compared to 19% who were not trained. A statistical significant association was found between having short and clean fingernails and basic food hygiene training ($P < 0.05$). A statistical significant association was found between handling food and money without washing hands in between and basic training in hygiene ($P < 0.05$). Only one vendor who was not trained out of the 9% did not handle food and money without washing hands in-between.

Table 2B: Basic food hygienic training between trained and untrained vendors in relation to jewellery, fingernails and handling of food and money

	Basic food hygiene training		Total	X^2	P-value
	Trained	Untrained			
Jewellery on					
Yes	14(14%)	37(37%)	51(51%)	4.9	0.03
No	24(24%)	25(25%)	49(49%)		
Short Nails					
Yes	25(25%)	19(19%)	44(44%)	11.8	0.001
No	13(13%)	43(43%)	56(56%)		
Handling Food and Money					
Yes	30(30%)	61(61%)	91(91%)	10.87	0.001
No	8(8%)	1(1%)	9(9%)		

Unhygienic practices such as smoking while selling food and not covering of food items during sales were observed between the trained and the untrained. Out of the 11% of vendors who were smoking, 2% had received basic training

in hygiene as opposed to 9% who had not trained (Table 2C). However, there was no statistically significant relationship between smoking and training ($P>0.05$). Food vendors who had not covered their foodstuffs but were trained in basic hygiene were 17% out of 51%. The ratio was 1:2, although there was no statistically significant association between covering of food and training ($P> 0.05$).

Table 2C: Basic food hygienic training between trained and untrained vendors in relation to smoking and covering of food items

	Basic food Hygiene Training		Total	X ²	P - value
	Trained	Untrained			
Smoking					
Yes	2 (2%)	9(9%)	11(11%)	2.1	0.51
No	36(36%)	53(53%)	89(89%)		
Covering Food Items					
Yes	13(13%)	14(14%)	27(27%)	1.64	0.44
No	17(17%)	34(34%)	51(51%)		
Partly Covered	8(8%)	13(13%)	21(21%)		

From the results in table 2A, 2B and 2C, the vendors who were trained were aware of the hygienic practices compared to the untrained. This trend was observed in all the three locations studied. Training here was seen as an important factor as it made the vendors aware of their responsibility in protecting food from contamination.

4.3.0 Microbiological Food Quality Analysis

4.3.1 Bacterial Counts. Mean values for the bacterial counts are shown in Table 3. Mean total plate count values for the *beef samosas* samples were higher, 1.6×10^5 CFU/g, compared to 9.0×10^4 CFU/g and 5.9×10^4 CFU/g of

mbaazi and *mahamri* respectively. Mean coliform counts in *beef samosas* were 21 per g, while the counts of *mahamri* and *mbaazi* were 15.00 per g and 14 per g respectively. Mean *E.coli* counts were higher in *beef samosas*, 7 per g compared to *mahamri*, 6 per g and *mbaazi*, 5 per g. Four samples of *beef samosas* tested from different vendors tested positive for *Salmonella*.

Table 3: Mean bacterial counts in the sampled food items

Source	TPC (CFU/g)	CC/g	<i>E.coli</i> /g	<i>Salmonella</i> <i>a</i>
Mbaazi				
(n=15)				
Range	1.7x10 ³ -3.6x10 ⁵	5.00-29.00	3.00-8.00	Nil
Mean	9.0x10 ⁴	14.00	5.00	
Mahamri				
(n=15)				Nil
Range	1.4x10 ³ -4.4x10 ⁵	5.00-25.00	3.00-10.00	
Mean	5.9x10 ⁴	15.00	6.00	
Samosas				
(n=15)				
Range	1.4x10 ³ -1.3x10 ⁶	4.00-75.00	4.00-10.00	0-4
Mean	1.6x10 ⁵	21.00	7.00	

One-way analysis of variance (ANOVA) was used to establish any statistical significant differences in the mean bacterial counts in the three locations studied. These results show that there was a significant difference ($P < 0.05$), in the mean total plate counts between the three locations studied (Table 4). Mean total plate counts in Old Town were higher, an implication that they differed from the ones of Mwembe Tayari and Majengo. Regarding the mean total plate counts for the three food types, they differed significantly from one another ($P < 0.05$), an implication that the foods were from different populations.

The mean coliform counts differed significantly ($P < 0.05$), from one location to

the other (Table 4). Mean coliform counts in Old Town were higher, an implication that they differed from the ones of Mwembe Tayari and Majengo. A significant difference was found in the mean coliform counts in the three food types ($P < 0.05$) with *beef samosas* having the highest coliform counts (Table 3).

Table 4: ANOVA test for total plate count and coliforms

Total plate counts	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.3×10^{11}	2	1.2×10^{11}	2.405	.103
Within Groups	2.0×10^{12}	42	4.8×10^{10}		
Total	2.3×10^{12}	44			
Coliforms					
Between Groups	232.933	2	116.467	.753	.477
Within Groups	6496.267	42	154.673		
Total	6729.200	44			

One sample t-test was carried out to determine any statistical differences between the hypothesized and the sampled total plate count mean from the study area. The mean from the analysed samples differed from the standard hypothesized mean of 1.0×10^6 CFU/g. The mean total plate count of the analysed sample was less, 7.0×10^4 CFU/g, than the standard mean of 1.0×10^6 CFU/g, an implication that the level of the total plate counts was within the acceptable limits. There was a statistical difference between the hypothesized mean and the sampled mean at 95% confidence interval.

4.3.2 Food-borne pathogens. *E.coli* was found in all the 45 samples tested. The mean counts for *E.coli* was, 7.00 per g in *beef samosas* and 5.00 per g and 6.00 per g in *mbaazi* and *mahamri* respectively (Table 3). There was no

significant difference in the mean count of the *E-coli* contamination in the three food types ($P>0.05$). An implication that, the foods were from the same population. However, there was a significant difference ($P<0.05$), in the mean counts of *E-coli* in the three locations (Table 5). Mean counts of *E-coli* differed from one location to the other in the study area with Old town having higher counts (Table 3).

Table 5: ANOVA test *E.coli*

		Sum of Squares	Df	Mean Square	F	Sig.
<i>E.coli</i>	Between Groups	27.911	2	13.956	3.764	.031
	Within Groups	155.733	42	3.708		
	Total	183.644	44			

Salmonella was found in 8.9% of the 45 samples tested, which were *beef samosas*. In this study all the food items that had *Salmonella*, were considered contaminated. The ratio of contamination was 1:11. For every 11 samples collected, one was contaminated, which was a 9% rate of contamination per sample. Two of the *beef samosas* samples that had *Salmonella* contamination were from Old town and one each from Majengo and Mwembe Tayari.

From the results total plate counts, coliform counts and *E.coli* counts in the food samples were within the acceptable limits according to The International Commission of Microbiological Specification for Foods (1996). *Salmonella* was positive in some samples therefore, they were considered unsatisfactory.

4.4.0 Potential Links Between Food Contamination and Risk Factors

The links between food contamination and risk factors are listed in table 6A-6H. Each of these factors is essentially a variable that might have had direct or

indirect bearing on the safety of the street vended foods.

Basic training in food hygiene, food preparation and level of education of the food vendors was examined to see if they were risk factors to food contamination. In Table 6A, 10.3% of 29 samples and 8.6% of 35 contaminated samples were from vendors who had not undergone basic food hygiene and food preparation training respectively. However, there was no statistical significant association between training in food hygiene and preparation with food contamination ($P>0.05$). Vendors who had no formal education had the highest percentage of food contamination, 28.6% of 7 samples. A statistical significant association was found between level of education and food contamination ($P<0.05$).

Table 6A: Basic training in food hygiene, food preparation and level of education in relation to food contamination

	Contaminated		Total	P - value
	Yes	No		
Basic Food Hygiene Training				
Yes	1(6.25%)	15(93.8%)	16(100%)	0.93
No	3(10.3%)	26(89.7%)	29(100%)	
Total	4(8.9%)	4(91.9%)	45(100%)	
Food Preparation Training				
Yes	1(10%)	9(90%)	10(100%)	0.62
No	3(8.6%)	32(91.4%)	35(100%)	
Total	4(8.9%)	4(91.9%)	45(100%)	
Education Level				
Primary	1(7.1%)	13(92.9%)	14(100%)	0.04
Secondary	-	21(100%)	21(100%)	
Certificate	1(50%)	1(50%)	2(100%)	
Diploma	-	1(100%)	1(100%)	
No formal education	2(28.6%)	5(71.4%)	7(100%)	
Total	4(8.9%)	4(91.9%)	45(100%)	

4.4.1 Food Display and Sales Location

Vendors used trays, basins and *sufurias* to display their food items for sale (Table 6B). Out of 13 food samples displayed on the trays and 25 on basins, 15.4% and 8% were contaminated respectively. Those sold in *sufurias* and covered with an aluminium lid were not contaminated. There was however no statistical significant association between food display and food contamination ($P>0.05$).

Food items were sold at different sites: on pavements, makeshift stalls or along the road. Food samples from make shift stalls were not contaminated, as

compared to 12.5% from 24 samples and 7.7% from 13 samples sold along the road and down on the pavement respectively. There was no statistical association between the place of sale and food contamination ($P>0.05$).

Table 6B: Food display and place of sale in relation to food contamination

	Contaminated		Total	P-value
	Yes	No		
Food Display				
Tray	2(15.4%)	11(84.6%)	13(100%)	0.50
Basin	2(8.0%)	23(92.0%)	25(100%)	
<i>Sufuria</i>	-	7(100%)	7(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Place of Sale				
Down on the pavement	1(7.7%)	12(92.3%)	13(100%)	0.55
Makeshift stall	-	8(100%)	8(100%)	
Along the road	3(12.5%)	21(87.5%)	24(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	

4.4.2 Environment of Food Sales

The environment where the food items were sold was examined (Table 6C). From 18 samples analysed from areas that had garbage, 16.7% were contaminated, compared to 3.7% from 27 samples that were sold away from garbage sites. There was no statistical significant association between the two variables ($P>0.05$). However, a statistical significant association was found between wastewater sewage and food contamination ($P<0.05$). Most of the samples from vendors who sold their food items near wastewater sewage, were contaminated, 37.5% out of 8 samples. This factor was considered a risk to food safety.

Table 6C: Environment of food sales in relation to food contamination

	Contaminated		Total	P-value
	Yes	No		
Garbage Around				
Yes	3(16.7%)	15(83.3%)	18(100%)	0.28
No	1(3.7%)	26(96.3%)	27(100%)	
Total	4(8.9%)	41(91.9%)	45(100%)	
Water Sewage				
Yes	3(37.5%)	5(62.5%)	8(100%)	0.01
No	1(2.7%)	36(97.3%)	37(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	

4.4.3 Covering of Food and The Material Used

Street vended foods should be placed in well-protected covered and clean containers. The street food vendors covered their foods items fully or partly using newspapers, plastic papers or aluminium lid (Table 6D). Analysed samples that were contaminated (8.3% out of 36 samples) were from vendors who covered the food items. Contaminated samples from vendors who partly covered their food items were 33.3% from 3 samples. Food items that were covered with aluminium lid were not contaminated. However, there was no statistical significant association between covering of the food items, and the materials used for covering, with food contamination ($P>0.05$).

Table 6D: Food covering and materials used in relation to food contamination

	Contaminated		Total	P- value
	Yes	No		
Food Covered				
Yes	3(8.3%)	33(91.7%)	36(100%)	0.25
No	-	6(100%)	6(100%)	
Partly	1(33.3%)	2(66.75)	3(100%)	
Total	4(8.9%)	41(91.95)	4(100%)	
Covering Material				
Newspaper	2(22.2%)	7(77.8%)	9(100%)	0.28
Plastic paper	2(10%)	18(90%)	20(100%)	
Aluminium lid	-	10(100%)	10(100%)	
Total	4(10.3%)	10(100%)	39(100%)	

4.4.4 Nature of The Roads Where Food Items Were Sold.

Table 6E, shows the nature of the road where the food items were sold and wastewater disposal. Forty percent from 5 samples analysed from vendors selling along murrum roads were contaminated as compared to 12.5% from 8 samples and 5.3% from 19 samples collected along dusty roads and tarmac roads with potholes respectively. There was no statistical significant association between the nature of the road and food contamination ($P > 0.05$). Vendors poured wastewater along the road or at the place of sale. As a result, 12.5% out of the 16 samples analysed from vendors who poured wastewater at their place of sale were contaminated. Out of 15 samples collected from vendors who poured wastewater along the road, 13.3% were contaminated. However, no statistical significant association was found between wastewater and food contamination ($P > 0.05$), even though the food samples analysed were contaminated.

Table 6E: Nature of the road and water sewage in relation to food contamination

	Contaminated		Total	P-value
	Yes	No		
Nature of the road				
Tarmac (no potholes)	-	13(100%)	13(100%)	0.05
Dusty	1(12.5%)	7(87.55)	8(100%)	
Murram	2(40%)	3(60%)	5(100%)	
Tarmac (with potholes)	1(5.3%)	18(94.7%)	19(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Waste water disposal				
Place of sale	2(12.5%)	14(87.5%)	16(100%)	0.67
Along the road	2(13.3%)	13(86.7%)	15(100%)	
Total	4(19.9%)	27(87.1%)	31(100%)	

4.4.5 Hygienic Practices That Were Considered as Risk Factors

Some of the poor hygienic practices of the vendors in Table 6F were a contributing factor to food contamination. Most of the contaminated samples were from vendors who wore jewellery, 11.5% out of 26 samples. Vendors who were coughing over food had 23% out of 13 samples contaminated. Out of the 45 samples of the food items analysed, 33.3% of the contaminated samples were from vendors who were smoking, compared to 7.1% of those who were not smoking. Despite having no skin rash, samples from these vendors were more contaminated (18.2% out of 11 samples), than those with a skin rash. Regarding short fingernails, 11.1% from the 18 samples analysed were contaminated compared to 7.4% from 27 samples of the vendors who did not have short nails. No statistical significant association was found between the practices and food contamination ($P > 0.05$).

Table 6 F: Hygienic practices of the vendors in relation to food contamination

Hygienic practices	Contaminated		Total	P-value
	Yes	No		
Jewellery				
Yes	3(11.5%)	23(88.5%)	26(100%)	0.63
No	1(5.3%)	18(97.7%)	19(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Short Nails				
Yes	2(11.1%)	16(88.9%)	18(100%)	0.91
No	2(7.4%)	25(92.6%)	27(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Rashes				
Yes	2(5.9%)	32(94.1%)	34(100%)	0.24
No	2(18.2%)	9(81.8%)	11(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Smoking While Selling Food				
Yes	1(33.3%)	2(66.7%)	3(100%)	0.25
No	3(7.1%)	39(92.9%)	42(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Coughing Over Food				
Yes	3(23%)	10(77%)	13(100%)	0.07
No	1(3.1%)	31(96.9%)	32(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	

4.4.6 Food Service and Handling

Bare hands were used for serving food items and as a result 9.1% out of 22 samples were contaminated (Table 6G). There was a statistical significant association ($P < 0.05$) between using of bare hands to serve and food contamination. Samples from vendors who handled money and food without washing hands in between were contaminated (9.3% out of 43 samples), although there was no statistical significant association between the two variables ($P > 0.05$).

Table 6G: Items used for service and food handling in relation to food contamination

	Contaminated		Total	P-value
	Yes	No		
Items Used for Service				
Spoon	-	16(100%)	16(100%)	
Bare hands	2(9.1%)	20(90.9%)	22(100%)	
Hands covered with paper	-	4(100%)	4(100%)	0.002
Paper used for wrapping	2(66.6%)	1(33.4%)	3(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	
Handling Food and Money				
Yes	4(9.3%)	39(90.7%)	43(100%)	
No	-	2(100%)	2(100%)	0.41
Total	4(8.9%)	41(91.1%)	45(100%)	

4.4.7 Transportation of Food and Treatment of Leftovers

Some vendors prepared their food items at home and transported them to the vending sites, as they did not have stalls and facilities at the point of sale. Basins, trays and *sufurias* were used to carry the food and the majority (90%) walked to the sales point. Where use of vehicles was required, *matatu* (public transport) was used as a means of transport. Thirty-four samples were analysed from vendors who prepared the food at home and transported to the site. Of this 8.8% were contaminated compared to 9.1% of the 11 samples prepared by vendors at the stalls (Table 6H). This shows that the food items are likely to be contaminated along the way during transportation, although statistically there was no significant association between the two variables ($P > 0.05$).

Sixty nine percent of the vendors did not sell all the food items prepared and 29% preserved them for resale the following day. Due to lack of refrigerators

by some vendors, they left the food items open on top of shelves or in the cupboard. From 31 leftover samples sold, 9.7% were contaminated. This shows that lack of proper preservation can lead to food contamination, though there was no statistical significant association between leftover foods and food contamination ($P>0.05$).

Table 6H: Place of food preparation and leftover foods in relation to food contamination

	Contaminated		Total	P-value
	Yes	No		
Where food is prepared				
At home	3(8.8%)	31(91.2%)	34(100%)	0.56
In stall	1(9.1%)	10(90.9%)	11(100%)	
Total	4(8.9%)	41(91.9%)	45(100%)	
Left over food				
Yes	3(9.7%)	28(90.3%)	31(100%)	0.77
No	1(7.1%)	13(92.9%)	14(100%)	
Total	4(8.9%)	41(91.1%)	45(100%)	

CHAPTER 5

DISCUSSIONS

In this study, women were the majority in the street food vending business. This could have been due to the responsibility charged on them for the preparation of food for their households. It was therefore easier for them to set up small businesses to get some income. Some married women said that they engaged in the business in order to assist in the maintenance of the families, as most of their husbands did not have well paying jobs (FGD. Majengo, October, 2004). Single and some married women were the sole breadwinners of their households. The income they got from vending was used to maintain their dependants. According to Mensah et al., (2002) the street food traders in Accra were mainly women. They played major roles in food control programmes and were involved in a wide variety of food processing activities. Studies in the Philippines, Senegal, Kenya, Uganda, and Nigeria found that over 60% of the vendors were female (Draper, 1996). The majority of vendors selling *beef samosas* were male while the females sold *mbaazi* and *mahamri*. During the FGD, some men claimed that making of *mahamris* and *mbaazi* was a woman's job, and was time consuming (FGD Mwembe Tayari, September, 2004). Further more, some of the men who sold the *beef samosas* bought them from a central place where they were prepared and they acted as middlemen. Vendors varied in ages with the predominant age group being 19 to 28 (Table 1). This was a clear indication that street food trade provided employment for the young who had no formal employment. Seventy percent of the vendors engaged in the business due to lack of formal employment. A study by Mensah *et al.*, (2002)

found that street food vending was common in many countries where unemployment was high. During the FGD, some vendors in Old Town said that street food vending was a relatively easy sector to venture into, given the low capital and skills needed for its establishment (FGD. Old Town, October, 2004).

The International Commission of Microbiological Specification for Foods standards, (1996), were used to determine the acceptable limits of the bacterial counts in the food items tested. From the study results, *Salmonella* was detected in 8.9% of the 45 samples analysed, which were *beef samosas*. These samples were considered contaminated, as *Salmonella* should be absent in all food items prepared and sold for consumption. The presence of *Salmonella* in the *beef samosas* could have been due to improper food handling (use of bare hands, Table 6G) or use of leftover foods (Table 6H). Unhygienic practices by some of the vendors (Table 6F), and probably insufficient cooking or reheating of the meat product could have been a contributing factor. This study confirmed the results of others that have identified meat products as being liable to contamination if not well handled. A study carried out in Johannesburg, South Africa, found a *Salmonella* sp. and a non-0157: H *E.coli* strain each in one meat sample (Mosupye and Holy, 1999). Garin *et al.*, (2002) found the presence of *E.coli* exceeding 10 CFU/ml and high prevalence of *Salmonella* in beef sandwiches.

E.coli was found in all the samples tested, though they were within the acceptable limits of 10.00 per g (Table 3). Their presence raised suspicion of improper food handling and poor hygienic practices along the food chain

(Figure 2). Coliform and total plate counts of 100 per g and 1×10^6 CFU per g respectively in the food items were within the acceptable limits (ICMSF, 1996). However, these counts could have been lower if food vendors improved and intensified their hygienic practices. The unhygienic practices of the vendors that could have lead to food contamination are outlined in Table 6F and Figure 2. People engaged in food handling activities should refrain from behaviour, which could result in contamination (FAO/WHO, 2001).

However, the bacterial counts in this study were not as high as those reported in other studies. A study carried out in Dominican Republic reported bacterial counts of between 5 and 9 log CFU/g in street vended fried fish, chicken, beef and meat stews (Mosupye and Holy, 1999). In Pakistan the counts were as high as 7 log CFU/g for cooked ground meat (similar to the one used for *beef samosas*), while in Zambia and Nigeria, the counts were between 3 and 9 log CFU/g for street vended meat balls and between 7 and 9 log CFU/g in meat products respectively.

Handling of cooked foods should be kept to a minimum to reduce the likelihood of introducing pathogens. Forty five percent of the vendors handled and served food using bare hands, which had been used to handle many other things including money. As a result 9.1% out of 22 samples analysed from these vendors were contaminated (Table 6G). There was a statistical significant association between using of bare hands and food contamination ($P < 0.05$). During the FGD, a vendor in Mwembe Tayari showed ignorance by not associating use of bare hand with contamination (FGD. Mwembe Tayari, September, 2004). The response was “*mkono wangu hauna uchafu, na mimi*

mwenyewe ndiye nimepika, na sijashika uchafu wowote,” (My hands have no dirt at all, I am the one who has cooked, and I have not touched any dirt). A study carried out in Accra, Ghana, found high bacterial counts in tomato stew with macaroni Mensah *et al.*, (2002). Service was performed using bare hands, as the macaroni was too slippery to be served with a spoon. Likewise, a study in India detected *E. coli* in 55 percent of the samples tested as bare hands were used during service (Chakravarty and Chanet, 1996). The vendors selling *mbaazi* used dessert spoons or small plastic cups for serving. Parts of the fingers were sometimes dipped in the food. The item used for serving was either put on top of the lid covering the food or in a small open bowl containing water. These serving items were therefore exposed to all kinds of microorganisms while awaiting the next service. This could have contributed to the level of bacterial counts in the food (Table 3). The scooping of *wankye* (boiled rice and beans boiled) into bowls or polythene bags was a major influence in the contamination of these foods in Accra, Ghana (Mensah *et al.*, 2002). These findings confirmed that contamination from utensils was possible during serving stage (WHO, 1996). The serving stage is a critical point in the street food industry. If care is taken during this stage, microbial quality can be markedly improved ((FAO/WHO, 2001). Clean tongs, forks, spoons or disposable gloves should be used when handling, serving or selling food. This agrees with the findings of Mensah *et al.*, (2002) that use of forks or spoons to serve food reduced the level of contamination, while the use of bare hands resulted in an increase. Vendors can be carriers of bacterial entero-pathogens, which can be transmitted to the humans via food due to defective personal

hygiene, contaminated surfaces, and human hands (WHO, 1989). During the FGD, some vendors in Mwembe Tayari said that due to lack of proper sanitation (toilets), they were forced to relieve themselves in isolated places (FGD. Mwembe Tayari, November, 2004). They lacked water to wash their hands. This could have led to the presence of *E.coli* in the foods items. *E.coli* was detected in hand washings of high and low income mothers in India, while in Peru it was detected in 11 of the 78 mothers hand washing (Mensah *et al.*, 2002). The samples were from homes where children were suffering from diarrhoea. Food handlers should wash their hands with soap and water, after engaging in activities that are likely to introduce biological hazards to the ready- to- eat foods (WHO, 1996).

Vendors who traded in areas that did not have garbage and waste water sewage were 63% and 80% respectively. Samples from vendors who sold their food items in areas with wastewater sewage were contaminated (Table 6C). A statistical significant association was found between the variable and food contamination ($P<0.05$). One vendor selling *mbaazi* was located in an area where there was stagnant dirty water with flies. The flies would occasionally settled on the serving spoon that was left uncovered on top of the lid and then used for service. This could have lead to the high level of total plate count of 3.6×10^5 CFU/g in this food item (Table 3). Twelve species of flies (Diptera) are documented in the scientific literature as repeatedly associated with food borne pathogens *E coli*, *Salmonella* and *Shigella* (Olsen, 1997). Mensah *et al*, 2002), in their study in Accra found only four vending sites out of 117 that were classified as very dirty. A study carried out in Kayole and Dandora in Nairobi,

Kenya, found that 85% of the vendors prepared their foods in areas that garbage and wastewater were conspicuously close to the stalls (Muinde and Kuria, 2005). Waste of any amount or sort should not be allowed to accumulate in food handling areas and adjoining environment (FAO/WHO, 2001).

The packaging material used by the vendors was observed, as this could have been a contributing factor to food contamination. Among the 45 vendors whose food items were tested, 24% used plastic bags, 15% newspapers, 5% brown paper bags, and 1% used white papers. When checked closely the foods wrapped in the newspapers had some slightly black ink on them. This was clearly visible on the *mahamri*. Mensah *et al.*, (2002) found that newsprint and leaves used for holding the food increased the risk of contamination. According to FAO/WHO, (2001), food grade packing materials like plastics and clean paper should be used for wrapping food.

Twenty six percent of the vendors kept leftover food items in the refrigerator, while 3% left them covered on top of the cupboard. These leftover foods were sold the following day (Table 6H). As a result, some of the leftover food items were contaminated. However, there was no statistical significant association between leftover foods and food contamination ($P>0.05$). In Zambia, *E.coli* counts exceeding 4.0 log CFU/g were found in some leftover foods and *Salmonella* spp. were detected in a cooked meatball sample (Mosupye and Holy, 1999). During the FGD, some vendors said that, if they had any leftover *beef samosas* in the evening, they would remove the meat and store it separately from the pastry (FGD. Old Town, November 2004). They refried them the next day for sale. They sometimes made fresh pastry or used the same

depending on the state. This could have been the possible cause of *Salmonella* contamination (Table 3), in addition to prolonged holding periods at ambient temperatures during sales. Among the four samples that tested positive for *Salmonella*, two of the vendors had made fresh pastries but used leftover meat. According to the vendors, the meat had been preserved in the refrigerator overnight. The other two vendors did not change the pastry, but preserved the *beef samosas* in the refrigerator and refried them in the same state. In a study by Mosupye and Holy, (1999), one vendor was found to have reheated leftover food in the morning. This food was not sufficiently reheated, as the meat was briefly dipped into hot oil and immediately displayed for an extended length of time without further reheating. As a result, food from this vendor had high bacterial counts. It is preferred to discard leftovers, especially foods liable to support microbial growth (WHO, 1996).

Vendors lacked proper equipment for controlling temperatures during the holding period. They used basins, trays and *sufurias* (Table 6B), this could have led to their food items being contaminated. From the results, the contaminated samples were from vendors who covered the *beef samosas* without controlling the temperatures (Table 6D). All the vendors in the three locations said that they did not have the money to buy the appropriate equipment for food display and temperature control. In studies carried out in Pakistan, Zambia and the Dominican Republic, high bacterial counts and high incidences of food pathogens were attributed to a process by which foods were held for long periods of time at temperatures of 46°C or lower (Mosupye and Holy, 1999). The vendors cooked their foods to no lower than 95°C, but held

the food at ambient temperature for more than 6h and sometimes held it overnight, without reheating. Inadequate food temperature control is one of the most common causes of food-borne illness or food spoilage (FAO/WHO, 2001). Such controls include time and temperatures of cooking, cooling and storage. Prepared foods served hot should be kept at temperatures of at least 60°C to prevent microbial growth, particularly if the sales period extends over 4-5 h (WHO, 1996).

Some street food vendors did not cover the food items during sales (Table 6D). For instance, some vendors selling *beef samosas* in Mwembe Tayari explained that, they did not cover the foods to allow air circulation and delay spoilage (FGD. Mwembe Tayari, November, 2004). The presence of contaminating bacteria in the food was attributed to cross contamination from environmental sources and to handling by the vendors during holding (Mensah *et al.*, 2002). *Salmonella* was detected in cooked meatballs in Zambia and *Salmonella arizonae* detected in light soup with meat in Accra, Ghana.

Lack of training in basic food hygiene is a risk factor for food products being contaminated (Garin. *et al.*, 2002). Statistical significant association ($P < 0.05$) was found in some cases very high, between vendors who were trained in basic food hygiene and those who were not trained in relation to hygienic practices (Table 2A and 2B). Samples that were contaminated were from vendors who had poor hygienic practices probably due to lack of training (Table 6F). Despite their lack of formal training in basic food hygiene and food preparation, some of the vendors claimed they took precautions to avoid food contamination. A vendor in Majengo (FGD. Majengo, October, 2004) claimed

that she used clean utensils, clean water, observed personal hygiene and sold fresh foodstuffs to avoid contamination. During the FGD, this vendor said, “*hata kama sija soma sana, mimi mwenyewe najua kupika na kuweka chakula changu kwa hali ya juu sana, hata kuliko waliosoma,*” (Even if I have not gone for any training, I know how to prepare and keep my food at high standards even better than those who are trained). The percentages of food items that were contaminated due to lack of training and education are in Table 6A. There was a statistically significant association between level of education and food contamination ($P < 0.05$). There was little evidence of training in food hygiene, in the study carried out by Garin *et al.*, (2002), where 682 ice samples out of 1,261 were unsatisfactory, and 717 sandwiches out of 1,742 did not fit to the bacteriological criteria. A study carried out by Mwangi on street food vendors in Nairobi, Kenya, established that vendors had basic hygiene knowledge but were unable to translate this knowledge into safe food practices (Mwangi, 2002).

All the vendors who participated in the study were aware of the illnesses caused by contaminated foods. On the question of medical examination, thirty percent of the vendors had gone for medical examination at least once during the study period (Table 2A). Medical examination is a necessity, as it enables early detection and treatment of diseases that can be spread to others through food, especially by food handlers. Food handlers are likely to introduce biological hazards especially when suffering from, or are carriers of, a disease or illness likely to be transmitted through food (FAO/WHO, 2001). In this study where use of bare hands was a risk factor, an infected vendor using bare

hands to serve would have easily spread the disease. There was a high statistical significant association between basic food hygiene training and medical examination ($P < 0.05$). The majority of vendors who went for medical examination were trained (Table 2A). This shows that through training they acquired knowledge regarding safe food handling and the importance of being medically examined.

Transportation of food can also contribute to its contamination if not properly handled (WHO, 1996). Seventy seven percent of the vendors prepared their foods at home and carried it to the various points of sale. Some vendors did not cover the food adequately during this period hence, exposing it to all kinds of environmental contaminants. Two ladies selling *mbaazi* carried the food all the way from Likoni (mainland, and crossed the ferry) to Old town, which is about 4 km away. The food was carried in *sufurias* and covered with an aluminium lid. When tested the bacterial counts were within the acceptable limits. This could have been due to inadequate sample size and sampling period. Food samples prepared at home and transported to the site for sale were more contaminated (Table 6H), than those collected from vendors who prepared them at the stalls. No statistical significant association was found between the two variables ($P > 0.05$).

One of the most critical problems in street food vending is the supply of water in acceptable quality and sufficient quantities for drinking, washing, cleaning, and other operations (WHO, 1996). All the vendors in the three locations had water either from the taps or boreholes for food preparation. Eleven percent of the vendors said that the water they had was not enough for their daily use.

They had to reuse the available supply especially for washing utensils. Mobile vendors could only carry a little (five litres), and even stationary vendors did not have direct access to the water supply. This could have led to some kind of contamination in some of the foods, especially from the serving items if the water was not changed after every use. However, this water was not biologically analyzed. Local street vendors in Johannesburg, South Africa had limited access to clean running water (Mosupye and Holy, 1999). As a result, water collected in the morning, was frequently used until the end of the day. Samples collected from this water showed high bacterial counts as well as relatively high incidence of *E.coli*.

Vendors were divided into stationary and mobile ones (Table 6B). Stationary vendors had permanent places while the mobile ones moved from one place to the other. This could have been a risk factor due to the dust and other contaminants from the environment. One sample from a vendor selling on the pavement (stationary) was contaminated, while out of 24 samples from the mobile vendors, 12.5% were contaminated (Table 6B). However, no statistical significant association was found between the place of sale and food contamination ($P>0.05$). According to Garin *et al.*, (2002), mobile vendors often have poorer working conditions than the stationary ones. This may have accounted for this characteristic being a risk factor.

During the FGD all the vendors in the three locations studied expressed the desire of having their trade recognized and issued with licences to operate freely. They were regularly harassed, evicted, and prosecuted by the municipal council and the public health personnel. Due to the harrasment, they were not

able to display their foodstuffs in a presentable manner for fear of the authorities. They carried the foods in items that they would easily run away with when they spotted the government personnel. A vendor in Old Town (FGD. Old Town, November 2004), said, “*nitawezaje kuweka chakula vizuri, na watu wa municipaa wakija wana tufukuza na kubeba vitu vyetu.*” (How can I display my food well, yet when the municipal council personnel come they take them all away!). This unhygienic presentation could have contributed to the introduction of microorganisms (Table 6B). Draper (1996), pointed out that in many countries the street food trade was not officially recognized and vendors operated unlicensed and unregulated. At best, the attitude of most governments was to either ignore or tolerate it, but in some places vendors suffered active harassment. The study by Chakravarty and Chanet (1996), revealed that licensing the street food vendors appeared to be a prerequisite for controlling street foods. That is, taking samples, analysing the food, reporting and taking action as necessary. However, even without licensing, food inspection should still be carried out if the vendors are and remain traceable.

Based on the findings, the quality and safety of *mbaazi* and *mahamri* sold on the streets of Mombasa Island, in relation to the pathogens, *E.coli* and *Salmonella*, was acceptable. They did not pose bacterial risks to consumers, though the quality could be improved if vendors intensified their hygienic practices. *Beef samosas* were considered a risk to consumers, given the percentage that tested positive for *Salmonella*.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.0 CONCLUSION

It is recognized that street vended foods play an important role in terms of employment potential, particularly for women. It also serves the food requirements of consumers at affordable prices to both the lower and middle class income groups. The economic significance of street vended foods is immense and it is estimated that millions of shillings change hands every day through sale of street foods. Sale of street foods play a big role in Mombasa Island even though they are not officially recognised. The street food vendors are considered a nuisance especially when they sell their foods on pavements or roadsides. This creates obstruction and disturbances to the citizen.

From the study, while street vended foods play an important role in food supply they are also recognised as health risks if not prepared and handled hygienically. For example, 8.9% of *beef samosa* samples tested positive for *Salmonella*. This study confirms the results of others that have shown that the quality of meats products if not handled and produced well is generally unsatisfactory.

The major factors that led of contamination of the street vended foods in this study were, defective hygienic practices, in particular use of bare hands to serve food and unsanitary environment such as wastewater sewage. Holding of foods for long periods at uncontrolled temperatures for more than 6h and sometimes selling leftover food items were also identified as contributing factors to food contamination. These factors were mainly due to lack of

knowledge in basic food hygiene and preparation. For the vendors who had basic food hygiene knowledge, the hindrance was the enabling environment. A vendor in Old Town, expressed fear of investing in the right equipment for displaying and holding food for fear of being confiscated by the municipal council workers. This is due to the fact that, they are not recognised and licensed.

The production of relatively safe street vended foods that have low bacterial counts could be possible, if appropriate measures such as education of the street food vendors in food safety risks and food handling practices are taken. There is need for vigilant monitoring of the street food vendors by food inspectors and control staff. However this can only be achieved if the street food vendors are licensed, as it would be easy to train, monitor and control them.

6.1 RECOMMENDATIONS

Based on the findings of this study the following recommendations are proposed:

- Street food vendors should be officially recognised and included in the urban development programme. This will aid in the economic growth of the country.
- Vendors should be licensed and the municipal council simplify the procedures without imposing tedious requirements that cannot be achieved by the vendors. They could be moved to specific locations or sites where people congregate and where they can be easily monitored by the public health authorities. In such sites they could be provided

with sanitary facilities such as running water, toilets, garbage disposal services and electricity at a set amount of fees. Any vendor or city authorities that contravenes the regulations should be charged in a court of law.

- The issuance of licence to operate (which could be valid for a certain period, like one year, unless the vendor is found guilty of a serious offence) should include restrictions on the type of food to be sold and the location for sale. The criteria for granting licenses should be based on the commitment of the vendors to the preparation of safe food and subject to their knowledge of safe food handling practices.
- The local authority should device a policy to assist, control and regulate the street food sector in order to maintain the benefits of the street vended food, while assuring the safety of the food sold. Designs and construction of vending stalls, push carts (the hot sausage vending trolley) and markets could be part of the action plan of the authority to improve the safety of street vended foods.
- Training programmes should be facilitated based on basic food and personal hygiene, proper food preparation and handling practices and small business management. Vendors, who will have gone through this training, can be given certificates or badges to display, as this would give them recognition and enhance a sense of pride in their work.
- There should be regulations set specifically to cover street foods. According to a public health officer, the regulations that are there are for all foods. Steps should be taken, to design codes of practice for the

street vended foods that would apply to the whole county. These could be modified to suit the local city. Food inspectors could then be trained to adequately monitor the safety of the street foods and ensure proper implementation of the codes of practice. Street foods consumed by children, especially those sold around the schools, should be given special attention as they are more vulnerable to food-borne diseases.

6.2 Recommendations for further research

- A similar study should be conducted in Mombasa mainland so that comparisons can be drawn.
- A survey on the microbiological quality of the commonly street vended foods and vendors hygienic practises should be carried out in major towns in Kenya, where street food vending is prevalent. This would be helpful especially when designing codes of practice specifically for street vended foods.
- The quality and safety of street vended foodstuffs commonly sold to school children should be assessed, as they are more vulnerable to food-borne diseases.
- A study can be carried out to establish the chemical contaminants in street vended foods.
- Other food-borne pathogens should be included in the subsequent studies.

REFERENCES

- Adams, M, Y and Motarjemi, Y., (1999). *WHO Basic Food Safety for Health Workers*. WHO, Geneva, 3-9.
- Altekruse, S., Street, D., Fein, S., and Levy, A., (1995). *Consumer Knowledge of Foodborne Microbial Hazards and Food Handling Practices*. *Journal of Food Protection*. 59(3): 287-294.
- Andrews, W., Feng, P., Grant A. M., Hammack, S. T., Weagent, D. S., (1998). *Bacteriological Analytical Manual for Foods*. United States.
- Angelillo, I. F., Viggiani, M.A.N., Rizzo, L, and Binco, A., (2000). *Food Handlers and Foodborne Diseases: Knowledge, Attitudes, and Reported Behavior, Italy*. *Journal of Food Production*. 63(3): 381-385.
- Centers for Disease Control and Prevention, Department of Human Services, (2002). *Food borne diseases*. Atlanta Georgia, 1-5.
- Chakravarty, I., and Canet, C., (1996). *Street foods in Calcutta*. Food, and Agriculture Organisation of the United Nation. FAO, Rome, 30-37.
- Dawson, R., Liamrangsi, S. and Boccas, F., (1996). *Bangkok's street food project*. Food, Nutrition and Agriculture, FAO, Rome, 1-9.
- Draper, A., (1996). *Street foods in developing countries. The Potential for Micronutrient Fortification*, London School of Hygiene and Tropical Medicine. London, 1-16.
- Escalante, A., (2001) *Street foods in Asia and The Pacific*. Asia, 3-14.
- FAO, (1989). *Street Food. A summary of FAO studies and other activities relating to street foods*. FAO, Rome, 1-3.

FAO, (1997). FAO Newslights: *Streetfood: Small Entrepreneurs, Big Business*.

FAO, Rome, 1-3.

FAO, (2001a). *Street foods made safer*. News and highlights, FAO, Rome, 1-2.

FAO, (2001b) *Street foods around the world: News and Highlights*. FAO, Rome.

FAO/WHO Geneva, (1984). *The Role of Food Safety in Health and Development*. Report Of A Joint FAO/WHO Expert Committee On Food Safety, WHO, Geneva, 4-26.

FAO/WHO, (1986). *Guiding Principles on Evaluation of Programmes to Ensure Food Safety*. WHO, Geneva, 2-13.

FAO/WHO, (2001). *Codex Alimentarius General Requirements (Food Hygiene)*. FAO of United Nations and WHO, Rome, 227-247.

Garin, B., Aldara, A., Spiegel, A., Arrive, P., Bastaraud, A., Cartel, J.L., Ben Aissa, R., Duval, P., Gay, M., (2002). *Multicenter Study of Street Foods In 13 Towns on Four Continents by the Food and Environment Hygiene Study Group of the International Network of Pasteur and Associated Institute*. *Journal of Food Production*, 65(1): 146-151.

Hutabarat, L.S.R., and FAO (1994). *Street foods in Bangkok. The nutritional contribution and contaminants content of street foods*. An Andre Mayer Research Fellowship Study, FAO, Rome, 2-18.

Kimani, D., (2001). *Report Blames Epidemics on Poor Facilities*. *The East African*, 1-3.

Kishwar, M., (2001). *Service, not a nuisance: The economic roots and realities of vending*. India Together, India, 4-8.

- Klontz, C. K., Timbo, B., Fien, S and Levy, A., (1995). *Prevalence of Selected Food Consumption and Preparation Behaviours Associated with Increased Risk of Foodborne Disease. Journal of Food Protection*, 58(1): 927-930.
- Martins, J. H., and Anelich, L. E., (2000). *Improving street foods in South Africa*. Pretoria, South Africa, 3-71.
- Mensah, P., Yeboah-Manu. D, Owusu-Darko and Ablordey. A., (2002). *Street foods in Accra, Ghana: How safe are they?* Accra, Ghana, 1-7.
- Mosupye, F. M., and Alexander, H., (1999). *Microbiological Quality and Safety of Ready- to Eat Street- Vended Foods In Johannesburg, South Africa. Journal of Food Production*, 62 (11): 1278-1284.
- Motarjemi, Y., Kaferstein, F., Moy, G., Miyagishima, K., Miyagawa, S., and Reilly, A., (1995). *Food Safety Issues*. WHO, Geneva, 3-16.
- Muinde, O.K., and Kuria, E.,(2005) *Hygienic and Sanitary Practices Of Vendors Of Street Foods In Nairobi, Kenya. African Journal of Food Agriculture and nutritional Development (AJFANDI)*, 5(1): 2-13.
- Mwangi, A., (2002). *Nutritional, Hygiene and Socio-economic dimensions of Street Foods in Urban Areas*. The case study of Nairobi. Doctoral Thesis, University of Wageningen, The Netherlands, 11-95.
- National Institute of Allergy and Infectious Diseases, (2002). *Fact Sheet, WHO. Foodborne Diseases*. Office of communication and public liaison, Bethesda, 1-5.
- Natural Research Institute, United Kingdom and Food Research Institute, Ghana, (2000). *Street foods in Africa*. Project on enhancing the food

- security of the peri-urban and urban poor through improvements to the quality, safety and economics of street vended foods, Ghana, 1-2.
- Natural Resources Institute, United Kingdom, National Institute for Scientific and Industrial Research (NISIR), Zambia and City Health Department (CHD), Zimbabwe, (2003). *Street Foods in Africa*. Project on improving food safety of informally vended foods in Southern Africa, Zambia, 1-3.
- Olsen, A.R., (1997). *U.S. Food and Drug Administration*. Almeda CA 94502.
- Orodho, J. A., (2004) *Techniques of Writing Research Proposals and Reports*. Reata Printers, Nairobi, 36.
- Population and Housing Census, (1999). *Ministry of Finance and Planning, Central Bureau of Statistics*, Government Printers, Nairobi, Volume 1: 36.
- The Food, Drugs and Chemical Substance Act, (1992). *Laws of Kenya*, Government Printers, Nairobi. Chap 254: 31-35.
- The International Commission on Microbiological Specification for Foods, (1996). *Microorganisms in foods and specification of food pathogens*. Blackie Academic and Professional, London.
- Tinker, I. (1997). *Street Foods: Urban Food and Employment in developing countries*. New York: Oxford University Press, 3-46.
- WHO, (1992). *Essential Safety Requirements for Street-Vended Foods*. Food Safety Unit, WHO, Geneva, 3.
- WHO, (1996). *Essential Safety Requirements for Street-Vended Foods*. Food Safety Issues, WHO, Geneva, 2-12.

WHO, (2002a). *WHO Global Strategy for Food Safety*. WHO, Geneva, 1-12.

WHO, (2002b). *Food Safety Issues, Terrorist Threats to Food*. WHO, Switzerland.

WHO, Food Safety Unit, (1995). *Essential Safety Requirements for Street-vended Foods*. WHO, Geneva, 3-13.

WHO, (2003). *Food Safety- a worldwide public health issue*. WHO, Geneva, 1-3.

WHO, Geneva (1989). *Evaluation of Programs to Ensure Food Safety. Guiding Principle*, WHO, Geneva, 9-13.

WHO Information, (2002). *Food Safety and Food Borne Illnesses*. Fact Sheet no. 237, WHO, Geneva, 1-5.

WHO and Ministry of Health (1994). *1st Provincial Food Safety Seminar Workshop*. Nyanza Province, Kenya, 7-8.

7.1 Appendix A: Questionnaire

7.1.1 Interview guide for the street food vendor

I am a Masters of Science degree student at the Kenyatta University, Nairobi, School of Environment and Human Sciences, Department of Hospitality and Tourism Management. I am carrying out a research on Hygienic Practises of The Street Food Vendors and Microbiological Quality of Selected Cooked Street Foods in Mombasa Island. You have been selected as one of the participants in the study. This study is aimed at promoting your business by clearing doubts of the safety of the foods you sell. Please assist me by answering the questions as accurately as possible. I assure you of confidentiality concerning any information you give. This information will be used for academic purposes only. Please tick the appropriate answers.

Thank you.

LOCATION.....

.....

STREET-VENDOR

CODE.....

1. Gender

1. Male

2. Female

2. Marital Status

1. Married

2. Single

3. Divorced

4. Widowed

3. How many children do you have?

1. One

2. Two

3. Three

4. Four

5. Five and above

6. None

4. How old are you?

1. Below 18

2. 19 –28

3. 29-38

4. 39 and above

5. Level of Education.

- | | |
|------------------------|------------------------|
| 1. Primary level | 2. Secondary level |
| 3. Certificate college | 4. Diploma College |
| 5. University level | 6. No formal education |

6. Reasons for selling foods on the street.

- | | |
|------------------------------|------------------------|
| 1. Lack of formal employment | 2. Employed by someone |
| 3. Interest | 4. Family business |

7. How long have you been selling food on the street?

- | | |
|-----------------------|--------------|
| 1. Below one year | 2. 1-3 years |
| 3. 4-6 years | 4. 7-9 years |
| 5. 10 years and above | |

8. What kinds of foods do you sell?

- | | |
|------------------------|------------------|
| 1. <i>Beef Samosas</i> | 2. <i>Mbaazi</i> |
| 3. <i>Mahamri</i> | |

9. Do you get your income from selling foods on the street only?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

10. What is your daily net income from selling the foods?

- | | |
|---------------------|--------------------|
| 1. Less than 500 Ks | 2. 501-1000 Ksh |
| 3. 1,001-2,000 Ksh | 4. 2,001-3,000 Ksh |
| 5. 3,001-4,000 Ksh | 5. 4,001 and above |

11 Have you undergone any food preparation training?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

12. If yes, at what level?

- | | |
|----------------|----------------|
| 1. Certificate | 2. Diploma |
| 3. Degree | 4. Homescience |

13. If no, how did you learn the skills of cookery?

- | | |
|----------------|--------------------|
| 1. Parents | 2. Trial and error |
| 3. Observation | |

14. Which gender consumes your food most?

- | | |
|---------|-----------|
| 1. Male | 2. Female |
| 3. Both | |

15. Do you have a license for selling food?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

16. If no, what do you do to escape from being arrested by the authority concerned?

1. We run away when we see them coming.
2. We give them some money to allow us to sell
3. Authority have not asked or told me to stop selling
4. Sell early in the morning before they come

17 Do you go for a medical examination?

1. Yes
2. No

18. If yes, how often?

1. Once a month
2. After six months
3. Once a year
4. Others specify

19. When did you last go for an examination?

1. One month ago
2. Six months ago
4. One year ago

20. If the answer is no, why have you not gone for an examination?

1. I am not aware of anything like that.
2. I only go to the hospital when I am sick
3. Lack of money to pay the fees.

21. Are you aware of any illnesses caused by eating spoilt food?

1. Yes
2. No

22. If yes, which ones are you aware of?

1. Diarrhoea
2. Vomiting
3. Stomach-ache
4. Fever

23. Has any of your customers complained of a stomachache, diarrhoea and vomiting after consuming your food?

1. Yes
2. No

24. Have you ever had a stomachache, diarrhoea and vomiting after consuming food bought elsewhere?

1. Yes
2. No

25. Have you received any training on basic hygiene?

1. Yes
2. No

26. If no, what safety measures do you take to ensure that your customers do not suffer from stomachache, diarrhoea and vomiting after consuming your food?

.....

7.1.2 Risk Factors:

1. Where do you buy your foodstuffs?
 1. Market
 2. Supplier
 3. Farm
 4. Shop

2. How do you transport the raw foods?
 1. By Matatu
 2. By Bicycle
 3. By handcart
 4. On Foot

3. How do you store the foodstuffs?
 1. Refrigerator
 2. Cartoons
 3. Shelves
 4. Cupboard
 5. Basin

4. Where do you prepare the food?
 1. At home
 2. At the stall

5. Who assists you in the food preparation?
 1. Relatives
 2. Hired assistants
 3. I do it myself

6. Do you sell all the food you prepare?
 1. Yes
 2. No

7. If no, what do you do with the leftovers
 1. Preserve it for resale the next day.
 2. Use at home
 3. Throw away
 4. Give to others

8. If you preserve it for re-sale, how do you do it?
 1. Keep in the refrigerator
 2. Leave it covered on top of the shelf
 3. Keep it in the cupboard

9. Where do you get your water for cooking?
 1. Bore hole
 2. Tape water
 4. Buy from the vendors

10. Is the water enough for your daily use?
 1. Yes
 2. No

11. Do you boil the water before use?
 1. Yes
 2. No

12. Do you enjoy your business of selling food on the street?

1. Yes

2. No

13. What are some of the problems you encounter in your business?.....

.....

14. How would you want to be assisted regarding these problems?.....

.....

15. What improvements would you like to be made regarding your business?...

.....

16. Do you have any suggestion to give in relation to the future of street food vending business?

17. Any other comments?.....

7.1.3 Observation Guide

1. What kind of foods is the vendor selling?

1. Samosas

2. Mbaazi

3. Mahamri

2. Location of the street food vendor.

1. Along the roadside

2. Further away from the road

3. Nature of the road where the food is being sold.

1. Dusty

2. Tarmac

3. Murram

4. Tarmac with potholes

4. Where is the food sold?

1. Down on the pavement

2. On a makeshift stall

3. Along the road.

5. If on a stall, what material is it made of?

1. Cement

2. Timber

3. Iron sheets

4. Polythene paper

5. Cardboard

6. Protective clothing used.

1. Apron

2. Dustcoat

3. None

4. Lessos

7. Jewellery on arms?

1. Yes

2. No

8. Short and clean finger nails?
 1. Yes
 2. No
9. Hands free of rash?
 1. Yes
 2. No
10. Smoking while handling food?
 1. Yes
 2. No
11. Coughing over food?
 1. Yes
 2. No
12. Handling food and money without washing hands in between?
 1. Yes
 2. No
13. What is being used for serving food?
 1. A spoon
 2. Bare hands
 3. Hands covered with plastic paper
 4. Paper used for wrapping
14. Packaging material being used.
 1. Plastic paper bags
 2. Used newspapers
 3. Brown paper-bags
 4. Used white papers
15. How is the food displayed?
 1. On a tray
 2. Basin
 3. *Sufuria*
16. Is the food covered?
 1. Yes
 2. No
 3. Partly covered
17. What is used for covering?
 1. Newspaper
 2. Plastic paper
 3. Aluminium Lid
18. Is there any garbage dump next to where the food is being sold?
 1. Yes
 2. No
19. Is there any wastewater sewage near the food selling area?
 1. Yes
 2. No
20. Waste water disposal
 1. Poured on the surface
 2. Poured along the road

21. Rubbish disposal

1. Left behind unwrapped
2. Left behind wrapped
3. Thrown in rubbish bins
4. Taken to garbage dump
5. Taken home

7.2 Appendix B: Focus Group Discussions (FGD)

1. Why do you engage in street food business?
2. Why don't men sell *mbaazi* and *mahamri*?
3. Do you think that handling food with bare hands could cause contamination?
4. Where do you go to relieve yourself while vending?
5. Do you have left over foods throughout the month or are there times you sell the entire lot?
6. What do you do with the remaining foods?
7. If you sell them the following day, how do you keep them?
8. Why do you not cover your foods when selling?
9. If you have not been trained in food hygiene and production, what measures do you take to ensure that your foods are not contaminated?
10. How do you carry or transport your food to the vending site?
11. Why don't you display your foodstuffs well, for example in glass-covered containers to avoid too much exposure?
12. Do you buy your raw foods on a daily basis or do you buy in bulk?

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