BACTERIOLOGICAL QUALITY OF STREET FOODS, AND KNOWLEDGE AND ATTITUDE OF STREET FOOD VENDORS AND CONSUMERS ABOUT FOOD SAFETY IN ADAMA TOWN

MSc. THESIS

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Bacteriological Quality of Street Foods, and Knowledge and Attitude of Street Food Vendors and Consumers about Food Safety in Adama Town

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APPROVAL SHEET
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As Thesis advisors, We hereby certify that We have read and evaluated this thesis prepared, under our guidance, by Sintayehu Bogale, entitled **"Bacteriological Quality of Street Foods, and Knowledge and Attitude of Street Food Vendors and Consumers about Food Safety in Adama Town''.** We recommend that it can be submitted as fulfilling of the thesis requirement.

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DEDICATION

I dedicate this thesis manuscript to my parents Zinash Woldemichael and Bogale Gebreyohanis for their love, affection and unrestricted encouragement they gave me to not only to accomplish this research, but also for every success in my life.

STATEMENT OF AUTHOR

For this thesis first, I declare that this thesis is the result of my own work and that all sources or material used have been duly acknowledged. This thesis is submitted for partial fulfillment of the requirements of M.Sc in biology at Haramaya University and to be made available at the university's Library under the rules of the Library. I confidently declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree or certificate. Brief quotations from this thesis are allowable without special permission provided that accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by Dean of the Postgraduate Program Directorate when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

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BIOGRAPHICAL SKETCH

The author was born in 1973 in Addis Ababa. He completed the elementary and secondary school education at Entoto Amba Elementary School, and Yekatit 12 Comprehensive High School, respectively, in Addis Ababa in 1991. Upon successful completion of his high school studies, he joined Dila University in October 2004 and graduated with B.Ed. in Biology in July 2009. After completing the training he was employed by Ministry of Education as Biology Teacher in Chafe Donsa Preparatory School in Gimbichu. Since then he has been teaching Biology in Chafe Donsa Preparatory School. In 2013, he joined the Department of Biology, Haramaya University to pursue his M. Sc. studies in Biology through summer program.

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ACRONYMS AND ABBREVATIONS

AMC	Aerobic Mesophilc Count
ANOVA	Analysis of Variance
CDC	Center for Disease Control
CFS	Center for Food Safety
CFU	Colony Forming Units
EC	*Escherichia coli*
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization
FBD	Food Borne Disease
ICMSF	International Commission on Microbiological Specifications for Food
Log cfu/g	Logarithm Colony Forming Units per Gram
MPN	Most Probable Number
NSW	North South Wales
PAHO	Pan American Health Organization
PDA	Potato Dextrose Agar
RTE	Ready to Eat
TCC	Total Coliform Count
TFCC	Total Fecal Coliform Count
TSC	Total Staphylococcus Count
TSI	Triple Sugar Iron Agar
WHO	World Health Organization

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ABSTRACT

Rapid urbanization leads many inhabitants of our young cities to adopt collective food for their daily nutritional needs. This situation may be a risk for consumers due to microbial contamination from street environment and unsafe practices related to hygiene. This study aimed on the bacteriological quality of the food sold in the streets, assessed the food safety knowledge, attitudes and food handling practices of vendors and consumers of street foods in Adama. A Questionnaire and a checklist were used to collect the data. A total of 120 consumers and 60 vendors participated in the study; 60 stalls were observed and 56 food samples (16 'Bread', 12 'Bonbolino', 16 'Potato chips' and 12 'Spaghetti') were aseptically collected from four locations of Adama (Amade, Bus Terminal, Posta Bet and Meberat Hail). Interview and observational assessments were used to collect data from street food vendors. Of the 60 vendors, who participated in the study, 78.3% were female and 85% did not have any training in food safety while among 120 consumers 34.2% of them were female and 65.8 were male, 112 (93.3%) did not have any food safety training. The 59 (98.4%) of vendors and 119 (99.2%) of consumers were aware of the importance of hand washing in prevention of food borne diseases. In the observational part of the study, it was found that 21(35%) of the stalls consisted of canopy on the side of the street. In 48.3% of the cases the food was prepared on site. In 43.3% of the cases, flies and animals were evident around the stall and 51.7% did not have access to potable water. Analysis of the food samples revealed that the level of aerobic mesophilic counts ranged from 3 log_{10} cfu/ml - 4.9log_{10} cfu/ml. The mean total aerobic mesophilc bacterial count of all food samples were below the acceptable limits ($1x10^5$CFU/ml)). The mean coliforms and total fecal counts were 3.5±0.9log_{10} CFU/ml and 3.2±0.5log_{10} CFU/ml, respectively). The mean value of fecal coliform count was above the acceptable limit which is the absence in 25g of ready-to-eat foods, the mean of total coliform in "spaghetti" 4.2±0.8log_{10} CFU/ml was only above the acceptable limits ($1x\ 10^4$ CFU/ml), the rest food samples total coliform counts were below the standard. The total aerobic bacteria, hygiene lack indicator organisms as coliforms and fecal coliforms detected in the street vended foods collected from selected places in Adama. This revealed that lack of personal hygiene, improper handling of food, access of potable water and lack of food safety training were the associated risk factors to contamination of street vended foods in Adama, regular inspections of food premises and food safety practice of food vendors is recommended as one of the measures to ensure improvement of the quality of street foods.

Key words/phrases; bacterial load, contamination, food-borne disease, food safety, street vended food,

1. INTRODUCTION

Street vended foods are beverages and foods prepared and/or sold by vendors in streets and other public places for immediate consumption or consumption at a later time without further processing or preparation (Von Holy and Makhoane, 2006). A street food vendor is broadly defined as a person who offers foods for sale to the public without a permanent built up structure but with a temporary static structure or mobile stall-head load/wheel-barrow/truck (Janie and Marie, 2010). Street-vended foods provide a source of inexpensive, convenient and often nutritious food for urban and rural poor; a source of attractive and varied food for tourists and the economically advantaged; a major source of income for a vast number of persons, particularly women and a chance for self-employment and the opportunity to develop business skills with low capital investment (Codex, 1999).

In contrast to the potential benefits, it is also recognized that street food vendors are often poor and uneducated and lack appreciation for safe food handling. Consequently, street foods are perceived to be a major public health risk. If a community is to have the full benefits of street-vended foods with minimal risk of food borne disease, government intervention is required to ensure that the standard of safety for such foods is the best attainable in the context of the prevailing local situation. Therefore, it is recommended that authorities undertake Hazard Analysis and Critical Control Point (HACCP) studies to identify and integrate critical control measures into strategies for improving the safety of street foods (WHO, 1996).

In June 1997, the Codex Alimentarius Commission adopted revised basic texts on food hygiene practice and codes of practice. They recommended their wide use and understanding by governments, regulatory authorities, food industries, all food handlers and consumers to ensure that food is safe and suitable for human consumption. The general hygienic requirements and practices to be followed by the vendors were also recommended for translation by the relevant authorities into Codes of practice. This was recognized as cost effective tools for the control of street foods, by fully taking into account local conditions including specific risk factors that are relevant to each operation (Codex, 1999).

A total of 2.5 billion people all over the world eat street foods everyday (Food and Agriculture Organization (FAO), 2007). The world is becoming rapidly more urban and the population of the developing countries is projected to double from 1.7 to 3.4 billion in 2020. Deprivation in urban areas including poverty, food insecurity and malnutrition is increasing faster and urban growth now presents a serious challenge in developing countries (Maxwell *et al*., 2000). Sale and consumption of street food are on the increase and this will continue to grow (WHO, 2006).

It is well established that urbanization is taking place quickly in Sub-Saharan Africa, and it is one of the greatest challenges of the 21 century (Amponsah-Doku, 2010). The demographic expansion, coupled with the urbanization requirements has given new dimensions to this activity. Many urban dwellers obtain a significant portion of their diet from street foods-prepared, increasing considerably the street food demand in major cities (Pikuda and Ilelaboye, 2009; Suneetha *et al*., 2011).

Food exposed for sale on the streets may become contaminated by pathogenic micro-organisms. Furthermore, it is also reported that street-vended foods have epidemiological links with illness (Muinde and Kuria, 2005). Most studies on street foods concluded that it could be harmful to health due to presence of harmful pathogenic microorganisms in foods. The common reason for the unacceptable bacteriological quality was unhygienic food cooking and handling practices (WHO, 2013).

In the past few years, street foods are flourishing in major towns of Ethiopia. There are many people who get involved in the preparation and sale of street foods. It becomes common practice to observe them around school, bus stations and other places where several people are found. In Ethiopia, almost all categories of people are consuming street foods; while some are protected from using these foods due to fear of contamination. Different studies in Ethiopia showed different level of contamination of street foods (Mesfin, 2011; Mastewal, 2011 and Getu *et al*., 2013). However, there is limited information on the food hygiene and food handling practice of street food vendors and bacteriological quality of food in street of Adama.

Therefore this study was carried out to determine the bacteriological quality of street vended foods and food safety practices among street food vendors in Adama.

The main objective of the study was to assess the bacteriological quality of some foods sold in the streets of Adama Town.

The specific objectives were:

to determine the prevalence of bacterial contaminants in street foods sold in Adama Town

to determine the bacterial loads of selected foods sold in the streets of Adama Town.

to evaluate vendors' food safety knowledge, attitude and practice.

to evaluate consumers' food safety knowledge and attitude

2. LITERATURE REVIEW

2.1 Importance of Street Foods in Urban Areas

In developing countries, a large proportion of ready to eat foods are sold on the street (Mensah *et al*., 2002). According to the Food and Agriculture Organization, 2.5 billion people worldwide eat street food every day (FAO, 2007). Increased reliance of street food has been identified as one of the characteristics of urban food distribution systems driven by changes in the urban way of life and poverty in developing countries (FAO, 1998). Street foods have already become a common feature of urban life. The increasing poverty and time constraints to survive in developing countries indicate that the street food will only increase (Hilda, 2002). With the increasing pace of globalization and tourism, the safety of street food has become one of the major concerns of public health, and a focus for governments and scientists to raise public awareness of (FAO, 2007). Street food feeds millions of people daily with cheap and easily accessible food (Latham, 1997).Increased reliance on street food has been identified as one of the characteristics of urban food distribution systems, driven by changes in the urban way of life and poverty in developing countries (FAO, 1998).

2.1.1. Nutritional benefits

The street food industry plays an important role in developing countries in meeting the food demands of the urban dwellers (Latham, 1997). Street foods play significant nutritional role for consumers, particularly for middle and low-income sectors of the population, who depend on street foods for their main food intake (Mensah *et al.*, 2002). FAO reports that street foods provide nutritionally balanced diets, sufficient in quantity and presenting options for variety and choice for consumers, particularly from middle and low-income sectors of the population, who depend heavily on them (FAO, 1997).

The contribution to the daily food intake of poor urban dwellers is scarcely quantified in energy and nutrients (Hilda, 2002).The foods have been shown to contribute a substantial proportion of the daily requirement of energy and protein (25%-50%) for adolescents attending schools (Oguntona and Kanye, 1995) and urban market women (Oguntona and Tella, 1999) in Nigeria.

They are reported to play a considerable role in the daily diet of low-income male urban workers in Hyderabad (Sujatha *et al.,* 1997), urban construction workers in Nairobi (Korir *et al.,* 1998) and Calcutta street traders (Chakravarty and Canet, 1996). Their nutritional value however depends on the ingredients used and how they are prepared, stored and sold. (Owusu Darko and Ablordey, 2002).

2.1.2. Economic benefits of street foods

The street food industry offers a significant amount of employment, often to persons with little education and training (Latham, 1997).Street food in Nairobi provides a substantial amount of income for most vendors, with most of them earning an income above the official minimum wage while some of them earn twice or more of this amount (Mwangi, 2002). Street food operations sometimes involve the entire family in the procurement of raw materials, preparation and cooking of the meals (Mensah *et al*., 2002). The role of women in the sector is significant, as they control a large share of market activity and commodity trading (Mensah *et al*., 2002). Street food vendors benefit from a positive cash flow, often evade taxation, and can determine their own working hours (Mensah *et al*., 2002). In selling snacks, complete meals, and refreshments at relatively low prices, they provide an essential service to workers, shoppers, travelers, and people on low incomes. However, the people who depend on such food are often more interested in its convenience than in questions of its safety, quality and hygiene (Mensah *et al.,* 2002; Muinde and Kuria, 2005).

2.2. Preparation of Street Foods

Street foods are prepared by the vendors at home or at the road side stalls (Muinde and Kuria, 2005). Vendor's sites are mostly within five to meters radius of dusty roads and foot paths (Mwadime, 2001). The vending sites are self-allocated and not varnished with sanitary amenities (Mwangi, 2002). Foods are held in different ways before selling; fish are placed openly on the stalls and chips are held in cup boards next to the stalls while fruit salads are held in open bowls (Muinde and Kuria, 2005). After the food is prepared, it is not reheated to high temperatures before serving (Muinde and Kuria, 2005). The stalls are poorly constructed and increase the exposure to contamination by dust and smoke on the road side (Muinde and Kuria, 2005).Street vendors use tap water supplied from the municipal council or buy from water kiosks (Mwadime, 2001;Mwangi, 2002). In other instances water is ferried from home of the food vendors because

there is no portable water available in their area of operation. This water is not enough for dish washing and food preparation and vendors do not wash fresh foods properly (Muinde and Kuria, 2005). Mensah (1999) noted that without formal education, the street food vendors lack knowledge on proper food handling and may play a role in transmission of food borne pathogens.

2.3. Food Borne Diseases

It is estimated that 48 million cases of food borne diseases occur each year in the United States of America (USA) alone, resulting in 128,000 hospitalizations and 3,000 deaths (CDC, 2013). In Europe a total of 5,262 foods borne diseases outbreaks were reported in 2011, causing 43,473 human cases, 4,695 hospitalizations and 25 deaths (EFSA, 2012). Unfortunately, in most of the developing countries, data regarding food borne illnesses remain scarce (WHO, 2007). However, according to the World Health Organization (WHO), diarrheal diseases were the third leading cause of death in low income countries resulting in 1.8 million deaths around the world in 2005 alone. In general most of the cases result from the consumption of contaminated food and water (WHO, 2013).

Although street vended foods are very common in developing countries, there is paucity in data and studies regarding the prevalence of food borne diseases related to these foods. However, it has been recognized that the conditions under which street vendors operate are often unacceptable for the purposes of preparing and selling of food (Bryan, 1988; Mosupye and Holy, 2000). Street food vendors are very often poor, uneducated and show little concern towards the safe handling of foods, and food safety knowledge and practice (WHO, 1996).

2.4. Food Safety Knowledge and Attitude

In 2000, WHO has recognized food safety as an essential public health function. Food safety has been defined by Henson and Traill (1993) as the inverse of food risk—"the probability of not suffering some hazard from consuming a specific food". If one is not aware of the origin and severity of food borne diseases, it's clear that they will be less motivated to change. It's therefore necessary to believe that someone can get sick by some bad food handling attitudes and by changing the behavior, one can prevent illnesses (Schafer *et al.*, 1993). Consequently, food safety knowledge is important in prevention of food borne illnesses although gain of knowledge

doesn't necessarily lead to change in behavior. That's why attitude is also very important (Henson and Traill, 1993).

Knowledge is defined as "a complex process of remembering, relating, or judging an idea or abstract phenomenon (cognitive abilities)" (Gotsch *et al.,* 2012). On the other hand attitude is defined "as a state of mind, feelings, or beliefs about a particular matter (affective abilities) (Gotsch *et al.,* 2012). In other words attitude is the mental state in which someone is ready and motivated to move to action. Attitude is shaped by knowledge, which itself is a product of exposure to sources of information and personal willing in obtaining information (McIntosh *et al.,* 1994). Knowledge, attitude and practice can also be shaped by habits and other perceptions that result from social, cultural, and economic influences (Rozin and Fallon, 1980). In a nationwide study conducted in the United Kingdom in 1993 (FDF-IEHO, 1993), it was observed that 45% of consumers were discouraged from eating some types of food because they knew the possible risk of food poisoning.

Many studies have been done to assess food safety knowledge and attitude of street food vendors; in comparison to developed countries, very few studies have been conducted in the third world countries on the consumer's food safety knowledge and attitudes in general and no studies could be found regarding street food consumers. Although it was observed that an unknown proportion of food borne diseases could be prevented by actions taken by the consumers themselves (Medeiros *et al.,* 2001).

According the food agriculture organization (FAO), when selecting a street food vendor, consumers attach importance to hygiene; however they are often unaware of the health hazards associated with street vended foods (FAO, 2013). Many people do not know the basic rules of food hygiene (Sockett, 1995). It has been shown in available literature that attitudes and knowledge of consumers in general differ according to their demographic and socio-economic (e.g. gender, age, sex and educational level) background (Wilcock *et al.,* 2004). According to Altekruse *et al.* (1999), men were more likely to report risky attitudes than women and the prevalence of risky behavior also increased with increasing socioeconomic status. McIntrye *et al.* (2013) reported contradicting findings. In their study it was observed that food handlers with college and university education had a higher score in food safety knowledge compare to those with incomplete or completed high-school education, trained workers scored significantly higher

also than untrained workers (McIntrye *et al.*, 2013). Another study conducted in Belgium indicated as well that male consumers attached more importance to safety compared to female (Verbeke and Viaene, 1999). Unklesbay *et al.* (1998) in a study conducted in the US found that students enrolled in a type of program that included food safety information had higher food safety knowledge compare to others. Change in lifestyle has been also shown to have an influence on consumer's attitudes toward safe handling of food. In a nation-wide postal survey conducted in the US, it has been shown that consumers had poor knowledge on the organisms responsible for food poisoning, which type of foods were associated with these microorganisms, the need of avoidance of cross contamination and the importance of proper cooking (Williamson *et al.,* 1992). Woodburn and Raab (1997) also reported that respondents could not identify which groups of people were particularly at risk of food poisoning and what a food borne illness was. There is more interest of consumers in convenience and saving time than in proper food handling and preparation (American Meat Institute, 1996) and consumers often use their senses in their descriptions of safe food, and feel that food that looks or smells bad should not be eaten (Seward,2003).

In different studies conducted on food safety knowledge and attitudes of street food vendors, it was observed that in general street food vendors have poor food safety knowledge (WHO, 1996, Rane, 2009 FAO, 2013;). Demographic characteristics such as age and gender do not seem to play a role in food safety knowledge of vendors (Soares *et al.,* 2012; Annor and Baiden, 2011). Regarding the role of educational level and food safety knowledge, the results are quite different. Soares *et al.* (2012) reported that there was a positive link between educational levels and food safety knowledge of vendors while Annor and Baiden (2011) didn't find any significant difference. In some studies, it was found that there was a significant relation between knowledge and attitude (Cuprasitrut *et al.,* 2011) while others found no difference (Omemu and Aderoju, 2008).

2.5. Food Handling Practices

Three main factors play a role in the occurrence of food poisoning with regard to food handlers' knowledge, attitude and practice (Sharif and Al-Malki, 2009). Food handlers are defined as persons who prepare food and those who sell it, if they are different persons" (WHO,

1989).According to the WHO, food handling is a key factor during production, processing, storage and preparation in order to ensure food safety (WHO, 1989). Although knowledge and attitude are important, there is a gap between food safety knowledge and self-reported practices (Woodburn and Raab, 1997). Woodburn and Raab (1997) found during a telephone survey that 20% of respondents reported unsafe practices in their food preparation even though they had a high awareness of food borne illnesses. Altekruse *et al.*, (1996) found that 86% of respondents knew that hand washing reduced the risk of food poisoning, however only 66% washed their hands after handling raw meat or poultry.

In an attempt to determine the risk factors for food borne diseases it has been found that most of the outbreaks resulted from improper food handling practices (Ehiri and Morris, 1996). According to different studies, it has been estimated that a considerable number of illnesses are caused by improper food handling practices in the domestic kitchen (Flint *et al.*, 2005). It has been observed that most of street- vendors have poor food handling practices and expose the food to dangerous conditions such as cross contamination (Ekanem, 1998).

Different food handling problems by handlers have been identified: unsafe sources, inadequate cooking or heating, improper cooling, long interval between preparation and eating, poor hygiene or handlers colonized by pathogens (Bryan, 1988). Several food borne diseases outbreaks have been determined to be a result of poor food handling practices, such as the cross contamination between raw and cooked products, temperature abuse, and poor personal hygiene of food handlers i.e. failure to wash hands after using the toilet (Todd *et al.*, 2007). In a study conducted by Bryan (1988), it has been observed that the same knife without being clean was used to cut raw meat and poultry as well as gravy and salad.

Food handlers can contaminate food either passively or actively. The biological hazards may be introduced from a sick handler, from organisms on the food handlers skin or faces, from their respiratory tract or by cross contamination after handling raw materials (WHO, 1989). Physical hazards may also be introduced by food handlers wearing jewelry, bandages or by careless food handling practices (WHO, 1989). The microorganisms are transferred from the faeces, nose and skin mostly by the hands of the food handlers (WHO, 1989).

It has been determined that *Salmonella*, non typhi *Salmonella*, *Campylobacter* and *E. coli* can survive on finger tips and other surfaces for different days (Pethers and Gilbert, 1971), from which they can contaminate food. Sometimes they were able to survive even after washing; supporting the fact that food handling can lead to contamination of street vended foods (International Commission on Microbiological Specifications for Foods (ICMSF), 1998).

2.6. Overview of Street-Vended Foods

Food and green groceries are available on the street for a fraction of the cost in a restaurant or a supermarket (FAO, 2007).This food is termed as 'street food' and the consumption is common among those in the low socio-economic bracket (Mensah *et al.,* 2002). Street food is obtainable from a street side vendor, often from a makeshift or portable stall (FAO, 2007). Some street foods are regional, while others have spread beyond their region of origin (FAO, 2007). The food and green groceries sold in farmers' markets may also fall into this category, including the food exhibited and sold in fairs such as agricultural show and state fair (FAO, 2007). Most street foods are both finger and fast food. Finger food is food eaten directly using the hands, in contrast to food eaten with a knife and fork, chopsticks, or other utensils (Kay, 1999). Fast food is food that can be quickly prepared and served (Jakle, 1999). Street foods represent a significant portion of the diet of many inhabitants in many major cities (Suneetha *et al.,* 2011).

Many countries have experienced a change in their socio-economic status during the past few decades. These changes have in part led to a significant growth in the popularity of street foods (WHO, 1996). As urbanization and population are growing, especially in developing countries, it is expected that the street-vended foods sector, which is mainly but not exclusively an urban phenomenon, will continue to expand (WHO, 1996). There are several benefits of street-vended foods: i) this sector provides a regular source of income for millions of people specially women and contributes to local and national growth ii) street foods represent a source of inexpensive, convenient and often nutritious food for urban and rural poor iii) street foods also provide an opportunity to develop business skills with low capital investment while giving a chance for self-employment at the same time (WHO, 1996).

Beside the fact that they may pose a problem of pollution by waste accumulation and traffic congestion in the city, the major concern about street foods is related to their safeness. They

remain a potential cause of serious food poisoning outbreaks in many countries all over the world, especially via microbiological hazards (WHO, 1996). In support of this, it has been determined that 691 food poisoning cases and 49 deaths from 1983 to 1992 in Shandong (China) were caused by street foods (Lianghui *et al.*, 1993).

Street foods are considered to be a major public health risk due to the fact that the operations tend to lack basic infrastructure and services, difficulties in monitoring and law enforcement, difficulty in controlling due to not only the large numbers of street food vending operations but also because of their diversity, mobility and temporary nature (Ghosh *et al.*, 2007).

In a survey conducted by the WHO (WHO, 1993), almost all countries have reported a large variety of street foods, types of preparation, facilities and infrastructure. Some key findings of the survey were:

i. In 74% of countries street-vended foods were a significant part of the urban food supply,

ii. Diverse type of foods such as meat, fish, fruits, cereals, frozen products and beverages were sold in the street,

iii. There were different methods of preparation varying from foods without any preparation (65%), ready-to-eat food (97%) and food cooked on site (82%),

iv. Vending facilities were also different, going from mobile carts to fixed stalls and food centers,

v. There were limited infrastructure development with restricted access to potable water (47%), toilets (15%), refrigeration (43%) and washing and waste disposal facilities,

vi. The majority of the countries reported contamination of food (coming from raw food, infected handlers and inadequately cleaned equipment),

vii. Time and temperature abuse were the major factors contributing to food borne disease;

viii. Most countries reported that there was insufficient inspection of the personnel, insufficient application of the HACCP concept and noted that registration, training and medical examinations were not part of the management strategies of street vended foods.

One of the biggest problems which play a role in the contamination of street vended foods is the water supply. The local water supply may not have an acceptable quality, may be in insufficient quantities for drinking, washing, cleaning and other operations. Stationary stalls as well as ambulatory vendors may not have direct access to water supply. There is also a need to take into account that there is in general a scarcity of water in developing countries and tap water is not always available. Many vendors re-use water that has been already used to clean and wash their utensils (WHO, 1999).

Beside water, the places where the food is prepared are often not clean and are often located close to potential sources of contamination such as waste, toilets etc. In 70 to 90 % of the cases, insects, animals and liquid waste have been observed in area were street-vended foods were being prepared (FAO, 1988). Most of the foods are not protected against insects, dust etc. which may harbor food borne pathogens (Rane, 2011). It was observed that street foods were not covered appropriately and the safe storage temperature was difficult to maintain (Bryan *et al.,* 1988; Ekanem, 1998). The surfaces where the food is prepared sometimes have remains of food prepared earlier which can become sources of cross contamination. Leftovers after spending the entire day exposed in the sun are usually stored overnight at unacceptably high temperatures and are reheated the day after before being sold (WHO, 1989). It has been observed also that the same knives are often used during food preparation without any cleaning between uses (Mensah *et al.*, 2002). The food is sometimes prepared long before its consumption; stored at ambient temperature, and undergo inadequate cooling and reheating processes leading to contamination of the food (WHO, 1989).In addition, as mentioned earlier street food vendors are most often uneducated and have poor knowledge and awareness regarding food safety.

2.7. Microbial Quality of Street Foods

Potential hazards vary from natural and environmental contaminant to chemicals from the agriculture field, veterinary drugs growth hormones, food packaging, physical foreign bodies etc. However, microbiological hazards are considered as a greater challenge to food safety because harmful microorganisms can either proliferate in the food or in the human body once ingested (Tent, 1999). Insufficient knowledge, poor practices and operation in unsanitary environments are considered as the major risk factors leading to the production of microbiologically unsafe street foods.

According to the Centers for Disease Control and prevention (CDC) 31 pathogens are known to cause food borne illnesses (CDC, 2013). Among the pathogens found in street vended food *Bacillus cereus*, *Clostridium perfringens*, *Salmonella* and *Staphylococcus aureus* are the most common ones (Bryan *et al.,* 1988,; Mosupye and Holy, 2000; Umoh and Odaba, 1999). In Several studies carried out in Brazil, food borne pathogens and high microbial counts have been found in different street foods in the country (Hanashiro *et al.,* 2005). In Sao Paulo city (Brazil), more specifically, approximately 35% of the street food samples were inappropriate for consumption and in 12.5%, 2.5% and 22.5% of street food samples, *B. cereus*, *S. aureus* and *E. coli* were present respectively (Hanashiro *et al.,* 2005). In another study conducted in Johannesburg, *B. cereus* was the most prevalent bacteria detected in 23 (17%) out of 132 street food samples (Mosupye, *et al.,* 2000). In the same study, *C. perfringens* was detected in one raw chicken sample, *S. aureus* in two raw beef and two stew samples of street vended foods (Mosupye *et al.,* 2000).

In some Latin American cities, the frequency of fecal contamination in street foods ranged from 9.4% to as high as 56.7% above the considered standard (Almeida *et al.,* 1996).The most implicated type of food (87.5%) regards to coliforms in a study in Latin America contained meat 15% of the samples were contaminated with *B. cereus* and *S. aureus* respectively (Umoh and Odoba, 1999). It has been observed in Ghana that a large proportion of street food dishes are contaminated with unacceptable levels of bacteria (Mensah *et al.,* 2002). In a study carried out on street foods in 13 towns, 41% of the samples did not meet the bacteriological criteria and 4.5% to 70.2% were contaminated with *E. coli* while 0.4% to 3% and 1.9% to 10.1% were contaminated with *B. cereus* and *S. aureus* respectively (Garin *et al.,* 2002) .In another study conducted in Johannesburg, *B. cereus* was detected in 17% of the street food samples while *S.aureus* was present in 3% of the samples (Mosupye and Holy, 2000). In Bangkok, out of the 92 street food samples collected, 14(15.2%) had an unacceptable total bacteria count and 38(41.3%)an unacceptable total coliform count (Cuprasitrut *et al.,* 2011).

In the south Indian taste of Karnataka, food like sweets, deep fried savories, milk lollies and other food showed the presence of *E. coli, S. aureus*, coliforms and Enterococci (Girish *et al*., 2002). while in Calcutta another study on urban street food showed similar organisms (*E. coli* and *S. aureus)* and also pointed out that the critical control points of contamination of both food and water samples are poor during handling and prolonged storage conditions (Gugnani, 1999).

In Ethiopia there are many different types of ready to eat foods in different areas. Health risks associated with street foods are common. For example, *Salmonella*, *Shigella* and other food borne pathogens were isolated from different street foods in Addis Ababa (Deriba and Mogessiei, 2001). *S.aureus* and *E. coli* were isolated from some street foods in Gonder (Getu *et al*., 2013).

Pathogens present in street vended foods come from different sources and practices. Improper food handling can lead to transfer of pathogens such as *Salmonella*, *E. coli* and *S. aureus* from human body and environment into foods (Rane, 2011). Improper waste disposal have been associated with transmission of enteric pathogens like *Salmonella*, *Shigell*a and *E. coli*. Contaminated water has been associated with pathogens such as *E. coli*, fecal *streptococci*, *Salmonella* and *Vibrio cholera* while vegetables and spices are associated with introduction of spore formers like *Bacilli* and *Clostridium* and pathogens like *L. monocytogenes*, *Shigella*, *Salmonella* etc (Rane, 2011). Improper storage temperature and reheating of food have been associated with production of heat stable toxins produced by pathogens like *C. perfringens* and *B. cereus* (Rane, 2011). A study performed in the Dominican Republic showed that the aerobic mesophilic colony counts exceeded 1 x 10^8 CFU/ml in beans collected from a vendor after being left overnight at ambient temperature (Bryan *et al.,* 1988). In another study carried out in the Pakistan, aerobic mesophilic counts greater than 1 x10^7 CFU/ml were observed in leftover beef and rice collected from a vendor at a bus station (Bryan *et al.,* 1992 b). It has been also reported in these studies that the average food holding temperatures were ranged from 26 ^{0} C to 50^0 C which is ideal for the rapid growth of bacteria (Bryan *et al.,* 1988, 1992 b). Utensils and equipment may also lead to microbial cross contamination of food with *S. aureus*, *E. coli* and *Shigella* due to contaminated water, dish cloth and handlers (WHO, 1996).

3. MATERIALS AND METHODS

3.1 Description of the Study Area

The study was conducted in Adama town. Adama is one of the regional cities located about 99km from Addis Ababa in the southeast direction. Adama is located at latitude and longitude of 08°32′29″N and 39°16′08″E, respectively and an elevation of 1,712m (5,617ft) above sea level. The average annual temperature in Adama is 20.5^0C. About 808mm of precipitation falls annually.

Adama has a total of area of 133.6km^2 which has been subdivided into 18 (14 urban and 4 rural) kebele administration and the town has more than 350,000 population (ACA, 2014). Street food vending is mostly done by females who migrate to the city and have low economic level. The study included four sites in Adama town (Posta Bet, Mebrat Hail, Amede Gabaya and Bus Terminal), where the number of street food vendors and their consumers are thought to be high.

3.2 Study Design

A cross-sectional analytical study was conducted during January, 2016 to determine the bacteriological quality of street food in Adama Town. Questionnaire was used to obtain preliminary information on the demographic characteristics of street food vendors and consumers as well as evaluated the food safety knowledge and practices of street food vendors with in Adama Town.

A total of 60 food vendors (15 per site) and 120 consumers (30 per site) from four street food vending sites were selected using systematic simple random sampling technique. A total of 56 samples of common street foods in Adama were collected using systematic random sampling techniques that included 16 potato ‘chips’, 12‘Bonbolino’, 12 spoonfuls of cooked ‘spaghetti’ and16 pieces of bread.

In the Laboratory studies, randomly collected street foods in the selected study sites were serially diluted and isolation, identification and determination of bacterial loads were done in Oromiyaa Public Health Research, Capacity Building and Quality Assurance Laboratory Center. The results of all bacteriological analyses were compared with microbiological criteria for foods stuffs provided by North South Wales Food Authority microbiological quality guide for ready-to-eat foods (NSW, 2009).

3.3 Methods of Data Collection

3.3.1 Assessment of food safety knowledge and attitude

Assessment of food safety knowledge and attitude of both vendors and consumers were done using structured questionnaire. Prior to starting this study, the researcher explained the aims of this study to food vendors in the study area. The questionnaire was adopted from Angelillo *et al.* (2001), Bolton *et al.* (2008) and Ansari-Lari *et al.* (2010). The questionnaire was first translated to Amharic a pilot test was conducted using 20 people in one of the selected sites. Based on the comments of the respondents, slight changes were made before adoption of the final version for the study. The questionnaire was organized into the following three main sections: demographic information, food safety knowledge and food safety attitudes. The questionnaires were filled in either by the participants themselves or by the researcher for participants with limited education (Appendix I and II).

The demographic section included information regarding sex, location, age, educational level and training in food safety. The knowledge section was designed to evaluate the food safety knowledge of vendors and consumers about food poisoning, food infection, high risk groups and proper cleaning. This contained 18 questions with 3 possible answers "yes", "no" and "do not know". Each correct answer was awarded one mark (one point) whilst each incorrect and 'do not answer' was awarded no point (0-point). A maximum of 18 points could attain in section. The compiled score were converted to its equivalent on a basis of 18 = 100. A score less than 50 was considered as poor knowledge, 50 to 75 was considered as median (adequate food safety knowledge) and more than 75 was considered as having a good level of food safety knowledge (Samapundo , 2012).

The food safety attitude section was designed to determine the understanding of consumers and vendors about food safety. This section contained 16 questions with three possible answers as described above. The same procedure was used for evaluation in the knowledge section. During the survey on the street food consumers the researcher situated his self in areas in and around markets, bus terminal or parks which were frequently visited by local inhabitants of Adama town. The researcher identified those pedestrians who were 15 years old and asked those to

voluntary participate in the study. This appeared to be repeated until 30 consumers had been interviewed in each of the four sites, giving the study a total of 120 consumers.

For selection of the street food vendors, highly frequented streets surrounding markets, bus terminal and in each of the four sites were selected for the survey. In order to make each vendor in these streets have an equal chance of being selected as a study subject, the researcher assigned each vendor a unique number. These numbers were written on separate pieces of papers which were then mixed in a hat. The numbers were picked from the hat and the order was noted. The vendors were then approached in this order and asked to participate voluntarily until 15 had been interviewed from each of the four districts.

3.3.2. Assessment of food safety practices

The food safety practices of vendors and consumers in the selected study area were evaluated using an observation checklist (Appendix III). The checklist was a combination of different checklists used in previous studies (Chukuezi, 2010; Dirks, 2010; Ruth, 2013).

Demographic data such as age, sex, location, educational level and food safety training was registered. The checklist contained five main components

I. Containers and adequate washing facilities
II. The environment around the stall (presence of flies, animals, and litter),
III. Personal hygiene - whether or not head gear and aprons were worn
IV. Food storage
V. Utensils (the use of soap and clean water). Absence (no) or presence (yes) of each component was recorded and a frequency table for all components was computed and was used for description of food handling practices by vendors.

3.3.3 Laboratory Examination of the Bacteriological Quality of Street Vended Foods

In the laboratory, samples were examined for enumeration of total coliforms, total aerobic mesophilic bacterial,fecal coliform, staphylococci and spore forming bacterial count of each sample were enumerated using appropriate Standard method (NSW, 2009). The mean number of colonies counted was expressed as log colony forming units (CFU/ml).

3.4. Sample Collection and Processing.

At least three vendors were selected for sampling from each location. A total of 56 samples of street foods consisting of 16 potato 'chips', 12'Bonbolino', 12 spoonful cooked 'spaghetti' and 16 pieces of bread were used for analysis purposefully. The food samples were collected using systematic random sampling technique. All the samples were purchased at dry season in January, 2016 over five different days during the course of a week at four different areas of Adama town (Posta Bet, Mebrat Hail, Amede Gabaya and Bus Terminal). Bread, Bonbolino and spoonful of cooked 'spaghetti' were collected from 8am-10am, potato chips from 5pm - 8pm when most of these foods were prepared and ready to sell consumer.

Upon collection, the samples were initially kept chilled in a cooler box packed with dry ice for a maximum of six hour, Thereafter, the samples were frozen (-18°C) until they were analyzed at the Laboratory. Twenty five gram of each sample was mixed with 225 ml of 0.1% sterile peptone water and was homogenized for 2 min. using a Stomacher (Model 400, Circular, England) and 1ml of the resultant homogenate was added to 9ml of sterile 0.85% saline in a test tube and diluted serially to obtain dilutions up to 10^{-8} (Kiiyukia ,2003). All the samples were processed in Oromiyaa Public Health Research, Capacity Building and Quality Assurance Laboratory Center based on Laboratory Manual of Food Microbiology for Ethiopian Health and Nutrition Research Institute.The ingredients and description of the four street foods were presented in table 1.

Table 1.The ingredients and description of local street foods analyzed from Adama town.

Food Items	Ingredients	Description
Spaghetti	Thin stick likes shaped Spaghetti (wheat),Tomatoes, Onion	Boiled Spaghetti and then mixed with already prepared tomato stew
Bonbolino	wheat flour fried in oil	It is a circular shaped made of wheat dough which is fried in oil.
Potato chips	Pieces of potato, fried in oil	It is a ring/circular shaped made of potato which is fried in oil until golden brown.
Bread	Wheat flour	It is a circular shaped made of wheat dough.

3.4.1. Enumeration of indicator microbial group

Enumeration was done for selected indicator microorganisms i.e. total aerobic mesophilic counts, Total coliform, fecal coliform and Staphylococcal. Total aerobic mesophilic counts were done to

determine the loads of microbial contaminants in the sample street foods. Total coliform and fecal coliform counts were done to examine possible contamination with materials of fecal origin. While staphylococcal count was determined to assess the hygienic status of personnel preparing the street foods (Kloos and Bannerman., 1999).

Table 2. Selective media for microbial analysis.

Parameters	Media	Method	IncubationTemperature and Time
Total aerobic mesophilic count	Platecount agar	Pour plate	30^0C, for 24-48 hours
Total coliform count	McConkey Agar	Spread plate count	37^0C,24-48 hours
Total fecal coliform count	McConkey Agar	Spread plate count	44^0C,24 hours
Total spore forming count	TriptonSoya Agar	Pour plated	80^0C,10 minutes 30^0C , 48 hours
Staphylococci	Mannitol salt agar (MSA)	Pour plated	37^0C,24-48hours

3.4.2. Total coliform count (TCC)

The presence of indicator organisms (total coliforms) in samples was done using spread plate count on Mckonkey agar at 37^oC for 24hr to 48hrs. Serial dilutions of the samples were made in 0.1% buffered peptone water. Then, 0.1ml of each diluted sample was inoculated into MacConkey agar medium and incubated at 37^0 C for 48 hours; peteridishes were then observed. The mean number of colonies was expressed as colony forming units (CFU)/ ml.

3.4.3. Total aerobic mesophilic bacterial counts

Mesophilic counts was made up to 10^{-7} dilution factors of sterile normal saline solution.0.1 ml of each dilution was pour plated into sterile petridishes containing Plate Count Agar (PCA),and incubated at 30^o C for 24 hours. After incubation, the plates were examined for the presence of discrete colonies which was used for estimating the actual number of bacteria. Colonies were counted from replicate plates and the average was taken to estimate the TAMC. The mean

number of colonies was expressed as colony forming units (CFU)/ ml using the following formula (Titarmare *et al.,* 2009).

CFU/ml = Number of colonies counted x Dilution factor/volume of sample plated

3.4. 4. Staphylococci count (SC)

From each sample of the serial dilution, 0.1 ml was pour plated into sterile petridishes containing 15 ml mannitol salt agar (MSA) medium (Oxoid company) was pour plated and incubated at 37^{o} C for 24-48 hours. Yellow and orange colonies that were surrounded by yellow zones due to mannitol fermentation then colonies were counted from replicate plates The mean number of colonies was expressed as colony forming units (CFU)/ml (Tasnim *et al*., 2010).

3.4.5. Total fecal coliform count (TFCC)

Serial dilution the samples were prepared in 0.1 buffered peptone water then 0.1 ml of each dilution was evenly spread on MacConkey agar medium and incubated at 45^{o} C for 48 hours. After incubation, the plates were observed for the presence of discrete colonies and the actual numbers of bacteria were estimated as colony forming units per ml (CFU/ml) following the methods used by Tasnim *et al*. (2010).

3.4.6. Total spore forming bacterial count

For spore forming bacterial count, 1:10 dilutions of the sample in distilled water was poured in a test tube and heated to 80^{o}C for 10 minutes. The sample tube immediately cooled and 1 ml of the heat shocked sample was transferred to petridish containing dextrose tryptone agar with bromcerol purple. After mixing it was incubated at 30^{o} C for 48 hours (Roberts and Greenwood, 2003).

3.5. Data Analysis Method

The microbial counts were normalized by transformation to $\log_{10}$ CFU/ml.in order to establish statistical significant of microbial loads in different street vended foods site, analysis of variance (ANOVA) was applied. The Statically Package of Social Science Software (SPSS) V.20 Microsoft office excel 2007 was used for data processing and analysis. Descriptive statistics was generate for variables under study, particularly with frequency distribution for categorical data to

explore the explanatory variables associated with the outcome of interest, factors that were statistically significant were established at 95% confidence interval and p-values<0.05.

3.6. Ethical Consideration

The investigator got ethical clearance from Haramaya University, School of Graduate Studies' Ethical Review Committee. Permission was also obtained from Adama Health office in order take permission to conduct the study. Informed oral consent was obtained from the study participants.

4. RESULTS AND DISCUSSION

4.1 Food Safety Knowledge, Attitude and Practice

The present study included 60 vendor participants, 47(78.3%) female and 13(21.7%) male, (Table 3). The mean age of vendors was 25.5 ± 7.8 years. Over 90 % of the persons interviewed were ranged in the age group 15 – 35 years old. With regards to the educational level, 41.7% were of primary school level, while 40% attended the secondary school. Few of the respondents (15%) were received food hygiene training.

Table 3 -Demographic characteristics of street food vendors of Adama town.

Characteristics	Number	Percentage	mean±SD	Range
Sex				
Female	47	78.3%		
Male	13	21.7%		
Age				
15-25 years	31	51.7%	25.5±7.8	15-46
26 35 years	23	38.3%		
36-45 years	5	8.3%		
46-55 years	1	1.7%		
>55 years	0	0%		
Education				
Illiterate	4	6.7%		
Primary school complete or not	25	41.7%		
High school complete or not	24	40%		
University complete or not	7	11.7%		
Food Safety Training				
Yes	9	15%		
No	51	85%		
Location				
Bus terminal	15	25%		
Posta Bet	15	25%		
Amede	15	25%		
Meberat Hail	15	25%		
Total	**60**	**100%**		

The results of this study have revealed that the street food business in Adama is dominated by females (78.3%). This was in agreement with studies in many developing countries including Ethiopia (Diriba *et al.,* 2000), (Mesfin *et al.,*2016) ,South Africa (Martins and Anelich, 2000);

1993 Botswana (Ohiokpehai, 2003); Ghana (Tomlins and Johnson, 2004); Brazil (Hanashiro, 2004); Kenya (Muinde and Kuria, 2005); Uganda (Muyanja, 2011) and in Nigeria (Nurudeen *et al*.,2014). Generally, the higher proportion of female vendors can be explained by the fact that women are responsible for traditional cooking and child care and generally have lower education and skill levels, which result in their greater involvement in informal sector's such as street food vending. Higher proportions of women vendors may actually advantageous as female vendors have been reported to provide street foods with higher nutritional quality than male counterparts Ohiokpehai (2003).

These finding might be advantageous as it has been found in a study conducted in the United States that women demonstrate safer food preparation techniques (Klontz *et al.,* 1995). However, it has to be noted that the women assessed in the study in the US had at least a high school education which differs from our study since half (48.3%) of the vendors did not have a high school education . Nevertheless, the educational background of the vendors in Adama is quite similar to those in Ghana, Nigeria, Kenya and Lome (Ackah *et al.,* 2011; Nurudeen *et al.,* 2006; Muinde and Kuria, 2005, Adjrah *et al.,* 2013).

According to strategies used to enhance the safety of street vended foods (WHO, 1996), studies of local street food systems and consideration of education of consumers as well as training of food handlers are important. In addition, most of studies on street vended foods have concentrated on the knowledge of vendors regarding to food safety. However, the understanding and attitudes of consumers about street food safety also have an important role towards this problem through their purchasing decision, in other words, through their decisions of what to consume and from whom to purchase.

The demographic characteristics of 120 consumers who participated in this study are shown in Table 4, 41 (34.2%) were female and 79 (65.8%) were males. The mean age of the participants was 31.3, and the ages ranged from 15- to 65 years. Eighty five percent of the consumers were between 15 and 45 years of age. With regards to the level of education attained, almost a half (50%) of the consumers did not have a high school education, 47.5% were of primary school level, while 34.7% attended the secondary school. Few of the respondents (6.7%) indicated that they have received food hygiene training.

Table 4 Demographic characteristics of street food consumers of Adama town

Characteristics	Number	Percentage	Mean±SD	Range
Sex				
Female	41	34.2%		
Male	79	65.8%		
Age				
15-25	39	32.5%	31.3±11.3	15-65
26-35	38	31.7%		
36-45	25	20.8%		
46-55	14	11.7%		
> 55	4	3.3		
Education				
Illiterate	3	2.5%		
Primary school complete or not	57	47.5%		
High school complete or not	41	34.2%		
University complete or not	19	15.8%		
Food Safety Training				
Yes	8	6.7%		
No	112	93.3%		
Location				
Bus Station	30	25%		
Posta Bet	30	25%		
Amede	30	25%		
Meberat Hail	30	25%		
Total	120	100%		

The results of the survey to determine the food safety knowledge of the vendors is shown in Table 5. The mean food safety knowledge score of the vendors was 67±14. 6 (10%) of the vendors who participated in the study had a score less than 50; 33 (55 %) had a score between 50 and 75 and 21 (35%) had a score higher than 75. Amongst the studies that have used the same scoring methods, the mean knowledge score of the vendors in Adama was found to be higher than that of food handlers from other countries such as Haiti (Ruth, 2013) and Thailand (Cuprasitrut *et al.*, 2011).

Table 5 -Vendor food safety knowledge score based on the demographic characteristics.

Characteristics	Number (% of correct answers) Score range					
	< 50%	50-75%	>75%	Mean±SD	Range	p-value
Sex						
Female	5 (8.3)	24 (40)	18 (30)	67±7	39-88	
Male	1 (1.7)	9 (22.5)	3 (5)	67±14	44-89	0.76
Age						
15-25 years	4 (6.7)	14 (23.3)	13 (21.7)	63±14	39-89	
26 -35 years	0 (0)	14 (23.3)	8 (13.3)	70±9	56-83	
36-45 years	2 (3.3)	4 (6.7)	0 (0)	56±13	30-72	0.001
46-55 years	0(0)	1 (1.7)	0 (0)	-	-	
Education						
Illiterate	2 (3.3)	1(1.7)	1 (1.7)	54±19	39-83	
Primary school complete or not	3 (5)	20 (33.3)	2 (3.3)	60±10	39-78	
High school complete or not	1 (1.7)	10 (16.7)	13 (21.7)	74±11	44-89	
University complete or not	0 (0)	2 (3.3)	5 (8.3)	77±6	67-83	0.003
Food Safety Training						
Yes	0 (0)	2 (3.3)	7 (11.6)	78±7	67-89	
No	6 (10)	31 (51.7)	14 (23.3)	65±13	39-89	0.16
Location						
Bus Station	3 (5)	7 (11.6)	5 (8.3)	65±17	39-89	
Posta Bet	2 (3.3)	6 (10)	7 (11.6)	68±14	44-83	
Amede	1 (1.7)	10 (16.7)	4 (6.7)	70±10	50-83	
Meberat Hail	0 (00	10 (16.7)	5 (8.3)	66±10	44-78	0.11
Total	6 (10)	33(55)	21 (35	67±14	39-89	

It is noticeable that the mean score of the vendors was 67, which shows that the vendors surveyed in the four districts had an adequate (satisfactory) food safety knowledge level. This

may in part be a result of the expansion of primary school almost all over the country by effort of Ethiopia Minster of Education (MOE).

The survey also indicated that there was no significant difference in food safety knowledge with regards to gender ($p = 0.76$), food safety training ($p = 0.16$) and location ($p = 0.11$). On the other hand, significant differences was observed in food safety knowledge level on the basis of age ($p = 0.001$) and educational level ($p = 0.003$). In more detail, the young age group (26-35 years) had the highest levels of food safety knowledge (70 ± 9), whereas the adult vendors (36-45 years) had adequate levels of knowledge of food safety (56 ± 13) and the vendors who had been educated at the university level had good food safety knowledge scores (77 ± 6), whilst those who had received only primary education had adequate (60 ± 10).

The results of the survey to determine the food safety knowledge of the consumers are shown in Table 6. The consumers had a mean food safety knowledge score of 64 correct answers, indicating that they generally had an average knowledge of food safety. 82 (68.3%) of the 120 consumers had a score between 50 and 75 and 16 (13.3%) had score higher than 75. This could partly be a result of the extensive radio and TV campaign on food borne diseases launched in the country since the occurrence of diarrhea and vomiting in November 2015.

No statistical difference was found between the food safety knowledge's of consumers on the basis of gender (male vs. female) ($p = 0.21$) and location in Adama ($p = 0.45$). Other studies have indicated that females obtained higher score compare to males (Bruhn and Schutz, 1998).

On the other hand, significant differences occurred in food safety knowledge level on the basis of age ($p=0$), educational level ($p = 0.008$) and food safety training ($p = 0$). With regards to the level of education, it seems that the more educated consumers had better knowledge of food safety. Consumers who had been educated at the university level had good food safety knowledge scores (72 ± 9), whilst those who had received only primary education had adequate (58 ± 12) and illiterate has the poorest (46 ± 3). With respect to age, the consumers between 26 and 35 years had better food safety knowledge scores (66 ± 10) which were significantly greater than those of the older consumers. The food consumers who had received training in food safety demonstrated better food safety knowledge (71 ± 9) than untrained consumers (63 ± 13). Though, it

is difficult to ascertain if these results are a matter of chance because none of the consumers could provide a certificate or an official document of the training received.

Table 6-Consumers food safety knowledge score based on the demographic characteristics

Characteristics	Number (% of correct answers) Score range					
	< 50%	50-75%	>75%	Mean±SD	Range	p-value
Sex						
Female	3 (2.5)	30 (25)	8 (6.7)	65±11	44-83	
Male	19 (15.8)	52 (43.3)	8 (6.7)	62±13	33-94	0.21
Age						
15-25 years	6 (5)	30 (25)	3 (2.5)	64±11	44-94	
26 35 years	1(.8)	28 (23.3)	9 (7.5)	66±10	44-94	
36-45 years	5 (4.2)	16 (13.3)	4 (3.3)	63±10	39-83	
46-55 years	7 (5.8)	7 (5.8)	0 (0)	55±13	39-72	
>55	3 (2.5)	1 (.8)	0 (0)	42±7	33-50	0.00
Education						
Illiterate	2 (1.7)	1 (.8)	0 (0)	46±3	44-50	
Primary school complete or not	17 (14.2)	36 (30)	4 (3.3)	58±12	33-83	
High school complete or not	3 (2.5)	32 (26.7)	6 (5)	68±10	50-94	
University complete or not	0	13 (10.8)	6 (5)	72±9	56-94	0.008
Food Safety Training						
Yes	0 (0)	6 (5)	2 (1.7)	71±9	56-83	
No	22 (18.3)	76 (63.3)	14 (11.7)	63±7	33-94	0.00
Location						
Bus Station	3 (2.5)	21 (17.5)	6 (5)	69±12	50-94	
Posta Bet	7 (5.8)	21 (17.5)	2 (1.7)	61±10	39-94	
Amede	3 (2.5)	23 (19.2)	4 (3.3)	74±11	44-83	
Meberat Hail	9 (7.5)	17 (14.2)	4 (3.3)	76±6	33-83	0.45
Total	22 (18.3)	82 (68.4)	16 (13.3)	64±13	33-94	

Table 7.Vendor food safety attitude score based on the demographic characteristics

Characteristics	Number (% of correct answers) Score range					
Characteristics	< 50%	50-75%	>75%	mean±SD	Range	p-value
Sex						
Female	5 (8.3)	24(40)	18 (30)	75±18	43-94	
Male	1 (1.7)	9 (15)	3 (5)	69±15	38-94	0.71
Age						
15-25 years	4 (6.7)	14 (23.3)	13 (21.7)	75±11	43-94	
26 35 years	0 (0)	14 (23.3)	8 (13.3)	74±15	38-94	
36-45 years	2 (3.3)	4 (6.7)	0 (0)	68±13	50-87	
46-55 years	0 (0)	1 (1.7)	0 (0)			0.45
Education						
Illiterate	2 (3.3)	1 (1.7)	1 (1.7)	59±12	43-69	
Primary school complete or	3 (5)	20 (33.3)	2 (3.3)	70±10	38-87	
High school complete or not	1 (1.7)	10 (16.7)	13 (21.7)	79±11	50-94	
University complete or not	0 (0)	2 (3.3)	5 (8.3)	80±13	62-94	0.05
Food Safety Training						
Yes	0 (0)	2 (3.3)	7 (11.7)	85±11	69-94	
No	6 (10)	31 (51.7)	14 (23.3)	72±11	38-94	0.12
Location						
Bus Station	3 (5)	7 (11.7)	5 (8.3)	71±12	43-94	
Posta Bet	2 (3.3)	6 (10)	7 (11.7)	77±11	50-94	
Amede	1(1.7)	10 (16.7)	4 (6.7)	71±17	38-93	
Meberat Hail	0 (0)	10 (16.7)	5 (8.3)	76±8	69-94	0.71
Total	6 (10)	33 (55.1)	21 (35)	74±13	39-94	

The results of the survey to determine the food safety attitudes of the vendors are shown in Table 7.The mean food safety attitude score of the vendors was 74±13.The scores ranged from 39 to 94. 6(10%) of the vendors had a score less than 50; whilst 54 (90%) had a score of at least 50.

No statistical difference was found on the basis of location (p =0.71) and level of gender (p = 0.71), food safety training (p = 0.12) and age of vendors (p = 0.45). While the vendors who studied at university had good food safety attitudes (80 ± 13), while the illiterate ones had adequate food safety attitudes (58 ± 15) (p = 0.05). Some studies have also reported that educated food handlers have higher food safety attitudes compared to illiterate food handlers (McIntyre *et al.,* 2013) while others have reported that no significant differences occur between the two (Bas *et al*., 2006, Ruth, 2014)

The results of the survey to determine the food safety attitude of the consumers are shown in Table 8. The consumers had a mean food safety attitude score of 73, which indicated that they (in general) had an average understanding of food safety attitude. The range of scores was between 25 and 94. With regards to distribution of the scores, it can be seen in Table 12 that the majority 111 (92.5%) had a food safety attitude scores greater than 50, whilst 48 (40%) could be considered as having a very good food safety attitude as they had scores greater than 75.

The food safety attitudes of the consumers were generally higher than their food safety knowledge (p= 0). No significant differences occurred between the food safety attitude scores of consumers on the basis of gender (p = 0.38) and location (p=0.11) however, the significant differences were found on the basis of age (p = 0.009) and education (p = 0.001) and food safety training (p=0). With respect to age, consumers, between 26 and 35 years had food safety attitude scores which were significantly greater than those of the older consumers. The younger consumers in Adama have better and higher educational backgrounds compared to older consumers. The consumers who had studied at university had good food safety attitudes (82 ± 8), while the illiterate ones had average food safety attitudes (58 ± 15). This was in agreement with the findings in Haiti by Samapundo *et al*., (2014) and other studies (Annor and Baiden, 2011; Rheinländer *et al.,* 2008) with regards to the food consumers who had received training in food safety demonstrated better food safety attitudes than (78±7) than untrained consumers (73±13).

Table 8-Consumers' food safety attitudes score based on the demographic characteristics

Characteristics	Number (% of correct answers), Score range					
	< 50%	50-75%	>75%	mean± SD	Range	p-value
Sex						
Female	1 (.8)	23 (19.2)	17 (14.2)	78±7	66-87	
Male	8 (6.7)	40 (33.3)	31 (25.8)	72±15	25-94	0.38
Age						
15-25 years	2 (1.7)	23 (19.2)	14 (23.3)	75±9	50-94	
26 35 years	0 (0)	13 (10.8)	25 (20.8)	79±9	50-93	
36-45 years	3 (2.5)	14 (23.3)	8 (6.7)	69±15	44-94	
46-55 years	2 (1.7)	12 (10)	1 (.8)	62±15	25-81	
>55	2 (1.7)	2 (1.7)	0 (0)	52±22	25-75	0.009
Education						
Illiterate	1 (.8)	2 (1.7)	0 (0)	58±15	44-75	
Primary school complete or not	8 (6.7)	35 (29.2)	14 (23.3)	67±14	25-94	
High school complete or not	0 (0)	20 (16.7)	21 (17.5)	79±9	50-94	
University complete or not	0 (0)	6 (5)	13 (10.8)	82±8	61-94	0.001
Food Safety Training						
Yes	1 (.8)	3 (2.5)	4 (3.3)	78±14	50-94	
No	8 (6.7)	60 (50)	44 (36.7)	73±13	25-94	0.00
Location						
Bus Station	2 (1.7)	14 (11.7)	14 (11.7)	75±15	44-94	
Posta Bet	4 (3.3)	18 (15)	8 (6.7)	67±15	25-87	
Amede	1 (.8)	16 (13.3)	13 (10.8)	77±10	50-94	
Meberat Hail	2 (1.7)	15 (12.5)	13 (10.8)	73±13	44-94	0.11
Total	9 (7.5)	63 (52.5)	48 (40)	73±13	25-94	

Table 9- Assessment of vendors' food safety knowledge

	Statement	Right	Wrong	Do not know
1	Washing hands before work reduces the risk of food contamination	59(98.3)	0(0)	1(1.7)
2	Bloody diarrhea can be transmitted by food	38(63.3)	0(0)	22(36.7)
3	During infectious disease of the skin, it is necessary to take leave from work.	52(86.7)	0(0)	8(13.3)
4	Typhoid fever can be transmitted by food	48(80)	0(0)	12(20)
5	Eating and drinking in the work place increase the risk of food Contamination	50(83.3)	6(10)	4(6.7)
6	Swollen cans can contain microorganisms	33(55.5)	2(3.3)	25(41.7)
7	Abortion in pregnant women can be induced by food-borne disease	23(38.3)	1(1.7)	36(60)
8	Hepatitis A virus is among the food-borne pathogens	4(6.7)	1(1.7)	55(91.7)
9	Microbes are in the skin, nose and mouth of healthy handlers	57(95.5)	0(0)	3(5)
10	Salmonella is among the food-borne pathogens	6(10)	0(0)	54(90)
11	Staphylococcus is among the food-borne pathogens	4(6.7)	0(0)	56(93.3)
12	Using gloves while handling food reduces the risk of food contamination	54(90)	2(3.3)	4(6.7)
13	AIDS can be transmitted by food	58(96.7)	0(0)	2(3.3)
14	Children, healthy adults, pregnant women and older individuals are at equal risk for food poisoning	14(23.3)	33(55)	13(21.7)
15	Food prepared in advance reduces the risk of food contamination	55(91.7)	5(8.3)	0(0)
16	Proper cleaning and sanitization of utensils increase the risk of food contamination	58(96.7)	2(3.3)	0(0)
17	Reheating cooked foods can contribute to food contamination	39(65)	20(33.3)	1(1.7)
18	Washing utensils with detergent leaves them free of contamination	12(20)	47(78.3)	1(1.7)

Figures in parenthesis indicate percentage

Tables 9 and 10 show the tallied responses of the vendors and consumers, respectively to each question in the questionnaire about their food safety knowledge. The results show that the majority of the vendors did not know that hepatitis A virus (91.7% of the respondents), *Salmonella* (90%) and *Staphylococcus aureus* (93.3%) are pathogens that are responsible for

Food borne diseases. In agreement with this finding, vendors in Brazil (Soares *et al*., 2012) also failed to identify these food-borne pathogens. However almost all vendors (96.7%) recognized that AIDS cannot be transmitted by food. 63.3% knew that bloody diarrhea can be transmitted by food and 91.7% knew the preparation of foods in advance can reduce the contamination of foods. On the other hand, 86.7% knew that it is necessary to take leave from work during cases of infectious skin diseases and 95.5% knew that microbes can be found in the skin, mouth and nose of healthy handlers.

60 % of vendors did not know that abortion could be induced by food borne diseases. 78.3 % of them believed wrongly that washing utensils with detergents leave them free of contamination. 83.3% recognized that eating and drinking in the work place increased the risk of food contamination. A considerable proportion of vendors were aware of the critical role of hand washing (98.3 %) and proper cleaning of utensils (96.7%) in the prevention of food borne diseases. 90 % knew that the use of gloves is important in reducing risk of contamination. However 41.7 % of the vendors did not know that swollen cans might contain microorganisms. In contrast to this finding, vendors in Iran (Ansari *et al.*, 2010) 80% of the vendors knew that swollen cans might contain microorganisms. 60% of the vendors incorrectly thought that the reheating of foods can contribute to food contamination.

In comparison to vendors, almost all consumers did not know that hepatitis A (95%) *Salmonella* (90.8%) and *Staphylococcus* (95.8%) were food borne pathogens. 46.7 % of the consumers did not know that bloody diarrhea can be transmitted through food. Compared to the vendors (96.7%), a slightly lower proportion of the consumers (88.3 %) knew that AIDS could not be transmitted by food even. In contrast to this finding, consumers in Haiti (Ruth, 2013) 69% knew that AIDS could not be transmitted by food even.

78.3 % also knew that it is necessary to take leave from work during infectious disease of the skin. 92.5% of the consumers knew that microbes could be found in the skin, nose and mouth of healthy handlers. In similarity to the results observed for the vendors (60%), 56.7 % of the consumers did not know that abortion could be induced by food borne diseases. 70% wrongly believed that washing utensils with detergent would leave them free of contamination and only (66.7%) recognized that eating and drinking in the work place increased the risk of food

contamination. Most of the consumers were aware of the importance of washing hands (99.2%), proper cleaning (100%) and the use of gloves (95%) in the prevention of food borne diseases.

Almost half of (50.8%) of the consumers in Adama were able to identify children, pregnant women and elderly as being at equal risk of food-borne diseases. 74.2% of the consumers correctly responded that a swollen can is a possible host of microorganisms. Slightly more consumers (77.5%) than vendors (65%) knew that reheating could be used to prevent the occurrence of food borne diseases.

Tables 11 and 12 show the tallied responses of the vendors and consumers, respectively to each question in the questionnaire about the food safety attitudes. Regarding food safety attitude of the vendors, the study found that the majority of vendors answered correctly half of the questions (questions 3, 4, 6, 8, 9, 10, 11, 13, 14 and 16). As in other studies conducted in Haiti, Ghana and South Africa, a high percentage of the street food vendors (84.4%) who participated in this study were aware of the importance of separating cooked and raw foods in order to prevent food borne diseases (Ruth 2013, Donkor *et al.*, 2009 and Lues *et al.*, 2006). However most of them wrongly believed that a well-cooked food is free of contamination (81.7%) and that washed vegetables by cold water is free of contamination (43.3%). More than half (58%) of the vendors did not know the use of checking the temperature of refrigerators/freezers periodically to reduce the risk of food contamination (58.3%) and only 46.7% of the vendors knew egg should be wash before cooking.

As observed for the vendors it can be seen in Table 13 that the majority of the consumers also correctly answered approximately most of the questions (questions 3, 4, 6, 8, 9, 10, 11,13, 14 and 16) that are used to assess their food safety attitudes. The consumers had the same difficulties in answering the same questions that the vendors also could not answer. The lowest percentage of correct answers (37.8%) was observed for the question concerning on the use of checking the temperature of refrigerators/freezers periodically to reduce the risk of food contamination.

Table 10 -Assessment of consumers ' food safety knowledge

	Statement	Right	Wrong	Do not know
1	Washing hands before work reduces the risk of food contamination	119(99.2)	1(.8)	0(0)
2	Bloody diarrhea can be transmitted by food	45(37.5)	19(15.8)	56(46.7)
3	During infectious disease of the skin, it is necessary to take leave from work .	94(78.3)	1(.8)	25(20.8)
4	Typhoid fever can be transmitted by food	91(75.8)	8(6.7)	21(17.5)
5	Eating and drinking in the work place increase the risk of food Contamination	80(66.7)	31(25.8)	9(7.5)
6	Swollen cans can contain microorganisms	89(74.2)	7(5.8)	7(5.8)
7	Abortion in pregnant women can be induced by food-borne disease	31(25.8)	21(17.5)	68(56.7)
8	Hepatitis A virus is among the food-borne pathogens	5(4.2)	1(.8)	114(95)
9	Microbes are in the skin, nose and mouth of healthy handlers	111(92.5)	2(1.7)	3(5)
10	Salmonella is among the food-borne pathogens	9(7.5)	2(1.7)	109(90.8)
11	Staphylococcus is among the food-borne pathogens	5(4.2)	0(0)	115(95.8)
12	Using gloves while handling food reduces the risk of food contamination	114(95)	3(2.5)	3(2.5)
13	AIDS can be transmitted by food	106(88.3)	1(.8)	13(10.8)
14	Children, healthy adults, pregnant women and older individuals are at equal risk for food poisoning	37(30.8)	61(50.8)	22(81.3)
15	Food prepared in advance reduces the risk of food contamination	107(89.2)	12(10)	1(0.8)
16	Proper cleaning and sanitization of utensils increase the risk of food contamination	120(100)	0(0)	0(0)
17	Reheating cooked foods can contribute to food contamination	39(65)	20(33.3)	1(1.7)
18	Washing utensils with detergent leaves them free of contamination	29(24.2)	84(70)	7(5.8)

Table 11 -Assessment of vendors' food safety attitude

	Statement	Right	Wrong	DO NOT KNOW
1	Well-cooked foods are free of contamination.	4(6.7%)	49(81.7)	7(11.7)
2	Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products	34(56.7)	17(28.3)	9(15)
3	Proper hand hygiene can prevent food-borne diseases.	59(98.3)	0(0)	1(1.7)
4	Raw and cooked foods should be stored separately to reduce the risk of food contamination.	51(85)	1(1.7)	8(13.3)
5	It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination	23(38.3)	2(3.3)	35(58.3)
6	The health status of workers should be evaluated before employment	53(88.3)	0(0)	7(11.7)
7	Washing vegetables with cold water leaves them free of Contamination	29(48.3)	26(43.3)	5(8.3)
8	Wearing masks is an important practice to reduce the risk of food contamination	50(83.3)	1(1.7)	9(15)
9	Wearing gloves is an important practice to reduce the risk of food contamination	59(98.3)	0(0)	1(1.7)
10	Wearing caps is an important practice to reduce the risk of food contamination	53(88.3)	3(5)	4(6.7)
11	Fruits must be washed before served as a food	58(96.7)	0(0)	2(3.3)
12	Eggs must be washed before cooking	28(46.7)	12(20)	20(33.3)
13	Dish towels can be a source of food contamination	50(83.3)	2(3.3)	8(13.3)
14	Knives and cutting boards should be properly sanitized to prevent cross contamination	58(96.7)	1(1.7)	1(1.7)
15	Food handlers who have abrasions or cuts on can increase the risk of food contamination	42(70)	4(6.7)	14(23.3)
16	Food shelves can be a source of food contamination.	52(86.7)	5(8.3)	3(5)

Table 12- Assessment of consumers ' food safety attitude

	Statement	Right	Wrong	DO NOT KNOW
1	Well-cooked foods are free of contamination.	79(65.8)	38(31.7)	3(2.5)
2	Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products	56(46.7)	48(40)	16(13.3)
3	Proper hand hygiene can prevent food-borne diseases.	116(96.7)	3(2.5)	1(.8)
4	Raw and cooked foods should be stored separately to reduce the risk of food contamination.	81(67.5)	19(15.8)	20(16.7)
5	It is necessary to check the temperature of refrigerators periodically to reduce the risk of food contamination	45(37.8)	7(5.8)	68(56.7)
6	The health status of workers should be evaluated before employment	85(70.8)	7(5.8)	28(23.3)
7	Washing vegetables with cold water leaves them free of contamination	81(67.8)	26(21.7)	13(10.8)
8	Wearing masks is an important practice to reduce the risk of food contamination	50(83.3)	18(15)	26(21.7)
9	Wearing gloves is an important practice to reduce the risk of food contamination	105(87.5)	10(8.3)	5(4.2)
10	Wearing caps is an important practice to reduce the risk of food contamination	117(97.5)	1(0.8)	2(1.7)
11	Fruits must be washed after purchase	113(94.2)	1(.8)	6(5)
12	Eggs must be washed after purchase	65(54.2)	21(17.5)	34(28.3)
13	Dish towels can be a source of food contamination	96(80)	0(0)	24(20)
14	Knives and cutting boards should be properly sanitized to prevent cross contamination	100(83.3)	1(1.7)	1(1.7)
15	Food handlers who have abrasions or cuts on can increase the risk of food contamination	98(81.7)	8(6.7)	14(11.7)
16	Food shelves can be a source of food contamination.	93(77.5)	2(1.7)	25(20.8)

Table 13 presents the characteristics of the observed stalls. 35% of the stalls observed consisted of an informal canopy, 35% consisted of wood and zinc and 26.7% consisted of in formal container in the street. As observed in this study other studies have also reported that street vending stalls are most often made in canopies (Chukuezi, 2010). Almost half of the street foods (48.3%) were prepared on the site and 52.7% of the food was prepared at home. Other studies have also reported that most of street vendors prepared the food at home in South Africa and Mauritius (Lues *et al.,* 2006; Subratty *et al.,* 2004). Regarding the sanitary conditions of the environment surrounding the vending sites, half (55%) of the vending sites were not protected from the sun, wind and dust. Dust potentially carries pathogens and therefore may become a vector for their transmission to prepared foods. Similar observations were reported by Muinde and Kuria (2005) and Mensah *et al.,* (2002) in studies conducted on street foods in Nairobi (Kenya) and Accra (Ghana), respectively.

Evidence of the presence of animal and/or pests and flies was observed at 43.3% of the stalls. The same situation has been reported in Uganda (Muyanja, 2011), India (Choudhury, 2010) and Kenya (Muinde, 2005). 51.7% the vending stalls had no direct access to potable water at the site, whilst 41.7% did not have adequate hand washing facilities and 55 % lacked waste water and food disposal facilities. This study is in agreement with those that have been performed in Accra, Ghana (Mensa et al. 2002), Uganda (Muyanja, 2011) and Kenya (Muinde, 2005), which found that running water was not readily available at street vending sites. However, a study performed in Nigeria (Chukuezi, 2010) reported that only 9.5% of the vendors complained of water shortages. Without enough water, hygiene and sanitary practices cannot be exercised correctly; moreover, safe water is an essential pillar for health (World Bank, 1995).

95 % of the vendors in Adama handled money while serving the food and only 53.3% washed their hands thereafter. These findings are a concern since the hands are vectors for pathogens such as *S.aureus*. Consequently, it is advised that food handlers should avoid handling food with bare hands and handling money at the same time (Anon, 1999). Additionally, according to the WHO, food should be preferably handled with clean tongs, forks, spoons or disposable gloves (FAO/WHO, 1999). The hair of 48.3 % of the vendors was covered, whilst 47 (78.3%) had clean and short nails. This percentage is lower compared to other studies performed in Haiti (Ruth, 2013) and Kenya (Muinde and Kuria, 2005).

Table 13- Food safety observation checklists of stalls

Observed point of stalls	Observation N (%) No	Yes
Kind of material the stall structure Were the food is prepared consist of:		
Wood and Zinc	0 (0%)	21(35%)
Canopy	0(0%)	21(35%)
Container	0 (0%)	16(26.7%)
Other	0(0%)	2(3.3%)
The food is prepared		
At home	0 (0%)	31(51.7%)
On site	0 (0%)	29(48.3%)
Is vending stall protected from sun	33(55%)	27(45%)
Animals or pests flies etc. evident around the vending stall	26(43.3%)	34(56.7%)
There is access to potable water at the site or close the site	(51.7%)	29(48.3%)
There are adequate hand washing facilities available	(41.7%)	35 (58.3%)
There are adequate waste water or food disposal facilities available	(74.2%)	15(25.8%)
Environment around the stall		
far from rubbish, waste water, toilet facilities	33 (55%)	27 (45%)
The operator washes their hands in clean water each time before the handling, preparation and serving of food	36 (60%)	24 (40%)
The operators clothes are clean and presentable	9 (15%)	51(85%)
The operator uses an apron when handling, preparing and serving food.	20 (33.3%)	40 (67.7%
The operator has clean and short nails	(21.7%)	47 (78.3%)
The hair of the operator is covered when	31(51.7%)	29 (48.3%)
The operator handles money while serving food	3 (5%)	57 (95%)
If yes are hands washed after handling money before handling food again	32(53.3%)	28(46.7%)
Dirt or dust is removed by:		
Apron	0 (0%)	3(5%)
Bared hands	0(0%)	2(3.3%)
Dirty cloth	0(0%)	10 (16.7%)

Clean cloth	0 (0%)	45 (75%)
Food storage		
Open table	0(0%)	9(15%)
Closed dish	0(0%)	27 (45%)
Transparent opaque containers	0(0%)	24(40%)
Utensils		
Are utensils covered	13 (21.7%)	47 (78.7%)
Are utensils cleaned adequately every time after use	20 (33.3%)	40 (66.7%)

In almost two third of the cases (66.7%), the utensils were covered and 78.3% of the vendors cleaned the utensils every time after use in cold and soapy water. This practice of washing the dishes seems to be common in other countries as well (Azanza *et al.,* 2000; Ruth, 2013; Lues *et al.,* 2006).In addition, personal hygiene can only be achieved if adequate potable water is available (Latham, 1997). Therefore, it is very important for the vendors to have sufficient potable water for drinking, preparation of all kinds of foods and washing operations. According to the FAO, the place of food preparation should be kept clean at all times and should be far from any source of contamination such as rubbish, waste water, dust and animals (FAO, 1995). In addition to this, the vendors disposed of their waste food and water next to their stalls. As a consequence, this dirty environment attracted flies, which are not only an indication of poor hygiene and sanitary conditions, but they are also vectors of fecal pathogens. Proper garbage collection and disposal facilities were also found to be lacking in a study performed in Nairobi, Kenya (Muinde, 2005). In order to decrease the risk of contamination of prepared food and potable water, sufficient drainage and waste disposal facilities should be installed properly in the street food stalls (FAO, 1999)

4.2. Bacteriological Assessment

4.2.1. The prevalence of food contamination

The prevalence of bacterial group in this study was illustrated in table 14 and 15. A total of 56 street vended food samples were analyzed for the presence of total fecal coliform, total coliform,

total aerobic mesophilc bacteria and staphylococci were found in 15 (26.8%), 19 (33.9%) , 25 (44.6%) and 22 (39.3%) of street food samples, respectively.

Table 14. Prevalence of bacterial group in different street food item in Adama

Food items	Total Examined	Bacterial Group (No (%)) Fecal coliform	Total Coliforms	AMC	Staphylococci
Spaghetti	12	4	8	10	9
Potato chips	16	3	2	4	2
Bread	16	3	6	5	6
Bonbolino	12	5	3	6	5
		0.71* 0.15**	0.03* 0.02**	0.04* 0.02**	0.7* 0.13**
Total food items	56	15 (26.8%)	19 (33.9)	25(44.6%)	22 (39.3)

*p-value, **chi-square

On comparing prevalence of aerobic mesophilic bacteria and total coliform, there were found that the significant difference were observed among the four food samples ($P < 0.05$). The highest prevalence of aerobic mesophilic bacteria 10 (83.3%) and coliform 8 (66.7%) were observed in Spaghetti. This could be due to the method of handling and preparation. 'Spaghetti' is cooked in boiling water for a few minutes and adds cold water after the hot water is drained. Numeration of the total aerobic mesophilic bacteria and the total coliforms on the selected street foods samples examined in the present investigation showed the high microbial contamination. Cenci-Goga *et al*., (2005) pointed out that the total aerobic bacteria count was a good indicator of food safety.

No significant differences occurred on the prevalence total fecal coliform, total coliform and staphylococci among the four vending site ($p >0.05$) however, the significant differences were found on prevalence of aerobic mesophilic bacteria among the four vending site ($p <0.05$).

The highest prevalence of total aerobic mesophilic bacteria 8 (57.1%) was found in the food samples were taken from Bus terminal than the others sites (Table-15). Observational studies

have shown that Bus terminal area is overcrowded and the mobility of people is high and market places are found. There are a number of street food vendors and consumers in Bus terminal. But the Street foods are displayed and sold openly at very dirty surrounding on the road side. This can easily be contaminated by dust, insects, and hands of intending consumers (Getu *et al*., 2013).

Table 15- Prevalence of bacterial group in different vending site in Adama

Food items	Total Examined	Bacterial Group (No (%))			
		Fecal coliform	Total Coliforms	AMC	Staphylococci
Bus terminal	14	6	4	8	7
Posta bet	14	2	4	4	5
Amede	14	4	5	5	5
Meberat Hail	14	3	6	8	5
		0.8* 0.9**	0.9 * 0.8**	0.03* 0.04**	0.1* 0.01**
Total	56	15 (26.8%)	19 (31.9)	25(44.6%)	22 (39.3)

*p-value, **chi-square

4.2.2. Total aerobic mesophilic bacterial count

The total colony counts on the food samples obtained in this study are illustrated in Table 16. The presence of aerobic mesophilic mean count in all the samples varied between 3.3 -4.9$\log_{10}$ CFU/ml. These results are lower than those of the studies conducted in Gonder by Getu *et al*. (2013) (4$\log_{10}$ CFU/ml–5.6$\log_{10}$ CFU/ml) and in Tirumala by Suneetha *et al*. (2011) (6.1$\log_{10}$ CFU/ml –6.4$\log_{10}$ CFU/ml). On comparing the mean count of the AMC, it was found that there was no significant difference between the qualities of Samples foods from the four study sites ($P > 0.05$), but significant difference were observed among the four food samples ($P < 0.05$). Based on the average AMC, the highest aerobic mesophilic count (4.3±0.6 $\log_{10}$ CFU/ml) was found in "spaghetti" and the lowest count 3.3 ± 0.8 log10 CFU/ml was found in "Bonbolino". The mean total aerobic mesophilc bacterial count of all food samples were below the acceptable limits (1x10^5CFU/ml) (NSW 2009). According to the studies conducted in Bahir dar (Mesfin *et al*., 2015) and in Addis Abeba (Mulata and Ashenafi, 2001), the mean counts of aerobic mesophilic

bacteria in Sambusa were 5.07 log10 CFU/ml and 5.2 log10 CFU/ml respectively. In addition to this, results of aerobic mesophilic count $>10^6$ CFU/ml was reported from ready to eat Spaghetti and macaroni, while roasted offals, fish soup, and shiro sauce had aerobic mesophilic counts relatively lower ($<10^5$ CFU/ml) in a study done in Awassa by Ashenafi (1995)

Table 16-Mean levels of aerobic mesophilic bacteria and staphylococci count (log CFU/ml) in different street food items and vending site in Adama town.

Food Item	AMC			Staphylococci		
	Mean±SD	Range	p-value	Mean±SD	Range	p-value
Spaghetti	4.3 ± 0.6^{Ga}	3.3-4.9		4.8 ± 0.7^{Bc}	2.9-5.6	
Potato Chips	4.3 ± 0.3^{Be}	4.0-4.7		3.8 ± 0.8^{Aa}	3.0-4.6	
Bonbolino	3.3 ± 0.7^{Ac}	3.0-3.7		3.3 ± 0.5^{Db}	3.0-4.2	
Bread	3.4 ± 0.1^{Db}	3.3-3.4	0.04	4.1 ± 0.6^{Cb}	3.4-4.9	0.45
Total	4.0±0.6	3.0-4.9		3.8±0.7	2.9-4.9	
Vending Site						
Bus Terminal	4.3 ± 0.7^{Ab}	3.2-4.9		4 ± 0.4^{Ba}	3.4-4.6	
Amede	3.3 ± 0.7^{Da}	3.3-4.8		3.8 ± 0.9^{Eb}	2.9-4.9	
Meberat Hail	4 ± 0.5^{Bc}	3.3-4.9		4.4 ± 0.4^{Ce}	3.9-4.8	
Posta Bet	4.4 ± 0.3^{Cd}	3.0-3.7	0.19	3.4 ± 0.5^{Dc}	3.4	0.47
Total	3.9±0.6	3.0-4.9		3.8±0.6	2.9-4.9	

Means followed by different small letters in row are significant at 0.05 probability levels of paired samples T-test within treatment. Means followed by different capital letters in column are significant different at 5% levels of significance between treatments.

4.2.3. Staphylococci count

The presence of staphylococci in the whole food samples was 22 (39.3%) with a range of 3.3 $\log_{10}$ CFU/ml – 4.8 $\log_{10}$ CFU/ml (Table 15). These results were greater than those of a study conducted by Suneetha (2011) but study conducted in Addis Abeba, the highest number of staphylococci 5.8 $\log_{10}$ CFU/ml was observed in "Macaroni"(Deriba,2000There was no

significant difference between staphylococci count in the four street food vending site and the types of food samples (P>0.05). The specification for street food served in the NSW Food Authority microbiological quality guide for ready-to-eat food recommended that the maximum counted permitted for total staphylococci counts should be 1x 10^4 CFU/ml (NSW, 2009).The mean staphylococci count found in "Spaghetti" (4.8 ±0.7 $\log_{10}$ CFU/ml) and bread 4.1±0.5 log CFU/ml were above the acceptable limit (1x10^4CFU/ml). Its presence suggests poor hygiene practices of operators. Bezirtzoglou *et al*. (2000) reported that the contamination by food handlers is the most common mode of transmission of this germ.

Staphylococci are common inhabitants of the skin and mucous membranes and 20% to 50% of normal healthy adults may be carriers of staphylococci (Talaro & Talaro 2012). The presence of staphylococci was an indication of contamination from the skin, mouth or nose of food handlers through coughing and sneezing. This contamination can be introduced into the street foods during handling, processing or vending (Sandel and McKellar, 2004). In addition its presence in a foodstuff may be attributed to it being introduced into the food from the handlers or from utensils used by vendors to serve food. Observation of preparation practices indicated the use of knives that had not been properly sanitized for cutting and chopping of raw vegetables. In a study done in the Johannesburg, South Africa, Mosupye and Von Holy (1999) reported similar observations

4.2.4. Total coliforms, total fecal coliform count and total spore forming bacterial count

The mean coliforms and total fecal counts were 3.5±0.9$\log_{10}$ CFU/ml and 3.2±0.5$\log_{10}$ CFU/ml, respectively (table17). The mean value of fecal coliform count was above the acceptable limit which is the absence in 25g of ready-to-eat foods (NSW, 2009), the mean of total coliform in "spaghetti" 4.2±0.8$\log_{10}$ CFU/ml was only above the acceptable limits (1x 10^4 CFU/ml) the rest food samples total coliform counts were below the standard. There was no a significant difference in the coliforms and total fecal counts evaluated in from all the four vending site and all food samples ($p < 0.05$).In our study the level of total coliforms varied between 2 $\log_{10}$ CFU/ml -5.2$\log_{10}$ CFU/ml. These results for contamination level were higher than those conducted in Tirumala (Suneetha C *et al*., 2011) with the reported finding 2.4 – 3.6 $\log_{10}$ CFU/ml

and Gonder (Getu *et al*., 2013) with 2.5-3.8 $\log_{10}$ CFU/ml. The presence of coliforms may indicate fecal contamination which might be due to inappropriate processing, probably at one or other stage of preparation or from the materials used. All the samples of street vended food in Adama were not contaminated with spore forming bacteria (table 17).

Table 17. Mean level of total coliforms, total fecal coliform count and total spore forming bacteria (log CFU/ml) in different street food items in and vending site Adama.

(Nd- not detected)

Food Item	Total Fecal coliform			Total coliform			Spore forming bacteria
	Mean±SD	Range	p-value	Mean±SD	Range	p-value	Mean±SD
Spaghetti	3.3 ± 0.5^{Aa}	3.3-4.9		4.2 ± 0.8^{Bb}	3.1-5.2		Nd
Potato Chips	2.6 ± 0.2^{Eb}	2.5-2.7		2.7 ± 0.5^{Ea}	2.0-2.7		Nd
Bonbolio	3.1 ± 0.3^{Bc}	3.0-3.7		3.4 ± 0.4^{Cc}	3.0-3.8		Nd
Bread	3.4 ± 0.1^{Bd}	3.3-3.5	0.41	2.9 ± 0.7^{Df}	2.0-3.7	0.11	Nd
Total	3.2±0.5	2.5-4.9		3.5±0.9	2.0-5.2		
Vending Site							
Bus Terminal	3.3 ± 1.1^{Ba}	2.6-4.1		3.7 ± 0.9^{Ab}	2.6-4.4		Nd
Amede	3.0 ± 0.5^{Dc}	2.6-3.2		3.5 ± 1.0^{Cd}	2-5.1		Nd
Meberat Hail	3.6 ± 0.6^{Fb}	3.3-4.9		4 ± 1.5^{Db}	2-5.2		Nd
Posta Bet	2.6 ± 0.4^{Ad}	3.0-3.7	0.72	3.2 ± 0.3^{Ea}	3.0-3.6	0.15	Nd
Total	3.2±0.5	2.5-4.9		3.6±1.0	3.0-4.9		

Means followed by different small letters in row are significant at 0.05 probability levels of paired samples T-test within treatment. Means followed by different capital letters in column are significant different at 5% levels of significance between treatments.

In Brazil, fecal coliforms were detected in 22 samples (55%) (>3 MPN/g), 50% were above acceptable limits, confirmed *S. aureus* and *E. coli* were present in 12.5%, 2.5% and 22.5% of street food samples, respectively. *S. aureus* counts ranged from 1.4 $x10^3$ up to 1.7 $x10^4$ CFU/ml of food sample (Hanashiro *et al.*, 2005). In Ghana, mesophilic bacteria were identified in 356 food samples (69.7%); and confirmed *B. cereus*, *S. aureus* and Enterobacteriaceae were found in 28 (5.5%), 163 (31.9%), and 172 (33.7%) street food samples, respectively, although the microbial quality of most foods was within acceptable limits (Mensah *et al.*, 2002). In Bangkok (Thailand), 14 samples (15.2%) and 38 samples (41.3%) of ready-to-eat food were contaminated with bacteria in general and coliforms, respectively (Cuprasitrut *et al.*, 2011). In Lome (Togo) median total aerobic bacteria and total coliform counts of 3.2 x 10^6 and 1.9 x 10^4 CFU/mlwere found in samples of salads. Sixteen samples (23.2%) were contaminated by confirmed *S. aureus* at levels between 10 and 200 CFU/ml (Adjrah et al., 2013).

As a result of differences in the types of street foods samples, environment as well as the method of preparation, differences occur between the results obtained in different countries. However, the majority of the studies including this study have indicated that street foods consumers are potentially at risk as a result of the unhygienic conditions under which these foods are mostly prepared and vended. In particular, this study showed that the presence of staphylococci and fecal coli form indicates that the safety of street foods vended in Adama town is questionable or suspect.

5. SUMMARY, CONCULUSIONS AND RECOMMENDATIONS

5.1. SUMMARY

Urbanization and rapid growth in the populations of developing countries is serving as a major driver for the large expansion of the production and popularity street vended foods. This trend can bring a lot of benefits especially for the urban and rural poor and provide a major source of income for people, particularly women. As a result, street food vending has to some extent decreased the burden of governments on food security for low-income urban populations and provided opportunities for a vast number of people for self-employment with low capital investment. However, contamination of street food on road side stalls is sometimes unacceptable for human consumption and creates significant health problems.

A cross-sectional analytic study was employed to determine the bacteriological quality of street vended foods and assessed food safety knowledge, attitude and practice of vendors and consumers in Adama town.

Analysis of the food samples revealed that the highest prevalence of aerobic mesophilic bacteria 10 (83.3%) and coliform 8 (66.7%) were observed in Spaghetti.The level of aerobic mesophilic counts ranged from $3\log_{10}$ CFU/ml - $4.9\log_{10}$ CFU/ml. The result of the study showed that some of the food samples showed much higher bacterial counts than the permitted counts. The overall mean of total staphylococci and total coliform 4 ± 0.7 $\log_{10}$ CFU/ml and $3.5\pm0.99\log_{10}$ CFU/ml respectively was above the standards.

Of the 60 vendors, who participated in the study, 78.3% were female and 22.7 were male while among 120 consumers 34.2% of them were female and 65.8 were male, the majority (93.3%) did not have any food safety training.

Consumers and vendors exhibited average food safety knowledge and attitude although they had a better food safety attitude compare to knowledge. Consumers and vendors did not know that *hepatitis A, Salmonella spp. and Staphylococcus spp*. are pathogens responsible of food borne diseases. They also had some difficulties in identifying the groups at risk of food borne diseases and most importantly they were not aware of the importance of reheating food to fight against food borne diseases.

The majority of vendors and consumers were aware of the importance of hand washing and proper cleaning in prevention of food borne diseases. In the observational part of the study, it was found that some of the stalls consisted of canopy on the side of the street. In 48.3% of the cases the food was prepared on site.

Almost half (55%) of the vending sites were not protected from the sun, wind and animal and/or pests and flies were observed at 43.3% of the stalls. Dust and flies potentially carry pathogens and therefore may become a vector for their transmission to prepared foods. Over 51.7% did not have access to potable water. The majority served the food with bare hands and did not wash their hands after touching money.

5.2.Conclusions

This study had the major objective of assessing the bacteriological quality of some foods sold in the streets of Adama Town. To a lesser extent determining the food safety knowledge, attitude and practice of street food consumers and vendors in Adama. The total aerobic bacteria, hygiene lack indicator organisms as coliforms and fecal coliforms detected in the street vended foods collected from selected places in Adama. This revealed that lack of personal hygiene, improper handling of food, access of potable water and lack of food safety training were the associated risk factors to contamination of street vended foods in Adama.

On the other hand, even if most of vendors and consumer exhibit average good food safety knowledge and attitude considerable percentage had a low score indicate that there is still a need for food safety education. The actual food handling practices by street vendors also raise some serious concerns. Since the majority of vendors did not have any food safety training, there is a need to organize formal training in food safety for the street foods vendors. There is also a need for the government to make more infrastructures available such as potable water, toilets and waste disposal facilities as the lack of these structures was evident in our study.

5.3 Recommendation

Based on the findings of the present study the following recommendations are made:-

- the practice of consuming street foods cannot be stopped on unhygienic grounds cannot made the street vendors prohibited from selling such items, as such activities provide them with a source of livelihood but Government Health Agencies must adopt measures

to educate the street foods 'vendors on food safety and hygienic practices and enforce adequate guidelines for street food vending.

- The Local Government and the ministry should consider establishment of appropriate infrastructure i.e. potable water and waste disposal facilities.
- There should be an urgent need to organize formal training of vendors in food hygiene and food safety.
- Vendors should use antiseptics for cleaning equipment and pure water to prepare street foods
- Regular monitoring of the quality of street vended foods for human consumption must be introduced to avoid any future bacterial pathogen outbreak.
- Due to the difficulties in the lack of resources, time and the number of samples as well as the types of the collected street foods was limited. Therefore, many other popular street foods were not included in this study, which may lead to arbitrary conclusions about bacteriological quality and safety of street foods in Adama town. This shows that there is a need for additional research in the area of street food vendors and the possible risks they may pose with regard to food safety.

6. REFERRENCES

Abdussalam, M., Kafersten, F.K. 1993. Safety of street foods. World Health Forum14:191 – 194.

ACA (Adama City Administeration). 2014. The profile of Adama City .U-tube printings, Adama, Ethiopia

Adjrah, Y., Soncy, K., Anani, K.,Blewussi, K., Karou, D. S., Ameyapoh, Y., de Souza, C. & Gbeassor, M. 2013. Socio-economic profile of street food vendors and microbiological quality of ready-to-eat salads in Lomé, International Food Research Journal, 20: 6570

Ahmed,M.S.U.,Nasreen, T.,Ferosa, B., Parveen S.2009.Microbiological Quality of Local Market Vended Freshly Squeezed Fruit Juices in Dhaka City,Bangldesh,*Journal of Scientific and industrial Research*, 44:421-424

Almeida, C. R., Schuch, D. M. T., Gelli, D. S., Cuellar, J. A. S., Diez, A. V. R. & Escamilla,J.1996. Microbial contamination of street foods sold in Latin America and Socioeconomic characteristics of their vendors and consumers. PAHO/WHO/INPPAZ, OPS/HCP/ HCV/FOS/96.22.

Altekruse, S. F., Yang, S., Timbo, B. B. &Angulo, F. J. 1999. A multi-state survey of Consumer food-handling and food consumption practices. *American Journal of Preventive Medicine*, 16:216–221.

American Society for Microbiology.1982.Manual of Microbiological Methods. Washington D.C American Meat Institute. 1996. Putting the food-handling issue on the table: the pressing need for food safety education. Washington, DC: American Meat Institute and Food Marketing Institute.

Amponsah-Doku, F., Obiri-Danso, K., Abaidoo, R. C., Andoh, L. A., Drechsel,P.and kondrasen F. 2010. Bacterial contamination of lettuce and associated risk factors at production sites, markets and street food restaurants in urban and peri-urban Kumasi,Ghana. *Scientific Research and Essay* 5: 217-223

Angelillo, I. F., Viggiani, N. M. A., Greco, R. M. & Rito, D. 2001. HACCP and food hygiene in hospital: knowledge, attitudes, and practices of food services staff in Calabri,Italy. *Infection Control Hospital Epidemiology*, 22: 1-7.

Annor, G, Baiden, E. A. 2011. Evaluation of Food Hyargiene, Knowledge, Attitudes and Practicies of Food Handlers in Food Businesses in Accra, Ghana. *Food and Nutirition Sciences*, 2: 830-836

Anon.1999. Trends and sources of zoonotic agents in animals, feedstuffs, food and man in the European Union in 1997. Part 1. Document No. VI/8495/98 – Rev.2 of the European Commission, Community Reference Laboratory on the Epidemiology of Zoonoses, Berlin,Germany

Ansari-Lari, M., Soodbakhsh, S. & Lakzadeh, L. 2010. Knowledge, attitudes and practices of workers on food hygienic practices in meat processing plants in Fars, Iran, *Food Control*, 21: 260-263

Ashenafi M. 1995. Bacteriological profile and holding temperature of ready-to-serve food item in an open market in Awassa, Ethiopia. *Trop. Geogr. Med*. 47: 244-247.

Azanza PV, Gatchalian CF,Ortega M. 2000. Food safety knowledge and practices of street food vendors in a Philippines university campus. Int J Food Sci Nutrit, 51: 235 – 246.

Bas, M., Ersun, A. S. A., & Divan, G. 2006. The Evaluation of Food Hygiene knowledge, Attitudes, and Practices of Food Handlers in Food Businesses in Turkey. *Food Control*, 17: 317 -322.

Bezirtzoglou,E.,Maipa, V.,Voidarou,C.,Tsiotsias, A.and Papapetropoulou,M. 2000.Food Borne Intestinal Bacterial Pathogens. Microbial Ecology in Health and Disease 2: 96–104.

Bruhn, C. M., & Schutz, H. G. 1998. Consumer food safety knowledge and practices. *Journal of Food Safety*, *19*, 73-87

Bryan FL. 1988. Critical Control Points of Street-vended Foods in the Dominican Republic. *Journal of Food Protection*, 51: 373-383

Bryan, F.L., Teufel, P., Riaz, S., Roohi, S.,Qadar, F., Malik, Z.1992b. Hazards and criticalcontrol points of street-vending in a mountain resort town in Pakistan. *Journal of Food Protection,* 55:701–707

Bryan, Fl. 1988. Risks of practices, procedures and processes that lead to outbreaks of Food borne diseases, *Journal of Food Protection*, 51:663-673

Bolton, D. J., Meally, A., Blair, I. S., Mcdowell, D. A. & Cowan, C. 2008. Food safety knowledge of head chefs and catering managers in Ireland. *Food Control*, 19:291-300.Burt, M., Volel, C. and Finkel, M.2003. Safety of vendor-prepared foods: Evaluation of processing mobile food vendors in Manhattan. Public Health Rep 118: 470-476

Cable news Network (CNN). 1999. Fourteen die in mass food poisoning in Cuba (News Report: 7 February 1999). CNN interactive, cnn.com.

Center for Food Safety (CFS). 2014. Microbiological Guide Lines for Food. (For ready to eat food in general and specific food items.3:21-30

CDC.2013.Estimates of Food borne Illness in the United States, viewed 15th May http://www.cdc.gov/foodborneburden/2011-foodborne-estimates.html

Chakravarty I. and Canet C. 1996.Street foods in Calcutta. *Food,Nutrition and Agriculture*, 17/18:30-37

Choudhury M, Mahanta L, Goswami J, Mazumder M, Pegoo B.2011. Socio-economic profile andfood safety knowledge and practice of street food vendors in the city of Guwahati, Assam, India. Food Control .21:96-203.

Chukuezi C. O. 2010. Safety and Hygienic Practices of Street Food Vendors in Owerri, Nigeria Studies in Sociology of Science, 1: 50-57

Codex International Food Guidelines .1999. Revised Regional Guidelines for the Design of Control Measures for Street-Vended Foods in Africa. CAC/GL-22R.

Cuprasitrut, T., Srisorrachatr, S., Malai, D.2011, Food Safety Knowledge, Attitude and Practice of Food Handlers and Microbiological and Chemical Food Quality Assessment of Food for Making Merit for Monks in Ratchathewi District Bangkok, Asia. *Journal of Public Health*.2:27-34

Dardano C. 2003. Carribean regional working group on street food vendors. Report of FAO,PAHO and BNSI. ftp:ftp.fao.org/es/esn/food/carribean_report.pdf April. 2010

Deriba Muleta and Mogessie Ashenafi, 1995. Bacteriological profile and Holding T^{O} at street vended foods from Addis AbebaInt, *J. food sciHum,nutril*, 11: 95-105.

Dirks, L .2010. Observation of food safety behavioral practices in foodservice employees after training and examination. *Msc. Thesis*. University of Missouri. USA

Donkor, E.S., Kayang, B., Jonathan, Q. & Moses, A. L. 2009. Application of the WHO keys of safer food to improve food handling practices of food vendors in a poor resource community in Ghana. *Int. J. Environ*. Res. Public Health, l6:2833-2842

FAD (Food & Drug Administration). 2002. Bacteriological Analytical Manual, Enumeration of *Escherichia coli* and the Coliform Bacteria Online.Chapter4:1-6

EFSA.2012. The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in. 2010. *EFSA Journal*, 10:2597

Ehiri, J. E., & Morris, G. P.1996. Hygiene training and education of food handlers: Does it work? *Ecology of Food and Nutrition,* 35:243–251.

Ekanem EO .1998. The street food trade in Africa: safety and socio environmental issues, *Food Control*, 9:211-215

FAO.1997. Agriculture food and nutrition for Africa: A resource book for teachers of Agriculture. FAN Rome 1997, 123

FAO. 1988. Food handling and street food preparation practices, particularly of dairy Products in Kathmandu, Technical report project TCP/NEP/6755. *Food and Agriculture Organization of the United States*, Rome

FAO.2007.School kids and street food, Accessed on May 21th2013, http://www.fao.org/AG/magazine/0702sp1.htm

FAO. 2013. Food for the cities: street foods, Accessed March10th2013on,http://www.fao.org/fcit/foodprocessing/

FDF-IEHO. 1993. Consumer willingness to pay for reduction in the risk of food poisoning in The UK. *Journal of Agricultural Economics*, 47:403–420 (cited in Henson, S. 1996)

Flint, J. A., VanDuynhoven, Y. T., Angulo, F. J., DeLong, S.M., Braun, P., Kirk, M.,Scallan, E., Fitzgerald, M., Adak, G. K., Sockett, P., Ellis, A., Hall, G., Gargouri, N., Walke,H., &Braam, P. 2005. Estimating the burden of acute gastroenteritis, food borne disease, and pathogens commonly transmitted by food: *An international review*. *Clinical and Infectious Diseases*, 41:698–704.

Garin, B., Aïdara, A., Spiegel, A., Arrive, P., Bastaraud, A., Cartel, JL., Aissa, RB., Duval, P., Gay, M., Gherardi, C., Gouali, M., Karou, TG., Kruy, SL., Soares, JL., Mouffok, F. Ravaonindrina, N., Rasolofonirina, N., Pham, MT., Wouafo, M., Catteau, M., Mathiot, C.,Mauclere, P. & Rocourt, J. (2002). Multicenter Study of Street Foods in 13 Towns on Four Continents by the Food and Environmental Hygiene Study Group of the Internationalnetwork of Pasteur and Associated Institutes, *Journal of Food Protection*, 65:146-152

Getu,D, Samuel, S, Mengistu, E.2013. Bacteriological Assessment of Some Street Vended Foods in Gondar, Ethiopia, *Journal of Food Safety*, 15:33-38

Ghosh,M.,Wahi, S., Kumar, M., Ganguli, A.2007. Prevalence of enterotoxigenic Staphylococcus aureus and Shigella spp. in some raw street vended Indian foods, *Environmental Health Research*, 17:151–157.

Girish R., Broor S., Dar L. and Ghosh D .2002. Food borne outbreak caused by a Norwalk Virus in India. *JMedViro* l.67 : 603-607.

Gotsch, RA., Keck, CW., Spencer, HC. 2012. Knowledge, Skills, and Attitudes (KSAs) for the Public Health Preparedness and Response Core Competency Model, CDC, Office of Public Health Preparedness and Response. Association of Schools of Public Health.

Goldman and Green. 2009. Practical Hand Book of Microbiology 2 ed.6:67:37:231-232

Gugnani, H.C. 1999. Some emerging food and water-borne pathogens.*Journal of Community.* 43:576-632

Hanashiro, A., Morita, M., Matte, G.R., Matte, M. H. & Torres, E .2005. Microbiological quality of selected street foods from a restricted area of Sao Paulo city, Brazil, *Food Control*, 6:439–444

Harely-Prescott.2002.Laboratory Exercise in Microbiolgy.5 thed.38:231-232

Henson, S. &Traill B. 1993. The demand for food safety: market imperfections and the role of government, *Food Policy*,18:152-162

Hilda Van t Riet .2002. The role of street foods in the diet of low-income urban residents, the case of Nairobi. *PhD Thesis*: 86-92

Idowu, O. A., & Rowland, S. A. 2006. Oral fecal parasites and personal hygiene of food handlers in Abeokuta, Nigeria. *African Health Science*, 6:160–164.

International Commission on Microbiological Specifications for Foods (ICMSF) .1998. Janie P, Marie T .2010.Street food in Kolkata- A hygienic perspective Project in practice 400040,Block 3

Jakle J. 1999. Fast Food: Roadside Restaurants in the Automobile Age. Johns Hopkins University Press, ISBN 0-8018-6920-X.

Kay H.1999. Finger Food. Tuttle Publishing. ISBN9625934448

Korir S.C.R, Imungi J.K. and Muroki N.M. 1998. Proximate chemical composition of street foods and their energy and protein contribution to the nutrition of manual workers in Nairobi. *Ecology of Food and nutrition*, 37: 123-133

Kiiyukia C. 2003. Laboratory manual of food microbiology for Ethiopian Health and Nutrition Research Institute. Unido Project Ya/ETH/03/436/:11-54.

Klontz, K. C., Timbo, B., Fein, S., & Levy, A.1995. Prevalence of selected food consumption and preparation behaviors associated with increased risks of food-borne disease. *Journal of Food Protection*, 58:927–930.

Lianghui, X., Xingling, SM., Yuju, C., Zhang, L., Haiyan,W. 1993. Analysis of street food safety in Shandong province, abstracts. In: Final program street foods epidemiology, management and practical approaches, Beijing, Oct 19–21, p 15

Latham M.C.1997. Human nutrition in tropical Africa. Rome: FAO, 329-437.

Lues, F.R., Mpeli, R.R., Venter, P. & Theron, M.M. 2006. Assessing Food Safety and Associated Food Handling Practices in Street Food Vending. International Journal of Environmental Health Research, 16: 319-328.

Martins, J.H. & Anelich L.E. 2000. *Improving Street Foods in South Africa*. Unpublished Report for the Food and Agricultural Organization of United Nations, Rome TCP/SAF/8924

Mastewal Balew. 2011. Microbiological quality and safety of ready to eat spaghetti and spaghetti sauce in Bahir Dar. *MSc. Thesis*, Bahir Dar University

Maxwell DG, Levin CE, Armar-Klemesu M, Ruel MT, Morris SS, Ahiadeke C .2000. Urban livelihood and food and nutrition security in greater Accra, Ghana. International Food Policy Research Institute, report 112.

McIntosh, WA.,Acuff, GR., Christensen L.B., & Hale D.1994. Public perceptions of food safety, *the soc.sc.journal*, 31:3.

McIntyre, L, Vallaster, L., Wilcott, L., a, Henderson, SB., Kosatsky, T. 2013. Evaluation of food safety knowledge, attitudes and self-reported hand washing practices in food safe trained and untrained food handlers in British Columbia, Canada. *Food Control*,30:150-156

Medeiros L, Hillers V, Kendall P, Mason A. 2001. Evaluation of food safety education for consumers. *J Nutr Educ*., 33:27-34.

Mensah, P.D., Yeboah- ManuK.,Owusu-Darko A.,Ablordey F.,K.N kurumar and Kamiya.1999.The role of street food vendors in the transmission of enteric pathogens. *Ghana Med.J*, 33:19-29

Mensah, P., Yeboah-Manu, D., Owusu-Darko, K. &Ablordey A. 2002. Street Foods in Accra,Ghana: How Safe is They? Bull World Health Organization, 80(7) Geneva.

Mesfin Angaw. 2011. Microbiological quality and safety of Sambusa and Fried fish in Bahir Dar. MSc. Thesis, Bair Dar University, *Faculty of applied microbiology*

Mesfin A,Mulugeta K,Bey A. 2015. Microbiological quality and safety of Sambusa and Fried fish in Bahir dar. *Food Science and Quality Management*. 45:65

Mosupye, F.M., Holy A. 1999. Microbiological quality and safety of ready-to-eat street vended foods in Johannesburg, South Africa. *Journal of Food Protection*, 62:1278 – 1284.

Mosupye F.M, Holy A. 2000. Microbiological hazard identification and exposure assessment of street food vending in Johannesburg, South Africa, *International Journal of Food Microbiology*, 61:137–145

MSPP. 2007. Rapport statistiqueannuel PDF, annee 2005, msspp.gouv.ht

Muinde, O. K., &Kuria, E. 2005. Hygienic and sanitary practices of vendors of street foods In Nairobi, Kenya. *African Journal of Food Agriculture & Nutritional Development*, 5:1–14.

Muleta D, Ashnafi M.2001. *Salmonella*, *Shigella* and growth potential of other food-borne pathogens in Ethiopian street vended foods. East African Medical Journal.576–580.

Mwadime E.N.M. 2001. Msc. Thesis. Nutritional and Safety Quality of street foods in Korogocho and Industrial area of Nairobi, Kenya.39-54

Mwangi A.M. 2002. Nutritional, hygienic and socio-economic Dimensions of Street Foods in Urban Areas: The Case of Nairobi. Wageningen University, Dissertation No. 3157 (Abstract) March: 47-79

Nurudeen.A ,Lawal..A and Ajayis.S .2014. Hygiene and sanitary practices of street food vendorsin Centeral State of Northern Nigeria. *Journal of Public Health and Epidemiology*. 33:44-66

NSW,Food authority , 2009. Microbiological quality guidline for ready-to-eat foods, a guide to interpreting microbiological results, NSW/FA/CP028/0906.

Ogontona C.R.B. and Kanye O.1995. Contribution of street foods to nutrient in takes by Nigeria adolescents. *Nutrition and Health*, 10: 165-171

Ogontona C.R.B.andTella T. O. 1999. Street foods and dietary intakes of Nigeria urban market women. *International Journal of Food Science and Nutrition*, 50:383-390

Ohiokpehai O.2003. Nutritional aspects of street foods in Botswana. Pakistan Journal of Nutrition, 56: 76–81.

Omemu A, Aderoju S.T. 2008. Food safety knowledge and practices of street food vendors in the city of Abeokuta, Nigeria A.M. *Food Control*, 19:396–402

Owusu-Darko K. and Ablordey A. 2002. 'Street food in Accra, Ghana: How safe are they? Bulletin of the World Health Organization, 80: 546-554

PAHO. 2007. The Pan American Health Organization, Health in the Americas, volume 2. June,1st http://ais.paho.org/hia_cp/en/2007/haiti%20English.pdf

Pethers JVS, Gilbert RJ .1971. Survival of Salmonella on finger tips and transfer of the organism to foods, J Hyg (Camb) 69:673– 681

Pikuda, O. O. and Ilelaboye, N. O. A.2009. Proximate Composition of Street Snacks Purchased from Selected Motor Parks in Lagos. *Pakistan Journal of Nutrition* 8: 1657-1660.

Rane, S. 2011. Street Vended Food in Developing World: Hazard, Indian, *J. Microbiology* l51 :100–106

Rheinländer, T., Olsen, M., Bakang, J. A., Takyi, F., Konradsen, H., & Samuelsen, L. 2008. 740 Keeping Up Appearances: Perceptions of Street Food Safety in Urban Kumasi, Ghana. 741 *Journal of Urban Health,* 85: 952-964

Roberts D and Greenwood M.2003.*Practical Microbiology*. *Third Edition*, USA, Blackwell puplishing Inc.

Rozin, P., & Fallon, A. E. 1980. Psychological categorization of foods and non-foods*: A preliminary taxonomy of food rejections*. Appetite, 1:193-201.

Ruth,C.2013.Microbial aspects of street foods in Haiti. MSc Thesis, Ghent University, Haiti.Samson,R.A.,Varga, J.2007. Aspergillus systematics in the genomic era. CBS Fungal Biodiversity Center,Utrecht. *J.Med.Microbial*. 25: 73-74

Samapundo S. 2012. Postharvest handling, processing and preservation. Laboratory of Food Microbiology and Food Preservation. Ghent University. Class notes.

Sandel MK and McKillip JL. 2004. Virulence and recovery of *Staphylococcus aureus* relevant to the food industry using improvements on traditional approaches. *Food Control*. 15:5–10.

Schafer, R .B., Schafer, E., Bultena, G.L. and Hoiberg, E.O. 1993. Food safety: an application of the health belief model. *J. Nutr. Educ*. 25:17– 24.

Seward, R.A. 2003. Definition of food safety.In:Food Safety Handbook, R.A. Schmidt and G.E. Rodrick (eds), pp 3-9. John Wiley and Sons, Inc. New Jersey.

Sharif, L., & Al-Malki, T., 2009. Knowledge, attitude and practice of Taif University students on food poisoning, *Food Control*. l2:55 - 60.

Soares L. S Almeida, RC, Ellayne S. Cerqueira, Joelza S. Carvalho, Itaciara L. Nunes .2012. knowledge, attitudes and practices in food safety and the presence of coagulase positive, staphylococci on hands of food handlers in the schools of Camaçari, Brazil, *Food Control*, 27:206-213

Sockett, P. N. 1995. The epidemiology and costs of diseases of public health significant in relation to meat and meat products. *Journal of Food Safety*, 15: 91–112.

Subratty A.H. Beeharry P. & Chan S M. 2004. A survey of hygiene practices among food vendors in rural areas in Mauritius, Nutrition & Food Science, 34: 203-205

Suneetha, C., Manjula, K. and Depur, B.2011. Quality Assessment of Street Foods in Tirumala. *Asian Journal of Experimental Biological Sciences,* 2:207-211.

Talaro & Talaro . 2012. Microbiolgical Assessement of Ready-to eat food in Port Harcourt city, Nigeria. *Nature and Science* 108; 1-25

Tasnim, F., Hossain, M, A.,Nusrath, S.,Hossain, M.K.,Lopa,D and Haque,K.M.F.2010.Quality Assessement of Industerially Processed Fruit Juices Available in Dhaka City Bangladesh. Malaysian *Journal of Nutrition* 16:431-438

Tent, H. 1999. Research on food safety in 21st century. *Food Control*, 10: 239–247.

Titarmare,A., Dabholkar,P.,Godbole,S.2009. Bacteriological Analysis of Street Vended Fresh fruit and Vegetable Juices in Nagpur City, India. Internet *Journal of food safety*, 11:1-3

Todd, E. C., Greig, J. D., Bartleson, C. A., & Michaels, B. S,. 2007. Outbreaks where food workers have been implicated in the spread of food borne disease. Part 2 Description of out breaks by size, severity and settings. *Journal of Food Protection*70:1975e1993

Umoh VJ, Odoba MB .1999. Safety and quality evaluation of street foods sold in Zaire,Nigeria *Food Control*, 10:9–14

Unklesbay, N, Sneed, J &Toma, R. 1998. College students' attitudes, practices, and knowledge of food safety. *Journal of Food Protection*, 61:1175-1180.

Von Holy, A. and F.M. Makhoane.2006**.**Improving Street food vending in Achievements and lessons learned. *Int. J Food Microbiology*, 111: 89-92.

Verbeke, W. and J. Viaen. 1999. "Beliefs, attitude and behavior towards fresh meat consumption in Belgium: empirical evidence from a consumer survey." *Food Quality and Preference*, 10:437-44.

WHO. 1989. Health surveillance and management procedures for food handling personnel. technical report series, Geneva,52

WHO. 1996. Essential safety requirements for street-vended foods (Revised Edition)

WHO. 2000. Food borne Disease: A Focus for Health Education,10th October 2000, http://bookorders.who.int

WHO. 2006. A Guide to Healthy Food Markets. Geneva. http://www.who.int/foodsafety/capacity/healthy_marketplaces/en/index.html

WHO. 2007. Initiative to Estimate the Global Burden of Food borne Diseases http://www.who.int/foodsafety/foodborne_disease/ferg/en/index.html

WHO. 2013. Diarrheal diseases, fact sheet N0 330, viewed May 2013, http://www.who.int/mediacentre/factsheets/fs330/en/index.html

WHO. 2013. Food borne diseases, 15th May, http://www.who.int/topics/foodborne_diseases/en/

Wilcock A.,Pun M.KhanonaJ. &Aung M.2004.Consumer attitudes,knowledge and behavior: a review of food safety issues, Trends in Food Science & Technology, 15:56–66.

Williamson, D.M., Gravani, R.B. & Lawless H.T. 1992. Correlating food safety knowledge with home food preparation practices. *Food Technology*, 46:94-100

Woodburn, M. J., &Raab, C. A. 1997. Household food preparers, food-safety knowledge and practices following widely publicized outbreaks of food borne illness. *Journal of Food Protection*, 60:1105–1109.

Yi-Wei Tang and Charles W.Stratton. 2006. Advanced Techniques in Diagnostic Microbiology Biochemical Profile based on microbial ID System.USA.6:85

7. APPENDICES

APPENDEX-I

Food Safety knowledge Questionnaire

Sex: Male / Female Age: Food safety training: Yes / No

Education: Illiterate Elementary school High school Higher education Study location

FOOD SAFETY KNOWLEDGE	YES	NO	DO NOT KNOW
Washing hands before work reduces the risk of food contamination			
Bloody diarrhea can be transmitted by food			
During infectious disease of the skin, it is necessary to take leave from work.			
Typhoid fever can be transmitted by food			
Eating and drinking in the work place increase the risk of food Contamination			
Swollen cans can contain microorganisms			
Abortion in pregnant women can be induced by food-borne disease			
Hepatitis A virus is among the food-borne pathogens			
Microbes are in the skin, nose and mouth of healthy handlers			
Salmonella is among the food-borne pathogens			
Staphylococcus is among the food-borne pathogens			
Using gloves while handling food reduces the risk of food contamination			
AIDS can be transmitted by food			
Children, healthy adults, pregnant women and older individuals are at equal risk for food poisoning			
Food prepared in advance reduces the risk of food contamination			
Proper cleaning and sanitization of utensils increase the risk of food contamination			
Reheating cooked foods can contribute to food contamination			
Washing utensils with detergent leaves them free of contamination			

በአዳማ ከተማ በመንገድ ዳር የሚሸጡ አንዳንድ ምግቦችን የባክቴሪያ ማጠንና የሻጫና ሸማቾዎች ምግብን በንጽህና የመያዝ እውቀትና ዝንባሌን የሚመግም ጥናት

ምግብን ከብክለት ነጻ አድርጎ የመያዝ እውቀትንና ዝንባሌን የሚመግም ማጠይቅ

ጾታ–   እድሜ-

የምግብ ዝግጅት ስልጠና ወስደዋል፡ አዎን/አይደለም

ተ.ቁ	ምግብን ከብክለት ነጻ አድርጎ የመያዝ እውቀትንና የሚመግም ማጠይቅ	አዎን	አይደለም	አላዉቀዉም
1	ምግብ ከማስራቶ በፊት እጅን ማታጠበ የምግብ ብክለት አደጋን ይቀንሳል			
2	የደም ተቅማጥ በሽታ በምግብ ይተላለፋል			
3	በእጃችነ ላይየቆዳ ኢንፌክሽን ችግር ሲገጥመን ምግብ ከማዘጋጀት መቆጠበ አስፈላጊ ነዉ			
4	ታይፎይድ በሽታ በምግብ ሊተላለፍ ይችላል			
5	በማንኛወም የስራ ቦታ መመገብና ማጠጣት የምግብ ብክለት አደጋን ይጨምራል			
6	የታሸጉ ጣሳዎች ደቂቅ ተዋሲያን ሊኖራቸው ይችላል			
7	በምግብ ወለድ በሽታ ምክንያት ነፍሰ ጡር ሴት ወርጃ ሊገጥማት ይችላል			
8	ሄፓታይሰስ A ቫይረስ ከምግብ ወለድ በሽታ አምጪተዋሲያን ዉስጥ ይመደባል			
9	ደቂቅ ተዋሲያን በአንድ ጤናማ ሰዉ ቆዳ፣አፍንጫ እና አፍ ዉስጥ ሊገኙ ይችላሉ			
10	ሳልሞኔላ ከምግብ ወለድ በሽታ አምጪተዋሲያን ዉስጥ ይመደባል			
11	ስታፊሎኮከ ከምግብ ወለድ በሽታ አምጪተዋሲያን ወስጥ ይመደባል			
12	ምግብ ስንይዝ ጓንት ማጠቀም የምግብ ብክለት አደጋን ይቀንሳል			
13	ኤድስ በምግብ ይተላለፋል			
14	ሕጻናት፣ጤናማ ጎልማሶች፣ነፍሰ ጡር ሴት እና አዛወንቶች ለምግበ መመረዝ አደጋ እኩል ተጋላጭ ናቸው			
15	በዘመናዊ ሜልክ ምግብን ማዘጋጀት የምግብ ብክለት አደጋን ይቀንሳል			
16	በአግባቡ የጸዳ እና በጥንቃቄ የተያዙ የምግብ እቃዎች የምግብ ብክለት አደጋን ይጨምራል			
17	ምግብን አመቆ ማጠቀም ለምግብ ብክለት አደጋን አጋላጭ ነው			
18	የምግብ ማዘጋጃ እቃዎችን በእቃ ማጠቢያ ሳሙና ማጠበ ከረቂቅ ተዋሲያን ንኪኪ ነጻ ያደርጋል			

APPENDEX-II

Food Safety Attitude Questionnaire

FOOD SAFETY ATTITUDES	YES	NO	DO NOT KNOW
Well-cooked foods are free of contamination.			
Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products			
Proper hand hygiene can prevent food-borne diseases.			
Raw and cooked foods should be stored separately to reduce the risk of food contamination.			
It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination			
The health status of workers should be evaluated before employment			
Washing vegetables with cold water leaves them free of Contamination			
Wearing masks is an important practice to reduce the risk of food contamination			
Wearing gloves is an important practice to reduce the risk of food contamination			
Wearing caps is an important practice to reduce the risk of food contamination			
Fruits must be washed before served as a food			
Eggs must be washed before cooking			
Dish towels can be a source of food contamination			
Knives and cutting boards should be properly sanitized to prevent cross contamination			
Food handlers who have abrasions or cuts on can increase the risk of food contamination			
Food shelves can be a source of food contamination.			

ተ.ቁ	ምግቡን ከብክለት ነጻ አድርጎ የሚያዝ ዝንባሌን የሚመለከት	አዎን	አይደለም	አላወቅሁም
1	በደንብ የበሰለ ምግብ ከተዋሲያን ንኪኪ ነጻ ነው			
2	የተለያዩ የታሸጉ ምርቶችን ከታሸጉ ምግቦች ጋርማነቀመጥ ተገቢ ነው			
3	በንጽሕና በተገቢ መልኩ ምግቡን መያዝ የምግብ ወለድ በሽታን ይከላከላል			
4	ጥሬ እና የበሰሉ ምግቦችን ነጣጥሎ ማነቀመጥ የምግብ ወለድ በሽታ አደጋን ይቀንሳል			
5	የምግብ ማቀዝቀዣ(ፍሪጅ) የመቆት ማጠን በየጊዜው መቆጣጠር የምግብ ብክለት አደጋን ይቀንሳል			
6	ከቅጥር በፊት የአንደኛ ሠራተኛ የጠፋ ሁኔታ ምርመራ ማድረግ አለበት			
7	አትክልቶችን በቀዝቃዛ ወሃ ማጠብ ማኡ በማኡ ጀርሞችን ሊያስወግድ ይችላል			
8	ማነክ መልበስ አንዱ የምግብ ብክለት መቀነሻ መንገድ ነዉ			
9	ጓንት ማጠቀም አንዱ የምግብ ብክለት መቀነሻ መንገድ ነዉ			
10	ኮፍያ/ሻሽ ማጠቀም አንዱ የምግብ ብክለት መቀነሻ መንገድ ነዉ			
11	ፍራፍሪዎች ለሽያጭ ከመቅረቡ በፊት የግድ መታጠብ አለበት			
12	እንቁላል ለሽያጭ ከመቅረቡ በፊት የግድ መታጠብ አለበት			
13	የሳህን መጥረጊያ ፎጣ ለምግብ በካይ ተዋሲያን ምንጭ ሊሆን ይችላል			
14	ማከተፊያን፣ቢለዋን በደንብ ማጠብ የጎንዮሽ የተዋሲያን ንኪኪን ይቀንሳል			
15	በእካሉ ላይ ኢንፊክሽን ያለበት አስተናጋጅ የምግብ ብክለት አደጋን ይጨምራል			
16	የምግብ መደረደሪያ ለምግብ በካይ ተዋሲያን ምንጭ ሊሆን ይችላል			

APPENDEX-III
Food Safety Observation Checklist of Stalls

Food safety observation checklist 0f Stalls

Location.

Age:

Sex

Education level

Food safety training:

1. - Indicate what kind of material the stall/structure were the food is prepared and sold is made

Wooden Canopy Van Wheelbarrow Zinc/ iron Container

- Is food prepared on-site or at home?
- Is vending stall protected from sun, dust and wind? Yes/No
- Are animals or pests (flies etc.) evident around the vending stall? Yes/No
- Is the vending stall maintained in a clean condition? Yes/No
- Is there access to potable water at the site or close to the site? Yes/No
- Are adequate hand washing facilities available? Yes/No

2. Environment around the stall

- Is environment around the stall clean: far from rubbish, waste water, toilet facilities, open drains and animals? Yes/No

3. Personal hygiene

- Does the operator wash their hands in clean water each time before the handling, preparation and serving of food? Yes/No

- Are the operators' clothes clean and presentable? Yes/No
- Does the operator use an apron when handling, preparation and serving of food? Yes/No
- Does the operator handle food with bare hands? Yes/No

o If answer was NO, do they use disposable or reusable gloves?

o Are the gloves cleaned properly i.e.. in clean water (with or with soap) before the handling, preparation and serving of food?

- Does the operator have clean short nails? Yes/No
- Is the hair of the operator covered when handling, preparation and serving of food? Yes/No
- Does the operator handle money while serving food? Yes/No

o Are hands washed after handling money before handling food again? Yes/No

- Does the operator wear jewelry? Yes/No

o Is the jewelry adequately covered? Yes/No

- Does the operator blow air into polythene bag before use? Yes/No
- Is dirt or dust removed by means of an apron, dirty cloth or bare hands?

4. Food storage

- Is food stored/displayed

Openly in the stalls

o In a wheelbarrow

o In sealed (transparent or opaque) containers

- Are raw, partially cooked and cooked food products kept separate? Yes/No

5. Utensils

- Are utensils cleaned with

o Warm soapy water

o Cold soapy water

o Clean water with no soap

o Dirty water with no soap

- Are utensils covered? Yes/No

- Are utensils cleaned adequately every time after use? Yes/No

ምጣቡን በጥንቃቄ ከብክለት ነጻ አድርጎ መያዝን የማመጣም ምልከታ ቅጽ

ቦታ---------- እድሜ--------- ጸታ----------

የት.ደረጃ----------

የምግብ ዝግጅት ስልጠና---አለ/የለም

1.ፋሲሊቲ

የምግብ ማዘጋጃ እና ማሻጫ ቤቶች ከምን የተሰሩ ናቸዉ

በእንጨት እና በቆርቆሮ/ ኮንቴይነር/ በላስቲክ እና እንጨት

ምግብ የሚዘጋጀዉ ቤት ዉስጥ ነዉ ወይስ መንገድ ዳር---------

ቤቱ ከጸሀይ፣ከአዋራ እና ንፋስ የተከለለ ነዉ-----------

እንስሳት እና ነፍሳት በአካባቢዉ ይገኛሉ-----

በቦታዉ ወይም በአካባቢዉ የዉሃ አቅርቦት አለ--------

በቂ የእጅ መታጠቢያ በቦታዉ ይገኛል-----

2.የማሻጫዉ ዙሪያ ምን ይመስላል

አካባቢዉ የጸዳ ነዉ

- ከቤት ጥራጊ ቆሻሻ
- ከቆሻሻ ዉሃ
- ከሽንት ቤት አገልግሎት
- ከእንስሳት መኖሪያ

3. የግል ንጽህናን በተመለከተ

ምግብ ከማዘጋጀቱ እና ከማቅረቡ በፊት እጁን በነጹ ዉሃ ይታጠባል-------

- የምግብ እቅራቢዉ ልብስ ጽዳቱ የተጠበቀ ነዉ--------
- ምግብ እቅራቢዉ ባልተሸፈነ እጁ ነዉ ምግብ የሚይዘዉ--------
  ሚሉሱ አይደለም ከሆነ
  የሚጠቀመዉ ጓንት– አንዴ ተጠቅሞ የሚጥል/ በተደጋጋሚ ሚየገለግል
  - ጓንቱ ይታጠባል---------
- ምግብ እቅራቢዉ ንጹህ ያጠሩ ጥፍሮች አሉት----------
- ካስተናገደ በኋላ ገንዘብ በእጁ ይቀበላል-------
- ገንዘብ በእጁ ከተቀበለ በኋላ ሌላ ምግብ ከማያዙ በፊት እጁን ይታጠባል-------
- ምግብ ሰሪዉ ለጥሬ እና ለበሰሉ ምገቦች ተመሳሳይ እቃ ይጠቀማል---------
- አስተናጋጁ የቤቱን እቃ ቆሻሻእና አዋራ የሚያጸዳዉ--
  በፍጣ/በቆሻሻ ጨርቅ/በባዶ አእጅ
- አፍንጫዉን በእጁ ከጠረገ በኋላ እጁን ሳይታጠብ የምግብ ማስተናገድ ስራዉን ይቀጥላል--------

4. ምግብ ማከማቻ

የምግብ ክምችት አለ

በክፍት ቤት---------   በጎደጓዳ ሳህን-------- በማስታዎት እቃ ዉስጥ-------

የበሰሉ እና ጥሬ ምግቦች በተለያየ ሚክሮስኮፕ ተቀመጫ ተቀመጭጠዋል----------

5.የማበሰያ እቃዎች

እቃዎቹ የጸዳት--

-መቅ መሃ እና ሳሙና-----

- ቀዝቃዛ መሃና ሳሙና-----

- በንጹ መሃ ብቻ------

- በቆሻሻ መሃና ሳሙና-------

-እቃዎቹ ሻፋን አላቸዉ-----

- እቃዎቹ ጥቅም ላይ ከዋሉ በኋላ ሌለ ከሚከተናገዳቸዉ በፊት ይታጠቡሉ------

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APPENDEX-IV
Consent Form

VOLUNTEER AGREEMENT FORM

Title: Bacteriological Quality of Street Foods and Knowledge and Attitude

of Street Food Vendors and Consumers about Food Safety in Adama Town

Principal Investigator: [Sintayehu Bogale]
Address: Haramaya University, Tel: 09 1174 6914
Email: manex.sintex@gmail.com

General Information about Research

This study will investigate Bacteriological Quality of Street Foods, and knowledge and attitudes of street food vendors and consumers about food safety in Adama town.

Possible Benefits, Risks and Discomforts

There are no direct benefits to be gained from this study immediately, neither are there any risks associated with it. The only inconvenience might come from the time you will spend completing the questionnaire. The data from this study will be used only for the purpose of the study. (MasterThesis)

Confidentiality

Your identity and your participation in this study will be treated strictly confidential. The information that we obtain from you will not be shared with anybody, except the study investigators. Your identity remains secret since your personal information will only be designated by a unique participant number. Your name will not appear in any reports or publications resulting from this study. After the study is completed, you may request information about the study results.

Voluntary Participation and Right to Leave the Research

You participate entirely voluntarily in this study. You have the right to refuse to participate in the study**.** You also have the right to stop your participation in the study at any time, even after you have signed this informed consent form. The withdrawal of your consent will not cause any disadvantage or loss of advantages/privileges.

Contacts for Additional Information

Any questions or any further clarifications concerning the study can be directed to:
Contact of the promoter:
Assistance.Prof. Ameha Kebede/ Dr.Misrak Kabede
Faculty of Competitional Science,Departement of Biology

Tel: 00 32 9 264 9902, Fax: 00 32 9 225 5510
Emai.
Contact of local researcher
Sintayehu Bogale
Tel: 0911746914
Email: manex.sintex@gmail.com

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title ***(name of research)*** has been read and explained to me. I have been given an opportunity to have any questions
about the research answered to my satisfaction. I agree to participate as a volunteer.

Date Name of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

Date Name of Witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Date Signature of Person Who Obtained Consent