# KNOWLEDGE, ATTITUDE AND PRACTICE OF MEAT HYGIENE AMONG SLAUGHTERHOUSE WORKERS AND MEAT TRADERS IN BOSASO DISTRICT PUNTLAND STATE OF SOMALIA

**Mohamud Abdisamad Mohamed**

**REG NO. J56/8498/20 17**

**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR MASTER OF VETERINARY PUBLIC HEALTH (MVPH) DEGREE OF THE UNIVERSITY OF NAIROBI.**

**DEPARTMENT OF PUBLIC HEALTH, PHARMACOLOGY & TOXICOLOGY,**

**UNIVERSITY OF NAIROBI**

**2022**

## DECLARATION

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

Signed:  Date**: 10th April 2022**

**Mohamud Abdisamad Mohamed (BVM)**

**REG NO. J56/8498/20 17**

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

**PROF. JACKSON N. OMBUI, (BVM, MSc. PhD.)**
Department of Public Health, Pharmacology and Toxicology,
Faculty of Veterinary Medicine, University of Nairobi

Signed:  Date: **12th April 2022**

**DR. GATHURA PETER BAARO, (BVM, MSc. PhD.)**
Department of Public Health, Pharmacology and Toxicology,
Faculty of Veterinary Medicine, University of Nairobi

Signed:  Date: **12th April 2022**

## DEDICATION

To my beloved parents, brothers, and sisters for their unceasing support during the academic struggle and whose consistent encouragement and sincere guidance and commitment to my education has been significant in making this thesis a reality.

## ACKNOWLEDGEMENT

All praise be to Allah the Almighty for his grace that has granted me the ability to finish this project. I am so much endeared to my lovely parents for their help and encouragement that have enabled me to make this achievement. I acknowledge the contributions and the endless support of my supervisors Prof. Jackson Nyarongi Ombui and Dr. Peter. Baaro. Gathura whose effort and guidance saw me complete this project successfully.

I wish to thank all slaughterhouse workers and meat traders in Bosaso City, Puntland for allowing me to interview them and access their facilities. I also express my gratitude to the management of the University of Nairobi, Kenya for allowing me to register for the degree program in the University..

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| HACCP: | Hazard Analysis and Critical Control Point |
| FAO: | Food and Agriculture Organization of the United Nations |
| WB: | World Bank |
| EU: | European Union |
| KEBS: | Kenya Bureau of Standards |
| CAC/RCP: | Codex Alimentarius Commission/Recommended Code of Practice |
| FSNAU`: | Food Security and Nutrition Analysis Unit |
| USA: | United States of America |
| UK: | United Kingdom |

## ABSTRACT

Most developing countries like Somalia have a challenge of widespread occurrence of meat related diseases due to inadequacy of laws on safety, practices of handling meat and sanitation conditions, weaknesses in regulatory framework, inadequate education to those involved in handling meat and inadequate financial resources for investing on safe equipment. The study sought to assess the level of knowledge, attitudes, and meat hygiene practices among butchers, slaughterhouse workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia. Specifically, the study sought to assess the level of knowledge and attitude of meat hygiene among butchers, slaughterhouse workers and meat traders in Bosaso Puntland State of Somalia and to determine the meat hygiene practices butchers, slaughterhouse workers and meat traders adopt while doing their work. The study population comprised of all slaughterhouse workers, butchers and meat traders in both abattoir and meat markets in Bosaso Puntland State of Somalia. A cross-sectional descriptive study design was used to estimate the level of knowledge, attitude and practices in meat hygiene among slaughterhouse workers, butchers and meat traders in abattoir and meat market in Bosaso. Face-to-face questionnaire and key informant interviews were used to collect information about knowledge, attitudes and practices of the target population regarding meat hygiene. Data collected from markets and slaughterhouses was edited and entered in the excel computer program. The statistical analysis was in terms of proportion, mean and standard deviation. Chi square ($\chi 2$ was significant in determining the relationship of the sociodemographic features with the practice and knowledge scores. $P < 0.05$ had a statistical significant value and the analysis was done by SPSS software. To preset the findings, figures and tables were used. The study findings indicated that most of the respondents (69.3%) agreed that wearing gloves is one part of individual hygiene, 64.6% agreed that washing hands regularly after contamination is one

part of personal hygiene and 71.4% agreed that employees should keep short nails and with makeup color. On the other hand, majority of the respondents (79.7%) disagreed that the regular washing of hands regularly before one begins work is a vital part of personal hygiene, 70.8% disagreed that the proper washing of hands properly reduces contamination risk, 62% disagreed that washing hands using water only is not effective enough and 60.2% disagreed that employees should not touch their hair after washing their hands. It was concluded that slaughterhouse workers and meat traders in Bosaso Puntland State of Somalia have good attitude and fair knowledge on meat hygiene, but poor in implementation of appropriate hygiene practices. There was a significant relationship between socio-demographic characteristics and the knowledge, attitude and meat hygiene practices among the meat actors. This study recommends that the government should increase training for slaughterhouse workers, butchers and meat market workers to enhance their knowledge and attitudes on food hygiene. Slaughterhouse workers and meat traders should be trained on appropriate meat hygiene practices. The various stakeholders in the meat chain should strive to maintain high standards right from the slaughter houses as well as in the transportation of the meat to the market, the sale process and consumption. This will ensure that the quality of meat produced of is maintained at the required standards. Furthermore, massive sensitization based on the outcome of this study and on moral persuasion campaigns should be rolled out by the relevant regulatory agencies. The government should endeavor to develop meat policies to ensure that all meat issues are addressed, especially the safety of the meat. Additionally, the government should review and harmonize the various legislations governing the livestock industry and meat safety to reduce disease outbreak and to enhance general safety management. This will ensure that all actors respond appropriately to ensure meat safety along the production and supply chain.

# CHAPTER ONE

## 1.0 INTRODUCTION

The livestock has a vital role towards economic growth and development of Somalia as reflected in animal exports standing at over 3 million annually. The sector also contributes towards creation of 60% of employment opportunities while contributing towards 40% and 80% of the GDP and earnings of foreign exchange in Somalia respectively (FSNAU 2010).The simplest definition of meat hygiene is the circumstances and measures that are needed for ensuring suitability and safety conditions of meat in all stages of the supply chain of the meat and its related products (CAC/RCP 58- 2005).Most of the meat inspectors in developing countries and rural abattoirs do not have adequate knowledge, information and facts that would help in proper evaluation of sanitary conditions of the organs, meat and carcasses of the slaughtered animals (Herenda *et al,* 2000**).** Meat has a large proportion of nutrients but it is largely exposed to contaminations resulting in food related illnesses to end users (Chepkemoi*et al,*2015).At the same time, contamination of food particularly the raw meat is the most significant cause of food related disease outbreaks or even food poisoning because of being improperly handled. Contamination in most cases arise when food that does not need cooking like salad is prepared on the same board used for preparing raw meat with no proper cleansing (Adesokan and Raji, 2014).

Good slaughterhouse activities and operation entail careful examination of live animals before being slaughtered, and during slaughtering an inspection process. These activities are so critical towards preventing diseases related with animals and ensuring that healthy meat is delivered to the public. Most slaughterhouses in many developing countries are characterized by lack of inadequate slaughtering and processing facilities, clean water supplies, good sewage or waste

disposal systems and refrigeration facilities. In Somalia for example, this has led to contamination of meat and poor state of disposing waste products (Alhaji and Baiwa, 2015). This study, therefore, is seeks to establish the knowledge level and meat hygienic practices among butchers, slaughter-house and meat market workers in Bossaso. Information generated from this study will serve to better educate individuals involved in slaughter and meat trade who are often recognized as important to assurance of meat safety and delivery of wholesome meat to the public.

## 1.1 Objectives

### 1.1.1: General Objective

To evaluate the attitudes, knowledge level and meat hygiene practices among slaughterhouse workers and meat traders in Bosaso city, Puntland State of Somalia.

### 1.1.2: Specific Objectives

- To determine the knowledge level and attitude of meat hygiene among butchers, slaughterhouse workers and meat traders in Bosaso city, Puntland State of Somalia.
- To determine the meat hygiene practices adopted by slaughterhouse workers and meat traders while doing their work.

## 1.2 Problem Statement and Justification

In 1996, Somalia produced 49,000 tonnes of goat and sheep meat, 46,000 tonnes of beef, approximating to 8.8 kg of small ruminant and 8.2 kg of beef meat per person per year in Somalia (FAO/WB/EU, 2004). The collapse of veterinary public health services and infrastructure during the civil war in 1991 led to an increase of health risks to meat consumers .Most developing countries like Somalia have a challenge of widespread occurrence of food related diseases due to

inadequacy of laws on safety, practices of handling food and sanitation conditions, weaknesses in regulatory framework, inadequate education to those involved in handling food and inadequate financial resources for investing on safe equipment. For most foods targeting human consumption, those originating from animals are more dangerous in exception to circumstances where food hygiene is considered **(**Haileselassie *et al*, 2013). An estimated 10% to 20% of the outbreaks related to food are because of contamination by people who handle food. In fact, about 200 cases of food related diseases can be treated by observing hygiene. The crucial factors causing safety and quality issues are the microbes. All individuals involved in food handling including the producers of food and marketers have a responsibility of adhering to safety practices (Abdelrazig *et al*, 2017).This is underlined by the fact that production, selling and handling of animal related food of poor quality attracts significant attention from the public domain of the country(Lawan *et al,* 2013)

**1.3 Hypothesis**

Ho: Slaughterhouse workers and meat traders in Bosaso city have no adequate meat hygiene knowledge and do not use recommended meat hygiene practices

Hi: Slaughterhouse workers and meat traders in Bosaso city have adequate meat hygiene knowledge and do use recommended meat hygiene practices.

# CHAPTER TWO

# 2.0 LITERATURE REVIEW

## 2.1 Importance of meat in diet

Meat is an important component of diet as it is a rich source of proteins. It consists of some amino acids closely matched to that of human beings and significant amounts of Vitamin $B_{12}$. They are excellent sources of minerals and micronutrients such as manganese, iron, zinc and copper (Rajesh Kumar 2006).

Most ancient people relied on meat as the major source of food and it has played a critical role since time immemorial by supplying plenty of nutrients to consumers. Meat is consumed both locally and globally (Ramya *et al,* 2015), and supplies more proteins and less of the starch to the body (Biesalski and Nohr, 2009). At the same time, meat supplies some of the critical micronutrients like the folic acid and vitamin A,

## 2.2 Slaughterhouse

A slaughterhouse (which is also called an abattoir) is a special structure constructed with approval and registration from relevant authorities for purpose of slaughtering livestock for production of meat. The construction of the slaughterhouse is such as to ensure hygienic slaughtering and dressing of animals with minimum contamination. Abattoir workers must strive to ensure that meat produced is hygienic and safe for human ensuring slaughtering and dressing is done hygienically (Lawan *et al,* 2013). Normal slaughterhouses need to have certain qualities; for instance, the personnel working there should be competent, the equipment should be using modern technologies and there should be steady flow of water. In addition, there should be proper systems of

safeguarding sanitation and hygiene and an efficient drainage system. There should be proofs for distracting insects and the floor should to be cemented (Akpabio *et al,* 2015).

### 2.2.1 Location and design of Slaughterhouse

An ideal slaughterhouse location should be free from objectionable odors, dust and smoke. It should be linked to the public road by adequate dust-proof access ways. In addition, the slaughterhouse and the meat processing site should be completely disconnected from any other industrial, commercial and residential buildings (FAO 2010; KEBS, 2017). The design of a slaughterhouse should provide for a continuous slaughter process, without any possibility of reversal, inter-section or over lapping between the live animals and meat, and between meat and by-products or waste (FAO 2010). The slaughterhouse consists of the following sections: The lairage for receiving and holding animals, slaughter hall which is divided into stunning area, bleeding area, flaying area, evisceration area, carcass splitting where applicable, carcass washing, and meat inspection area (FAO, 2010). A stunning area should be adequately designed for different species of animals. The bleeding area should be of acceptable size and strategically located so that the blood does not splash on to other animals being slaughtered or on the carcasses being skinned. A floor wash point should be provided for intermittent cleaning (FAO 2010). Suitable means of hoisting the slaughtered animal shall be provided with sufficient height for the animal carcass to hang above the floor to facilitate bleeding, flaying and evisceration operations.

Flaying of carcasses should be done when slaughtered animal is hanging and never on the floor. Adequate means and tools for dehiding or belting of the animals and for immediate disposal of hides or skins shall be provided. Hides or skins, heads and legs shall be immediately transported to a room where they shall be held before further processing. Facilities shall be provided for the

evisceration to be done hygienically, including facilities for the sterilization of the evisceration equipment and for handling red and green/rough offals (FAO, 2010)

Carcass splitting should be done straight down the middle as appropriate so as not to damage the meat. This is only applicable for beef and pork carcasses. Appropriate carcass splitting equipment and potable water for washing carcasses should be provided in the slaughterhouse. Carcass washing should be done using potable water with sufficient pressure to remove all blood and other types of dirt. Adequate postmortem inspection facilities are provided for efficient conduct of inspection and maintenance of sanitary conditions. Facilities that ensure chilling of the meat at temperature range -2 to $4^{o}$c are important in a modern slaughterhouse. Suitable and sufficient room shall be provided for the retention of all meat condemned as unfit for human consumption and shall be locked up separately. Suitable and sufficient facilities shall also be provided for the isolation of meat requiring further examination by the veterinary inspector within the premises of the slaughterhouse (FAO, 2010)

### 2.2.2 Sanitation of slaughterhouse

Sanitation is a broader term referring ensuring that the slaughterhouse is cleaned and disinfected while at the same time ensuring that rodents and insects are controlled by the use of chemicals. For proper and efficient cleaning, the surfaces of premises and other equipment need to be smooth for easy of cleaning. Cleaning should be done using food grade detergents and disinfectants. Cleaning seeks to eliminate organic substances and dirt for instance fat and protein particles from the surfaces of walls, tools, equipment or floor. There are several approaches to be employed during cleaning; dry cleaning (where scrap is physically removed), wet cleaning (water hoses or brushes are used), cleaning driven by high pressure (where pressure is used to pump water for cleaning) and chemical cleaning (where detergents are used during the process). Disinfection on

the other hand, is where, microorganisms are completely removed from floor, surfaces or tools. This can be achieved with the help of hot water (probably steam) or even chemicals. In meat industries, chemical disinfection is the most preferred method. Staff in the slaughterhouse should be trained in proper methods of cleaning and sanitation. (FAO, 2010).

### 2.3 Slaughter techniques

Slaughter techniques throughout the world are governed by tradition, ritual or legislation depending upon the people and the country. These methods relate to the manner in which the animal is killed and bled and to some extent dressing and handling prior to use as food (Clottery 2011). There are two main methods of slaughtering animals . These are stunning and non-stunning methods of slaughter.

#### 2.3.1 Stunning methods of slaughter

This is the process of rendering animals unconscious, immediately prior to slaughtering them for food. After stunning, the animal remains unconscious until it dies from blood loss. Stunning also renders the animals immobile thus eliminating excitement and possible injury to personnel. Stunning is achieved by use of mechanical, electrical or chemical methods (Clottery,2011). Mechanical stunning method involves stunning animals by the way of shooting, usually following two forms: using captive bolt pistols by force to make concussion in the animal's head or using a freely penetrating firearm or gun. Sometimes, penetrating heads filled with air are also used to immobilize livestock (Clottery, 2011). Electrical stunning is used mainly on pigs and poultry. In pigs, electrodes are applied between the ears and a current with a voltage of 70-80 Volts /AC 50-60cycles is passed through for a period of 1-4 seconds and thereafter the animal is bled within 5-7 second by sticking or severing of jugular veins. Poultry stunning involves dipping head of bird

in an electrolyte solution carrying a current for a few seconds after which the birds are bled by severing the jugular veins.

Chemical stunning is achieved by use of carbon dioxide in making animals immobile before bleeding., Carbon dioxide stunning is used commonly on small livestock including sheep and goats. The animals are led individually or in pairs into a pit, tunnel or a compartment where $CO_2$ of 65–75 percent (optimum 70 percent) concentration is released for 60 secs. The animals quickly pass into an unconscious state. They are then removed and bled immediately (Clottery 2011). Stunning of animal before slaughter is an obligatory procedure in many countries. Stunning also renders the animals motionless thus eliminating excitement and possible cruelty.

### 2.3.2 Non-stunning methods of slaughter

**a). Halal Slaughter**

This describes a slaughter technique that is guided by strong Muslim practices such that the slaughter man should be trained. The animal must be alive at the time of slaughter and death is achieved using a sharp knife. The slaughtermen are trained on the need to cut the neck of the animal so that the jugular veins are severed simultaneously, while ensuring that the spinal cord is not severed when the animal is still alive (Shimshony andChaudry 2005). The sudden severing of the jugular veins initiates a great deal of hemorrhage which causes maximum drain of blood causing ischemia and anoxia of the brain (Aidaros, 2005: Mohammad, 2007). This disables the sensory centre and causes the animal to become entirely insensitive to pain (Mohammad, 2007).

**b). Kosher method of slaughter**

In this method, a very sharp knife is used to simultaneously sever the jugular veins and carotid arteries making the animal lose consciousness 30 seconds after both major blood vessels are severed, immediately cutting off blood to the brain. The principle of this method is to initiate sudden massive blood loss to cause cerebral ischemia and anoxia, which disables the sensory centre inducing insensitivity to pain (Yardimci, 2019). The shortest time of achieving unconsciousness using this method has been reported to be 3 seconds and the longest time to be 60 seconds (Pleiter 2010)

**c. Hindu method of slaughter**

In the Hindu method of slaughter, the head of the animal is attached to a stable column and the posterior legs are stretched out in the opposite direction. The animal is beheaded from the backbone side with a single stroke of a sword or axe. This will cause a sudden death of the animal because the spinal cord is cut and the circulation of blood to the brain is immediately stopped, resulting in brain failure within seconds. Thus, the animal will not feel or realize any pain. For this reason, this procedure is considered to cause the minimal pain and suffering to the animal compared to other procedures [Seiad and Joe 2019].

**2.4 Meat markets**

These are establishments where meat is sold. They should be planned and constructed to improve on hygiene status. The materials for building the internal structures and fittings within meat markets and butcheries should be durable, for easy of maintenance, cleaning and disinfection. The establishments should be well ventilated with adequate lighting, hand washing and cleaning

facilities, supplies, waste disposal facilities and well-maintained drainage. Still, the design and hygiene conditions of butcheries and many meat markets in most African countries is poor **(**Ombui et *al*, 2012**).**

### 2.5 Meat hygiene and safety

Meat is the flesh of an animal, typically a mammal or bird, used as human food. Food is defined as any material that people and animal eat that contains constituents that are taken in and used by the living body for growth and repair and as a source of energy for various activities. It is considered as one of the requirements of human consumption (Nhoel *et al*, 2016). Meat safety is the assurance that a given meat product is suitable for human consumption. The most critical component of the manufacturing process is meat quality as consumers of the produced meat are highly susceptible to any kind of contamination likely to occur through the manufacturing process (Kumar *et al*, 2013). meat safety is one of the scientific areas that deal with how food is prepared, handled and stored for prevention of meat related diseases and illnesses (Giuseppe and Monica 2010). It covers any activity including handling, preparation or processing of meat with the aim of ensuring production of safe food for human consumption (Griffith, 2006).

#### 2.5.1 Meat Hygiene

Meat Hygiene are a set of activities that are used to ensure production of safe meat for human consumption. Meat is deemed as unsuitable for human consumption either because of the fact that the meat was derived from live animal is exposed to a health condition or diseases or because the meat is contaminated and spoiled after slaughter. Spoilage of meat usually occurs during post mortem either due to breakdown of chemicals or through the growth of microorganisms. Presence

of diseases may render meat unacceptable for human consumption as such meat will result in the spread of human infections (Warriss, 2000).

### 2.5.2 Purposes of meat hygiene

Meat hygiene practices primarily strive to ensure that diseases and other infections are not transmitted to the man. It also ensures that meat products provided to human are safe and ready for consumption without any health effect. The secondary purpose is an economic aspect. Meat hygiene will lead to reduction of loss of meat and its by-products. The tertiary purpose is to prevent the adulteration of meat, and to prevent the sale and consumption of contaminated carcass meat, which is not demanded by consumer other than as food for animals (Woldecherkos and Yitayal, 2003).

## 2.6. Food Borne Illness

Foodborne and related diseases refer to any illness that arises after consuming food that is contaminated with pathogens, parasites or viruses (Adley and Ryan, 2016). Foodborne illnesses and diseases arising from consumption of food affected by chemical substances, toxins and pathogens is a problem that affects people on a global scale for a number of reasons (Feltes *et al*, 2017). The leading and key cause of morbidity around the world is Diarrheal diseases and this is particularly evident in developing countries. The World Health Organization (WHO) estimate that about 2.2 deaths among people of all age categories were attributed to diarrheal diseases and 1.8 million people in low income countries alone. Of all these reported deaths, 1.5 million were from infants aged 14 months and below (Woldt and Moy, 2015). On a global scale, unsafe meat is the greatest challenge endangering the life of everybody around the world especially young children,

women that are pregnant and the elderly persons (Ahunna *et al*, 2017). The major source of food borne diseases and illnesses is consumption of meat that is contaminated (Bhattarai *et al*, 2017).

### 2.7 Knowledge and meat hygiene practices among meat handlers

The safety and health status is significantly determined by people who are involved in handling meat within the supply chain. An estimated large number of people either die or become ill on account of consumption of contaminated meat resulting from poor meat safety and methods of handling. Improper handling, preparation and storage of meat brings about contamination resulting into food poisoning arising from the pathogens and other disease causing microorganisms *(*Galgamuwa *et al*, 2016). Individuals who are involved in handling of meat should adhere to high level of hygiene and methods of sanitation since the probability of contamination of meat largely relies on hygiene and health practices and activities undertaken (Abdelrazig *et al*, 2017). All people involved in handling of meat must have sufficient skills and knowledge for proper handling of meat. In reduction of meat related illness, there is need for profession and message regarding the best way of ensuring safety of meat. However, these messages and education programs regarding the safety of meat are not substitutes of research practices and regulatory activities (AI Kaabi *et al*, 2010). Most developing countries are affected by meat borne diseases because of their poor state of sanitation and meat handling practices. The inadequacy of funds and insufficient training and education of people involved in handling meat is also the main cause of increased meat borne diseases in developing countries. At the same time, most developing countries have poor regulatory frameworks guiding how meat safety should be ensured. Based on these arguments, there is need for clear understanding of the link existing between the activities and practices of meat handlers, their level of knowledge and skills set and the safety of meat in relation to reduction of meat borne diseases (Auwalu *et al*, 2016). In countries where there is high level of improper

hygiene of meat, there are higher chances of meat borne disease outbreaks. The skills, knowledge and practices of individuals who are involved in handling of meat are key in ensuring the safety status of meat. Thus, having in place training programs to target individuals involved in handling meat is key in prevention of meat borne diseases. The key challenge especially among developing countries is that the level of training offered to meat handlers is not adequate (Madhup *et al*, 2017).

The other challenge encountered in safeguarding the health status and quality of meat is that individuals involved in handling of meat do not have clear understanding of their roles and responsibilities of strengthening the environmental and personal hygiene. As such, an assessment of the practices, attitudes and knowledge of meat vendors will significantly help in obtaining the required support in the establishment and development of preventive, integrated, effective and coordinated strategies as enshrined in the 'Safe Food Key' by World Health Organization. This also helps in reduction of risks arising from contamination of meat and this reduced meat borne diseases (Anthony*et al*, 2017). meat handlers play a significant role in strengthening the safety of meat through the supply chain from the production stage to the point when meat is processed, stored and prepared ready for human consumption. The major cause of meat contamination is mishandling and inability to recognize proper measures of hygiene which significantly explain the spread of meat related illness and food poisoning. Health conditions and illnesses such as cholera and typhoid are mainly brought about by improper handling and preparation of meat (Andy *et al*, 2015).

### 2.8 Personal hygiene of food handlers

There are a number of habits that describe personal hygiene including brushing of teeth and ensuring hands are properly washed and this plays and important role in preventing fungal, virus

and bacterial infections. Personal hygiene in the medical field refers to personal attention aimed at preventing how germs and diseases spread. This can be attained by use of personal protective instrument like boots and gloves (Abdul, 2012). It is defined as the study of the healthy status and living of an individual. The bodies of human beings usually carry bacteria that poison meat into the skins, noses and intestines. It is therefore important that individuals involved in handling meat wash their hands properly, use clean clothes and make sure they wear no jewelry when handling meat. All these measures are geared towards preventing cross contamination and thus preventing meat borne illnesses. Thus, the personal hygiene level of the meat handlers is critical in preventing meat borne diseases (Adetunji *et al*, 2018). meat handlers are charged with the responsibility of ensuring that safe meat is provided to consumers. However, most meat handlers in developing countries have inadequate skills and knowledge on personal hygiene explaining the high level of food borne diseases.

Any change in eating habits and the techniques of preparing meat would increase the probability of meat contamination because of improper handling practices. Bacteria mostly are found in sources like dust, air and water and is major cause of food contamination (Ismail *et al*, 2016*).* Meat handlers simply refer to individuals involved in preparation, processing, storage and serving of meat within the supply chain. Such individuals have greater risk of contaminating meat by transmission of microorganisms like bacteria and pathogens via their hands, mouth or through breathing from the nose (Zarisha *et al*, 2015). Thus, anybody coming in direct or indirect contact with consumable parts of the animal including meat should ensure he/she adheres to the highest standard of cleanliness. Meat handlers should ensure that their clothes are well cleaned before and after work, their hands are well washed and always use protective clothing (CAC/RCP 58-2005).

## 2.8 Hazard Analysis and Critical Control Point (HACCP)

Hazard Analysis Critical Control Point (HACCP) is a technique that systematically identifies, assesses and control hazards and its development was done by Pillsbury Company during 1960s. The HACCP was developed to help space flights ensure high standards of safety of food and it has been recognized as an exceptional compared to the conventional end-point-testing by United Nations (UN) agencies like FAO and WHO. HACCP has been recommended in production of food on a commercial scale (Ropkins and Angus, 2000). Today, HACCP iswidely recognized as management system safeguarding the quality of food that has greater capability of adhering to higher standards of safety of food through the supply chain (Wilkinson and Wheelock 2004). For slaughtered poultry and meat products, the HACCP records should be kept within a period of 1 year while for the shelf stable, preserved or frozen food, the HACCP records should be stored for a period of about 2 years (Eubanks *et al*, 2009). The HACCP framework plays an important role in ensuring food safety through its easiness's to monitor. It also help in proper resource management, ensuring proper hygiene of food, improvement in productivity and profitability and a reduction in costs of production. In spite of these numerous benefits, HACCP is also associated with a number of challenges including low customer and business demand, absence of legal requirements, inadequate human capital and financial constraints (Michałowska and Korczak 2008). Meat handlers can apply the HACCP all through the supply chain from production to the consumption point. The implementation of HACCP should also be based on scientifically proven evidence in regard to risks related to the health *(*CAC/RCP 1-1969, Rev. 4-2003**).** Implementing HACCP takes a lot of time and its effectiveness arise when the implementation is slowly done in successive and progressive stages. The critical factors during implementation of HACCP include empowerment and training if employees (Sneed and Henroid 2003). Today, HACCP system is

widely recognized around the world as a method and technique of ensuring safety of food. The increased use and adoption of HACCP is the increased concern of safety of food by different stakeholders like public health officers, consumers and government agencies (Ackah *et al,*2018).

### 2.8.1. Seven Principles of HACCP

**Principle 1: Identify Hazards**

It is critical to identify possible hazards that could be chemicals, physical substances or microbiological elements. Identification of hazards should be done at every stage in the supply chain system that is from the point of growth to the time food is processed, manufactured, stored and distributed to the final consumers.

**Principle 2: Determine Critical Control Points**

It is also essential to decide the most critical points. This entails identification of the critical step to control the determined and identified hazard.

**Principle 3: Establishing Critical Limits**

Once every control point has been determined, it is important to check and determine if it is under an influence during the processing stage. This may be attained through observation or measurement for instance time or temperature.

**Principle 4: Establishment of a Monitoring System**

In order to increase effectiveness of the critical limits, a monitoring system should be set up to check performance at the critical points.

**Principle 5: Establishment of corrective actions**

A decision should be made on the possible corrective actions to be undertaken when monitoring depicts a deviation in a given critical point.

**Principle 6: Establish verification procedures**

After establishing the HACCP system, procedures for verification and checking how the system work should be set up.

**Principle 7: Establish record keeping and documentation requirements**

The document level needed largely relies on complexity and need of the food businesses. For instance, in small firms, what is needed is the simple diary or log book. For bigger and complex businesses, there is need for more formal or detailed documentation (New Zealand Food Safety Authority 2003).

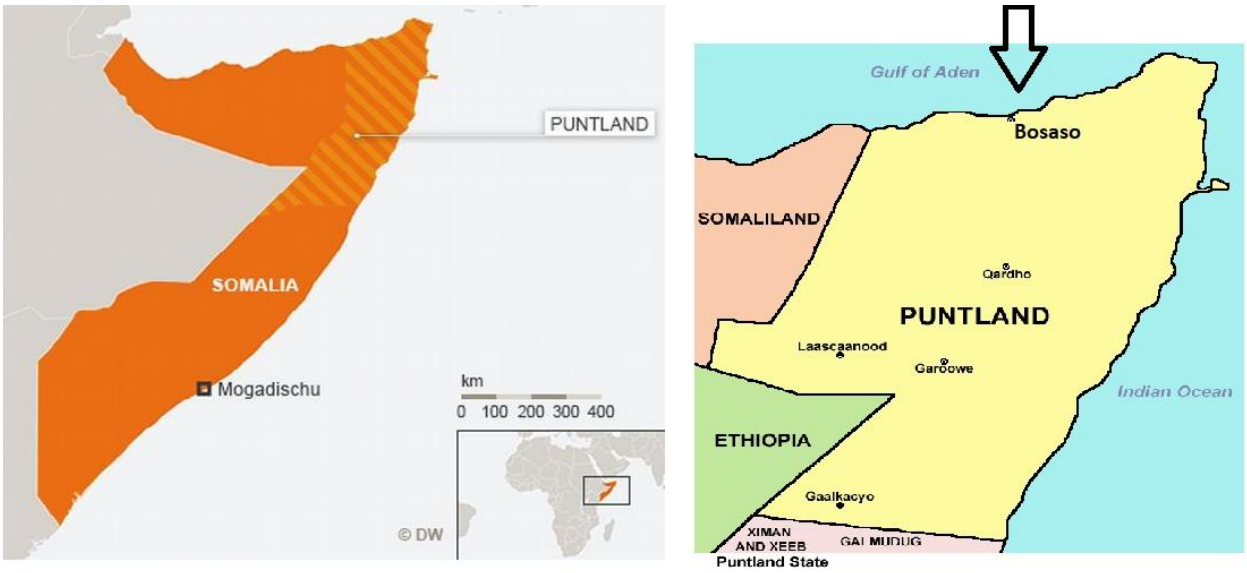
# CHAPTER THREE

# 3.0 MATERIAL AND METHODS

## 3.1 study area

Bossaso, one of the largest cities in Somalia, is the headquarters of Bari region. The city is located in Puntland State along the southern cost of the Red sea and the Gulf (latitude: 11° 17' 0.42" N, and longitude: 49° 10' 31.26" E). Located at an elevation of 12 meters above sea level, the city is a major commercial center in Puntland State, Somalia. Bossaso, also referred to as Bender Qasim, hosts around 700,000 people, majority who consume meat and offal from indigenous livestock breeds of camel, cattle and sheep and goats. Offal consumption is highly embraced among the population in Bosaso. The kidney, heart, liver marrow, head muscles and the bones are the most consumed within the community (FSNAU 2010). However, offal consumption is also commonly consumed by women. The liver and the kidney is traditionally considered as the reserve of men.

Livestock reared in pastoral systems also contribute significantly to the national economy and is the key means of sustenance for families as it supplies them with end products like skin, hides, meat and milk. At the same time, domestic animals in Somalia play an important role as far as human welfare and livelihood is concerned. The livestock kept in Puntland are indigenous breeds of goats, sheep, camel and cattle breeds that are more adaptable to arid environment and more resistant to diseases, drought and capable of surviving on poor nutrition that have become major challenges to livestock production. Productivity is low compared to improved types of livestock; nevertheless, it is widely agreed that these indigenous breeds should be promoted and conserved while enhancing the traits for meat and milk production. Bossaso has two slaughterhouse and five meat markets (Robert *et al*, 2015).




Map of Puntland in Somalia and the location of Bossaso.

### 3.2 Study Population

The study population comprised of all slaughterhouse workers, butchers and meat traders in both abattoir and meat markets in Bosaso Puntland State of Somalia.

### 3.3 Study Design

The researcher used to the cross-sectional study design for the estimation of the knowledge level, attitude and practices in meat hygiene among slaughterhouse workers, butchers and meat traders in abattoir and meat market in Bosaso. Face-to-face questionnaire and key informant interviews were used to collect information about knowledge, attitudes and practices of the target population regarding meat hygiene. The guidelines used to carry out the key informant interviews were based on pre-prepared structured questionnaires.

### 3.4 Sample size determination

The sample size was determined according to the formula in Dahoo *et al*,(2003)

$n= Z\alpha^2PQ/L^2$

Where n= is the appropriate sample size

Zα= the normal deviate that provide 95 per cent confidence interval (1.96)

P= a prior estimate of the prevalence of disease. A prevalence value of 50% was assumed due to the lack of previous study

Q= 1-p

L= the allowable error

$n= 1.96^2\times (0.5\times0.5)/ (0.05)$

The total sample size is 384

### 3.5 Data Collection

Questionnaires were used to collect data from eligible respondents. Detailed literature on food safety guided the formulation of questionnaires. The formulation of questionnaires was informed by four sections according the study objectives. The first section detailed the demographic features of respondents while the other subsequent sections assessed the knowledge level, attitude and personal hygiene practices of individuals working in slaughterhouses and butchers. Some questions were structured using a nominal scale of Yes or No while other questions relied on a Five Point Likert scale with 1=strongly disagree on one extreme and 5=strongly agree on the other extreme. The questionnaire indicated the purpose and completing instructions. The participants confidentially was assured by use of identification number on the questionnaires instead of individual's names. Before their involvement in this study, the consent of the participants was sought whereby the participants were required to participate in the study voluntarily. The questionnaires were administered by the researcher.

In addition to administration of questionnaires, Key informant interviews were done involving the Mayor of Bosaso, slaughterhouse supervisors, and veterinary staff of the Ministry of livestock operating in Bosas city.

### 3.6 Data Analysis

Data gathered from markets and slaughterhouses was cleaned and entered in the excel computer program. The statistical analysis was in terms of proportion, mean and standard deviation. Chi square ($\chi 2$) test to establish how sociodemographic features interact with practice scores and knowledge. P-value less than0.05 was considered statistically significant and the analysis was done by SPSS software. To preset the findings, figures and tables were used. Inferential statistics such as chi square tests were employed in testing the study hypothesis.

# CHAPTER FOUR

# RESULTS

## 4.1 Introduction

This section reflects on the outcomes of the research that are related to the material gathered. The main aim of the research was to evaluate the attitudes, knowledge and meat hygiene practices among butchers, slaughterhouse workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia. The expositions were conducted based on the study queries and the assessment of major affiliations between the variables particular to the research.

## 4.2 The Respondents' demographic information

The data was inclined on their genders, age, education level, training and marital status. This data was to be used in the analysis of the knowledge, attitude, and practice of meat hygiene among slaughterhouse workers, butchers and meat traders in Bosaso District, Puntland State of Somalia.

### 4.2.1 The respondents' gender

The study pursued to determine the respondents' gender. Findings are indicated in Table 4.1.

**Table 4.1: Respondents' Gender**

| | Meat Traders | | Slaughterhouse workers | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Male | 85 | 63.4 | 230 | 92 |
| Female | 49 | 36.6 | 20 | 8 |
| **Total** | **134** | **100** | **250** | **100.0** |

The findings established that majority of meat traders were male as indicated by 63.4% while 36.86% were females. In addition, majority of slaughterhouse workers (92%) were males while 8% were females. This implies that majority of slaughterhouse workers and meat traders in Bosaso District, Puntland State of Somalia are males.

### 4.2.2 Respondents' distribution by age bracket

The study sought to ascertain the age composition of the respondents who were requested to state their age. The study finding showed that majority of meat traders (44%) were between 31-40 years of age, 23.1% were between 41-50 years of age, 20.8% were between 22-30 years of age while 12.1% were 50 years of age and above. On the other hand, majority of slaughterhouse workers (62%) were between 31-40 years of age, 22% were between 41-50 years of age, 10% were between 22-30 years of age while 6% were aged 50 years and above. Table 4.2 shows the age distribution of slaughterhouse workers and meat traders.

**Table 4.2: Respondents' Distribution by age bracket**

| | **Meat Traders** | | **Slaughterhouse workers** | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| 22-30 years | 28 | 20.8 | 25 | 10.0 |
| 31-40 years | 59 | 44.0 | 155 | 62.0 |
| 41-50 years | 31 | 23.1 | 55 | 22.0 |
| ≥50 years | 16 | 12.1 | 15 | 6.0 |
| Total | **134** | **100** | **250** | **100.0** |

### 4.2.3 Distribution of respondents according to education level

The participants were asked to specify their education level. According to the findings, majority of meat traders (63.4%) had primary-level education, 29.9% had secondary-level education, while 6.7% were University graduates. On the other hand, majority of slaughterhouse workers (72%) had primary level of education, 22% had secondary level of education, while 6% were University graduates (Table 4.3).

**Table 4.3: Distribution of respondents according to their education level.**

| | Meat Traders | | Slaughterhouse workers | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Primary | 85 | 63.4 | 180 | 72.0 |
| Secondary | 40 | 29.9 | 55 | 22.0 |
| University | 9 | 6.7 | 15 | 6.0 |
| **Total** | **134** | **100.0** | **250** | **100.0** |

### 4.2.4 Meat hygiene training of the respondents

The study further aimed to establish whether the respondents were trained in various aspect of meat hygiene. Based on the findings, as presented in table 4.4 below, majority of meat traders (70%) were trained, while 29.3% were not. On the other hand, majority of slaughterhouse workers (72%) were not trained, while 28% were trained

**Table 4.4: Distribution of respondents on training in various aspects of meat hygiene**

| | Meat traders | | Slaughterhouse workers | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Yes | 94 | 70.1 | 70 | 28.0 |
| No | 40 | 29.9 | 180 | 72.0 |
| **Total** | **134** | **100.0** | **250** | **100.0** |

### 4.2.5 Marital Status

The participants were requested to specify their marital status. Based on the findings, majority of meat traders (79.9%) were married while 20.1% were single. On the other hand, majority of slaughterhouse workers (82%) were married while 18% were single. Table 4.5 below shows the study findings on marital status of respondents.

**Table 4.5: Marital Status of the meat traders and slaughterhouse workers**

| | **Meat traders** | | **Slaughterhouse workers** | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Single | 27 | 20.1 | 45 | 18.0 |
| Married | 107 | 79.9 | 205 | 82.0 |
| **Total** | **134** | **100.0** | **250** | **100.0** |

### 4.3 Knowledge of meat hygiene among slaughterhouse workers and meat traders

The study sought to establish the knowledge of meat hygiene among slaughterhouse workers and meat traders in Bosaso Puntland State of Somalia. The findings of the study are as shown in subsequent subheadings

### 4.3.1 Personal hygiene

Respondents were asked to indicate their knowledge on personal hygiene. The findings of the study are as shown in Table 4.6 below

**Table 4.6: Responses of meat traders and slaughterhouse workers on personal hygiene**

| | Yes | | No | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Wearing gloves is a key personal hygiene responsibility | 266 | 69.3% | 118 | 30.7% |
| Regular washing of hands before starting work is part of personal hygiene | 78 | 20.3% | 306 | 79.7% |
| Regular washing of hands after contamination is a key part of individual hygiene | 248 | 64.6% | 136 | 35.4% |
| Proper washing of hands can significantly reduce the contamination risk. | 112 | 29.2% | 272 | 70.8% |
| Washing hands using water only is not effective enough | 146 | 38.0% | 238 | 62.0% |
| Employees should not touch their hair after washing hands | 153 | 39.8% | 231 | 60.2% |
| Employees should keep short nails and makeup coloring. | 274 | 71.4% | 110 | 28.6% |

According to the findings above, it is shown that most of the respondents (69.3%) agreed that wearing gloves is one part of individual hygiene, 64.6% agreed that washing hands regularly after contamination is one part of personal hygiene and 71.4% agreed that employees should keep short nails and with makeup color. On the other hand, majority of the respondents (79.7%) disagreed that the regular washing of hands regularly before one begins work is a vital part of personal hygiene, 70.8% disagreed that the proper washing of hands properly reduces contamination risk, 62% disagreed that washing hands using water only is not effective enough and 60.2% disagreed that employees should not touch their hair after washing their hands. This implies that slaughterhouse workers, butchers and meat traders in Bosaso District of Puntland State of Somalia

are aware that wearing gloves, washing hands regularly after contamination and keeping nails short without color are part of personal hygiene. However, the respondents were oblivious of the significance of the proper washing of their hands before one starts to work, that the proper washing of hands can significantly reduce contamination risk, washing hands with water only is not effective enough and that employees should not touch their hair after washing their hands in preparation for work.

Regression Analysis on Factors Influencing slaughterhouse workers and meat traders knowledge of meat hygiene indicated that there exists a positive correlation between the responses and the percentage variable (p-value : 0.03703). There. It implies that more workers at the slaughterhouse are likely to accept the challenge that personal hygiene has a considerable effect on the sales and wellbeing of their customers. On the other hand, the graph of the respondent who said no during the survey produced an inverse correlation. It implies that the workers at the slaughterhouse and the butchers are less likely to disagree with the suggested opinion. It is further evidenced by adjusting the 'x-axis scale from the initial 150 to 100. Since the number of workers who disagree with the stated opinion is decreasing proportionally, it is easy to deduce that the probability of more workers saying 'No' in the future is likely to decrease.

Furthermore, we can deduce the factors influencing the workers' knowledge of meat hygiene. Among the leading factors is ignorance. The research reveals that most workers only possess a primary level of education. This means they are not yet exposed to the numerous dangers of illness that assail places with poor hygiene considerations. Most of these diseases are rarely mentioned at the primary level due to their complexity in understanding. Age is another factor. Most of those who voted 'yes' are middle-aged and older. This correlated directly with the level of education and

life experience. Most elderly workers who probably have witnessed the consequence of both results were more willing to vote 'yes'.

Since the calculated p-value is less than the theoretical value, we reject the null hypothesis and accept the alternative hypothesis.

### 4.3.2 Cross-contamination

Respondents were asked to indicate their knowledge on cross-contamination. The findings of the study are as shown in Table 4.7 below

**Table 4.7: Responses of meat traders and slaughterhouse workers on cross -contamination**

| | Yes | | No | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| Contamination refers to the propagation of is the transfer of harmful micro-organism from food or non-food surface s | 114 | 29.7% | 270 | 70.3% |
| Using gloves can help in the reduction of the risk of infection transmissions | 162 | 42.2% | 222 | 57.8% |
| Broken gloves need to be changed | 177 | 46.1% | 207 | 53.9% |
| Using hot water for equipment cleaning can significantly reduce the contamination risk. | 307 | 79.9% | 77 | 20.1% |
| Equipment such as knives can transfer diseases | 146 | 38.0% | 238 | 62.0% |
| Cross contamination can be reduced by a thorough cleaning of equipment after work | 267 | 69.5% | 117 | 30.5% |
| Separating between dirty and clean zone can reduce cross contamination | 283 | 73.7% | 101 | 26.3% |

From the above study findings, most of the respondents (79.9%) agreed that cleaning equipment with hot water can decrease contamination risk, 69.5% agreed that cross-contamination can be reduced by a cleaning equipment after work and 73.7% agreed that separating between dirty and clean areas can be significant in reducing cross contamination. However, majority of the respondents (70.3%) disagreed that contamination refers to the propagation of harmful micro-organisms to food either from food or non-food surfaces, 57.8% disagreed that using of gloves can help in the reduction of infection transmissions to consumers and 62% disagreed that equipment such as knives can transfer diseases. This implies that slaughterhouse workers, butchers and meat traders in Bosaso District in Puntland State of Somalia are aware that using hot water to clean equipment, cleaning equipment after work and separation of dirty and clean zones will decrease the risk of cross-contamination. However, they are not aware that contamination refers to the propagation of harmful microorganisms to food from either food or nonfood surfaces, using gloves

can help in the reduction of transmission infections to consumers and that equipment such as knives can transfer diseases.

### 4.3.3 Food borne illness

Respondents were required to note whether they are aware of food borne illness. The outcome of the study is presented in Table 4.8 below

**Table 4.8: Responses of meat traders and slaughterhouse workers on food borne illness**

| | Yes | | No | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Diarrhea refers to the illness that people suffer from after they have eaten unclean food | 307 | 79.9% | 77 | 20.1% |
| Diarrhea can be transmitted from sick people to healthy people | 146 | 38.0% | 238 | 62.0% |
| Employees can get disease when they contact blood directly | 87 | 22.7% | 297 | 77.3% |

Based on the outcome of this study, the majority of the respondents (79.9%) agreed that diarrhea is an illness that people can acquire after they have eaten unclean food. In addition, majority of the respondents (62.0%) disagreed on the statement that diarrhea can be transmitted form sick people to others. Also, 77.3% of the respondents disagreed on the statement that employees can get disease by getting into contact with blood directly. This implies that slaughterhouse workers and meat traders in Bosaso District Puntland State of Somalia are aware that Diarrhea diarrhea is an illness that people can acquire after they have eaten unclean food. However, they are not aware that diarrhea can be transmitted from sick people to others and that employees can get disease when they contact blood directly.

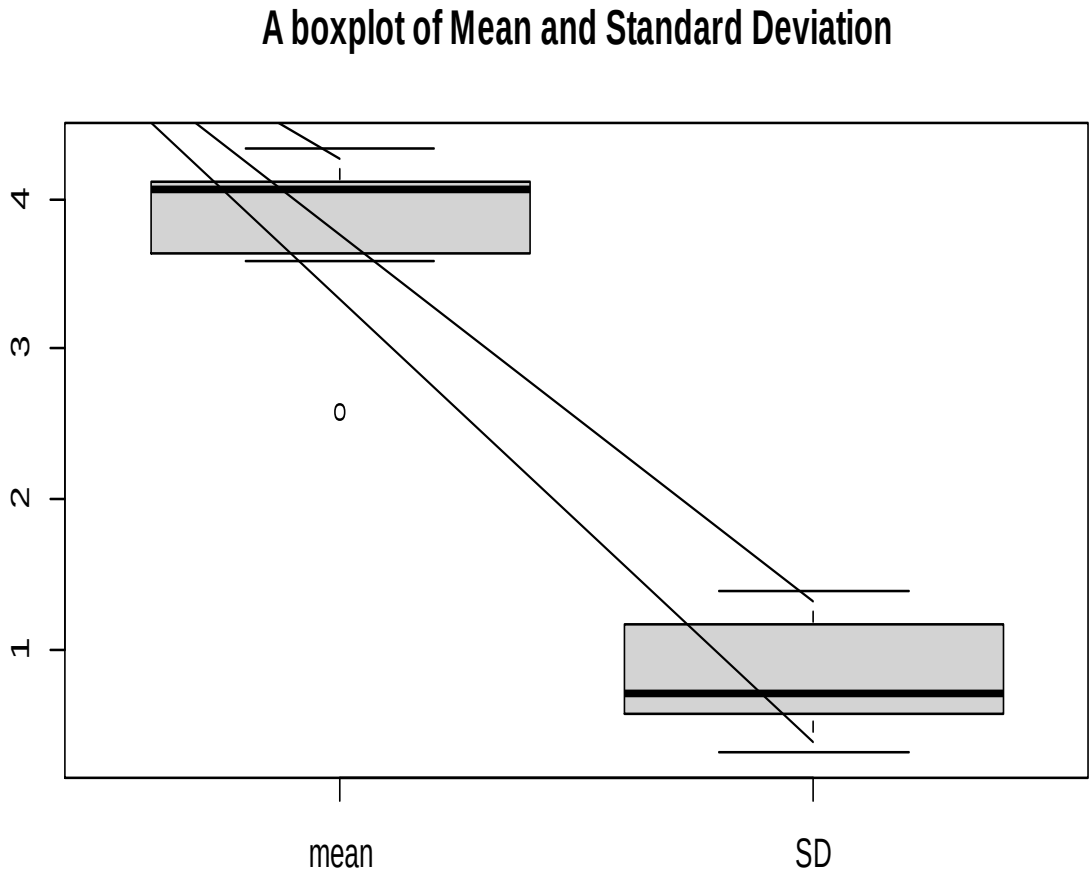
### 4.4 Attitude of meat hygiene among butchers, slaughterhouse workers and meat traders

Respondents required to note their attitude towards meat hygiene. A five-point Likert scale was used to measure the status of the variable, ranging from strongly agree (5) on one extreme and strongly disagree (1) on the other extreme. The findings are presented in table 4.9 below:

**Table 4.9: Attitudes of slaughterhouse workers and meat traders on meat hygiene practices**

| | Mean | Std. Deviation |
|---|---|---|
| It is my responsibility to handle meat safely | 4.02 | 0.67 |
| I will handle meat properly if I am trained on meat safe handling techniques | 4.11 | 0.31 |
| Knowledge about meat safety will be critical to my personal life | 4.06 | 0.56 |
| Does not matter if I use gloves or not when handling meat | 3.63 | 0.70 |
| You should not sell spoiled meat to your customers | 4.34 | 0.84 |
| Workers should keep their nails clean and short | 4.13 | 0.50 |
| Meat should only be handled by workers who do not have cuts or abrasions on their fingers | 3.58 | 1.29 |
| Employees should not wear rings and watches when handling meat | 4.12 | 1.38 |
| Diarrhea cannot stop one from selling meat | 2.58 | 1.16 |

From the findings most of the respondents strongly agreed that they should not sell spoiled meat to their customers (mean=4.34), Workers should keep their nails clean and short (mean=4.13), Employees should not wear rings and watches when handling meat (mean=4.12) and that they will handle meat properly when they know what is incorrect (mean=4.11). In addition, respondents agreed that food safety knowledge will be beneficial to their personal life (mean=4.06), it is my responsibility to handle meat properly (mean=4.02), does not matter if they use gloves or not when handling meat (mean=3.63) and that workers with cuts or abrasions on their fingers and/or hands should not handle meat (mean=3.58). However, the respondents disagreed that diarrhea cannot stop one from selling meat (mean=2.58). In my opinion, respondents have good attitude on meat hygiene and have good knowledge on how to ensure hygiene of meat, except that they should be educated on the importance of using gloves when handling meat.




The median of the recorded means is here than the mean of all the mean values. This implies that most of the workers at the slaughterhouse and in the meat market agree that factors affect their attitudes towards meat hygiene. Many of them agree that it is their responsibility to handle meat properly. Nevertheless, since the most significant population have only attended the primary school level of education, they suggest that if further training on how to better handle the meat is given, they shall be in a better position to improve. Some also suggest that lack of hygiene could be contributed by the additional ornaments they wear at work, such as bangles and wristwatches.

The highest population believed that spoiled meat should never be sold to customers. In contrast, the lowest population believed that diarrhoea could not stop one from engaging in the meat business. An average number thought it wise that protective gears should be considered when handling meat both at the slaughterhouse and in the meat market. Since the p-value is less than the theoretical value of 0.05, we reject the null hypothesis and conclude that there is a significant difference in their attitudes on meat hygiene.

### 4.5 Meat hygiene practices of slaughterhouse workers and meat traders

The respondents were asked to indicate their practices during meat handling. A five-point Likert scale was used to measure the status of the variable, ranging from strongly agree (5) on one extreme and strongly disagree (1) on the other extreme. The findings are presented in table 4.10 below.

**Table 4.10: Meat hygiene practices of slaughter-house workers and meat traders**

| | Mean | Std. Deviation |
|---|---|---|
| You should handle meat only after washing your hands | 4.10 | 0.47 |
| You should use detergents for hand washing | 4.06 | 0.50 |
| You should do away with all unnecessary adornments and ensure your nails are short before handling meat | 4.03 | 0.61 |
| You should keep away from handling meat if you have cuts or abrasions in your fingers or hands | 4.01 | 0.37 |
| You should wash your hands with soap after going to the toilet | 3.98 | 0.73 |
| You should use a face mask always when handling meat | 3.94 | 0.70 |
| You should use an apron always when handling meat | 2.63 | 0.60 |
| You should use a cap always when handling meat | 3.83 | 0.67 |
| You should use gloves always when handling meat | 3.08 | 1.28 |

From the findings, most of the respondents strongly agreed that they should wash their hands before processing meat (mean=4.10), they should use detergents to wash their hands (mean=4.06), they should keep their nail short and remove all unnecessary adornments before starting meat handling activities (mean=4.03) and that they should not handle food while at work when they have abrasion or cuts on their hands (mean=4.01). In addition, respondents agreed that they should use face mask (mean=3.94) use apron (mean=3.89), cap (mean=3.83) and gloves (mean=3.08).when working with meat. However, respondents disagreed that they should wash their hands with soap after going to the toilet (mean=2.63). This implies that slaughterhouse workers and meat traders in Bosaso District Puntland State have fairly good knowledge of appropriate meat hygiene practices but they should be educated on the importance of using soap to wash their hands after visiting the toilets. According to the information gathered from key informants, the government had a significant role in influencing the meat players in the meat industry to observe proper hygiene measures The administration at the slaughtering sites and the market also took part in these efforts including slaughter and other meat handling premises. The customers were also concerned, which put pressure on the workers to observe more on the hygiene.

**Table 4.11: Hı - There is significant relationship between sociodemographic characteristics and knowledge of meat hygiene practices among butchers, slaughterhouse workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia.**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.925 | 1 | .005 |

| | | | |
|---|---|---|---|
| Likelihood Ratio | 2.203 | 1 | .038 |
| Linear-by-Linear Association | 1.750 | 1 | .036 |
| **No. of Valid Cases** | **384** | | |

The results presented in the table show a chi-square test with a 1.925 statistic value, whose chi-square, linear-by-linear association and likelihood ration *p,* presented as p<0.05. Therefore, there is a critical relationship between the socio-demographic characteristics and the knowledge meat hygiene practices among butchers, slaughter-house workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia.

**Table 4.12: Hı - There is significant relationship between sociodemographic characteristics and attitude of meat hygiene practices among butchers, slaughterhouse workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia.**

| | **Value** | **df** | **Asymp. Sig. (2-sided)** |
|---|---|---|---|
| Pearson Chi-Square | 1.925 | 1 | .005 |
| Likelihood Ratio | 2.203 | 1 | .007 |
| Linear-by-Linear Association | 1.750 | 1 | .019 |
| **N of Valid Cases** | **384** | | |

The results show a chi-squared test statistic of 1.925with the associated Chi-Square, linear-by-linear association p, a likelihood ratio and which is < 0.05. Thus, there is a significant relationship between sociodemographic characteristics and the attitude of meat hygiene practices among butchers, slaughterhouse workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia.

# CHAPTER FIVE

# 5.0 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 DISCUSSION

This study aimed to assess the knowledge level, attitudes, and practices of meat hygiene among butchers, slaughterhouse workers and meat traders in abattoirs and meat markets in Bosaso Puntland State of Somalia on meat hygiene.

### 5.1.1 Level of knowledge on food hygiene among slaughterhouse workers and meat traders

The study revealed that slaughterhouse workers and meat traders in Bosaso District Puntland State of Somalia are aware that wearing gloves, washing hands regularly after contamination and keeping nails short without color makeup are part of personal hygiene. However, the respondents were not aware of the importance of washing hands before one starts to work, that the effective washing of hands can significantly reduce the contamination risk, washing hands with water only is not effective and that employees should not touch their hair after washing hands in preparation for work. Food safety is the degree of assurance that a particular kind of food is suitable for human consumption. The most important factor in the manufacturing process is the quality of the food (Kumar et al, 2013), as consumers of produced food are very sensitive to all kinds of contamination that may occur during the production process. Food safety is one of the scientific disciplines covered i.e. how food is prepared, processed and stored to prevent food-related diseases and illnesses (Giuseppe & Monica 2010). It covers all activities, including handling, preparation, or processing of food, for the purpose of ensuring the production of safe food for human consumption.

The study also established that slaughterhouse workers, butchers and meat traders in Bosaso District in Puntland State of Somalia are aware that using hot water to clean equipment, cleaning equipment after work and separation of dirty and clean zones will decrease the risk of cross-contamination. However, they are not aware that use of gloves will reduce the risk of infection transmission infection to consumer and that equipment such as knives can transfer diseases. All people involved in handling of food must have sufficient skills and knowledge for proper handling of food. Similar to the study findings, Galgamuwa *et al*, (2016) observed that the safety and health status is significantly determined by people who are involved in handling it within the supply chain. An estimated large number of people either die or become ill on account of consumption of contaminated food resulting from poor food safety and methods of handling. Improper handling, preparation and storage of food brings about contamination resulting into food poisoning arising from the pathogens and other disease causing microorganisms.

To reduce food related illness, there is need for professional messages regarding the best way of ensuring safety of food. However, these messages and education programs regarding the safety of food are not substitutes of research practices and regulatory activities (AI Kaabi *et al*, 2010). Most developing countries are affected by food borne diseases because of their poor state of sanitation and food handling practices. The inadequacy of funds and insufficient training and education of people involved in handling food is also the main cause of increased food borne diseases in developing countries. At the same time, most developing countries have poor regulatory frameworks guiding how food safety should be ensured. Based on these arguments, there is need for clear understanding of the link existing between the activities and practices of food handlers, their level of knowledge and skills set and the safety of food in relation to reduction of food borne diseases(Auwaluet *et al,* 2016). In countries where there is high level of improper hygiene of food,

there are higher chances of food borne disease outbreaks. The skills, knowledge and practices of individuals who are involved in handling of food are key in ensuring the safety status of food. Thus, having in place training programs to target individuals involved in handling food is key in prevention of food borne diseases.

### 5.1.2 Attitudes of slaughterhouse workers and meat traders on meat hygiene

The respondents have good attitude on meat hygiene and have good knowledge on how to ensure hygiene of meat, except that they should be educated on the importance of using gloves when handling meat. AI Kaabi *et al*, (2010) observed that all people involved in handling of food must have sufficient skills and knowledge for proper handling of food. To reduce of food related illness, there is need for professional messages regarding the best way of ensuring safety of food. However, these messages and education programs regarding the safety of food are not substitutes of research practices and regulatory activities. Food handlers play a key role in strengthening the safety of food through the supply chain from the production stage to the point when food is processed, stored and prepared ready for human consumption. The major cause of food contamination is mishandling and inability to recognize proper measures of hygiene, which significantly explain the spread of food related illness and food poisoning. Any change in eating habits and the techniques of preparing food would increase the probability of food contamination because of improper handling practices.

Bacteria mostly found in sources like dust, air and water are major causes of food contamination (Ismail et al, 2016). Food handlers involved in preparation, processing, storage and serving of food within the supply chain have greater risk of contaminating food by transmission of microorganisms like bacteria and pathogens via their hands, mouth or through breathing from the nose (Zarisha *et*

*al*, 2015). Thus, anybody coming in direct or indirect contact with consumable parts of the animal including meat should ensure he/she adheres to the highest standard of cleanliness. Health conditions and illnesses such as cholera and typhoid are mainly brought about by improper handling and preparation of food (Andy *et al*, 2015). Good slaughterhouse activities and operation entail careful examination of live animals before being slaughtered, during slaughtering, evisceration, inspection of carcasses (post–mortem inspection) and the disposal of wastes. These activities are so critical towards preventing animal related diseases and ensuring that healthy meat is delivered to the public. In most slaughterhouses in many developing countries, facilities for slaughtering and processing are not available, or are inadequate, have no supplies of clean water, no good sewage or waste disposal systems and lack refrigeration facilities. In Somalia for example, this has led to contamination of meat and environment due to poor disposing of slaughterhouse waste products (Alhaji &Baiwa, 2015).

### 5.1.3 Meat hygiene practices among butchers, slaughterhouse workers and meat markets

The study revealed that slaughterhouse workers and meat traders in Bosaso District Puntland State of have fairly good knowledge of appropriate meat hygiene practices but they should be educated on the importance of using soap to wash their hands after visiting the toilets. The safety and health status of food is significantly determined by people who are involved in handling it within the supply chain. An estimated large number of people either die or become ill on account of consumption of contaminated food resulting from poor food safety and methods of handling. In tandem with the study findings, Galgamuwa *et al.*, (2016) opined that improper handling, preparation, and food storage brings about contamination resulting in food poisoning arising from the pathogens and other diseases causing microorganisms.

Individuals who are involved in handling of food should adhere to high level of hygiene and methods of sanitation since the probability of contamination of food largely relies on hygiene and health practices and activities undertaken (Abdelrazig *et al*, 2017). All people involved in handling of food must have sufficient skills and knowledge for proper handling of food. In reduction of food related illness, there is need for professional messages regarding the best way of ensuring safety of food. However, these messages and education programs regarding the safety of food are not substitutes of research practices and regulatory activities (AI Kaabi *et al.*, 2010). Meat is deemed as unsuitable for human consumption either because of the fact that the live animal is exposed to a health condition or diseases or because the meat is spoiled. Spoilage of meat usually occurs post-slaughter either due to breakdown of chemicals or through the growth of microorganisms. Presence of diseases may render meat unacceptable for human consumption, as such, meat will result in the spread of human infections (Warriss, 2000)

## 5.2 CONCLUSIONS

The study made the following conclusions.

1. Slaughterhouse workers and meat traders in Bosaso, State of Puntland have a fair knowledge of best meat hygiene practices and implement some of them
2. The slaughterhouse workers and meat traders in the study area have good attitude towards implementation of meat hygiene and safety measures.
3. There was a significant relationship between socio-demographic characteristics and the knowledge, attitude and meat hygiene practices among the meat actors

## 5.3 RECOMMENDATIONS

1. The government should increase refresher training for slaughterhouse workers, butchers and meat market workers to enhance their knowledge and attitudes on food hygiene.
2. Slaughterhouse workers and meat traders should be trained on appropriate meat hygiene practices.
3. The various stakeholders in the meat supply and production chain should ensure that the necessary standards for meat handling and hygiene are kept.
4. The government should ensure that the various policies addressing meat handling and the production and the meat supply chain are harmonized by legislating the various laws and regulations on the livestock industry. This will ensure enhanced safety in the management of diseases associated with meat and ensure that disease outbreaks among livestock are effectively controlled.

### 5.4 Recommendations for further studies

From the outcome of this study, more research is recommended on the following areas:

i. More strategies on how to cope with the various challenges faced in meat-borne diseases control and the prevention of those diseases in the high-risk area of Somalia should be formulated.

ii. Models for the harmonization and review of the various meat safety laws concerning the production, handling, transportation and handling of meat should be developed.

iii. The variations in knowledge levels concerning beef safety are concerned in the meat supply chain should be developed.

## REFERENCE


**Abdelrazig, A., Mustafa, K., and Mohamed, M. (2017).** Hygienic Practices among Food Handlers in Restaurants of Al-Nohod Locality Market-West Kordofan-Sudan-2017. *International Journal of Public Health & Safety*. *5(9):304-311*

**Adesokan H.K., Raji a.o.q. (2014**). Safe meat-handling knowledge, attitudes and practices of private and government meat processing plants' workers: implications for future policy, *J Prev Med Hyg ; 55: 10-16*

**Ahunna Zainab Ezenwoko, Kehinde Joseph Awosan, Mansur Oche Oche,Muhammad Aliyu Makusidi, Bilkisu Gulma Abubakar (2017)** Knowledge and Practices Related to Food Hygiene among Food Handlers in Sokoto, Nigeria *International Journal of Tropical Disease& Health26(1):Article no.IJTDH.35728 ISSN: 2278–1005, NLM ID: 101632866*

**Akpabio U., Kalu E. and Babalola S. A.(**2015**)**Assessment of Facilities and Slaughter Practices inAba Abattoir, Abia State, Nigeria, *J Vet Adv, 5(6): 957-961*

**Aidaros H (2005).**The global perspective-the Middle East. *Egypt Reviews of Science and Technology, 24:589-596.*

**Alemayehu Woldecherkos, Mezgebu Yitayal (2003**).Food Hygiene Part II. *Journal of the Royal Society of Health, 112*(1), 34-38.

**Alhaji NB, & M Baiwa (2015)** Factors affecting workers' delivery of good hygienic and sanitary operations in slaughterhouses in north-central Nigeria, *Sokoto Journal of Veterinary Sciences, Volume 13 (Number 1).*

**Anna Gramza-Michałowska, Józef Korczak (2008)**VEGETABLE PRODUCTS AS HACCP SYSTEM SUBJECT IN MODERN GASTRONOMY *Acta Sci. Pol., Technol. Aliment. 7(3) , 47-53*

**Anthony C. Iwu, Kenechi A. Uwakwe, Chukwuma B. Duru, Kevin C. Diwe, Henry N. Chineke, Irene A. Merenu, Uche R. Oluoha, Ugochukwu C. Madubueze, Emmanuel Ndukwu1, Ikechi Ohale (2017)** Knowledge, Attitude and Practices of Food Hygiene among Food Vendors in Owerri, Imo State, Nigeria Occupational Diseases and Environmental Medicine, 11-*25 http://www.scirp.org/journal/odemISSN Online: 2333-357XISSN Print: 2333-3561*

**Auwalu Abdullahi, Azmi Hassan, Norizhar Kadarman, Ahmadu Saleh, Yusha'u Shu'aibu Baraya, Pei Lin Lua (2016)** Food safety knowledge, attitude, and practice toward compliance with abattoir laws among the abattoir workers in Malaysia.*International Journal of General Medicine 2016:9 79–87*

**Bassam Abdul Rasool Hassan(2012)** Importance of Personal Hygiene .*Pharmaceut. Anal Acta Volume 3 • Issue 8 • 1000e125 ISSN: 2153-2435 PAA, an open access journal*

**Bhattarai, J., Badhu, A., Shah, T., & Niraula, S. R. (2017).** Meat Hygiene Practices Among Meat Sellers in Dharan Municipality of Eastern Nepal. *Birat Journal of Health Sciences*, *2*(2), 184-190.

**CAC/RCP 58- (2005).**Code of hygienic practice for meat

***CAC/RCP 58-2005*** CODE OF HYGIENIC PRACTICE FOR MEAT

**Catherine C Adley and Michael P Ryan (2016)** Antimicrobial Food Packaging *https://www.researchgate.net/publication/286445114*

**Chepkemoi Sharon, Lamuka Peter Obimbo , Abong George Ooko and MatofariJoseph (2015)** Sanitation and Hygiene Meat Handling Practices in Small and Medium Enterprise butcheries in Kenya - Case Study of Nairobi and Isiolo Counties, *Internet Journal of Food Safety, Vol.17, p.64-74*

**Christopher J. Griffith (2006)** Food safety: where from and where to? *British Food Journal Vol. 108 No. 1, pp. 6-15*

**Clottery J.A (2011).** Manual for slaughter of small ruminants in developing countries. FAO Animal Production and Health Division, Rome.

**Drasthya Zarisha, Budi Darmawan, Ardini S. Raksanagara, Elsa PudjiSetiawati (2015)** Knowledge of Personal Hygiene among Food Handlers in Canteen at Faculty of Medicine. *Althea Medical Journal, 2(2), 245-249.*

**Emmanuel Andy, Mangai JM, Kayong EA, Afoi BB, Goshit JD, Naman Kasang, Innocent O (2015)** Assessment of Practice of Food Safety and Hygiene Among Food Vendors within Jos North Local Government Area of Plateau State, Nigeria. *International Journal of Medical and Health Research Volume: 1, Issue: 2, 83-86*

**Enne Giuseppe., Serrantoni Monica (2010)** Science for Food Safety, Security and Quality: a Review - *Part 1 Quality Of Life **1**(1):26-40 Review paper UDC: 613.2*

**Enne Giuseppe., Serrantoni Monica (2010)** Science for Food Safety, Security and Quality: a Review - Part 1 Quality Of Life **1**(1):26-40 *Review paper* UDC: 613.2

**FAO (2010),**Abattoir developmentoptions and designs for hygienic basic and medium-sized abattoirs, *Regional Office for Asia and the Pacific publication 2008/1*

**Faridah Hanim Ismail, Chemah Tamby Chik, Rosmaliza Muhammad, Norhayati Mat Yusoff (2016)** Food Safety Knowledge and Personal Hygiene Practices amongst Mobile Food Handlers in Shah Alam, Selangor, *Procedia - Social and Behavioral Sciences 222 290 -298*

**Fatemeh Esfarjani, Hedayat Hosseini, Fatemeh Mohammad Nasrabadi, Alireza Abadi, Roshanak Roustaee, Haleh Alikhanian, Marjan Khalafi, Mohammad Farhad Kiaee, and Ramin Khaksar(2016).** Development of a Home Food Safety Questionnaire Based on the PRECEDE Model: Targeting Iranian Women, *Journal of Food Protection, Vol. 79, No. 12, Pages 2128–2135*

**Food Security and Nutrition Analysis Unit, Somalia, FSNAU (2010).** Offal Consumption among the Somali Population in Boroma, Burao and Bossaso Towns. *Food Security and Nutrition Analysis Unit*.

**H. K. Biesalski and D. Nohr, (2009). T**the nutritional quality of meat. University ofHohenheim**,** Germany**,***Woodhead Publishing Limited.*

**Hamed Adetunji, Mohammad Baothman, Faisal Alserhan, Ali Almunyif, Ghaleb Alsharbe, Husssam Samaren (2018)** Knowledge, Attitude, and Practice (KAP) of Personal Hygiene among Food Handlers in the South Region of Makkah, Saudi Arabia, *International Journal of Medical Research & Health Sciences, 7(5): 96-102 ISSN No: 2319-5886*

**Herenda, D. C., Chambers, P. G., & Ettriqui, A. (1994).** *Manual on meat inspection for developing countries* (No. 119). Food & Agriculture Org.

**Jackson N. Ombui, Gathura P. Baaro and Senerwa D. Mugangai. (2012)** Best hygiene practices in meat inspection and prevention of food borne diseases and zoonoses. *Revue Scientifique et Technique-Office International des Épizooties*, *23*(2), 685-700.

**Jeannie Sneed, Daniel Henroid (2003)** HACCP Implementation in School Foodservice: Perspectives of Foodservice Directors, *the journal of child nutrition and management volume 27 issue 1*

**Karl Ropkins and Angus J. Beck (2000)**Evaluation of worldwide approaches to the use of HACCP to control food safety. *Trends in Food Science & Technology*, *11*(1), 10-21.

**Kenya Bureau of Standard (2017),** Basic requirements for a slaughterhouse –Specification, *PUBLIC REVIEW DRAFT 47-53*

**Lahiru S. Galgamuwa1, Devika Iddawela, Samath D. Dharmaratne (2016)** Knowledge and practices of food hygiene among food handlers in plantation sector, Sri Lanka.*International Journal of Scientific Reports.,2(12):304-311*

**Larry Eubanks, Chad Carr, and Ronald H. Schmidt (2009).** Hazard Analysis Critical Control Points (HACCP) Principle 7: Establish Record Keeping and Documentation Procedures. *Journal of Dairy Science*, *80*(12), 3449-3452.

**Lawan, M. K., Bello, M., Kwaga, J. K. P., & Raji, M. A. (2013).** Evaluation of physical facilities and processing operations of major abattoirs in North-western states of Nigeria. *Sokoto Journal of Veterinary Sciences*, *11*(1), 56-61.

**Madhup,Sakshi,Saurabh,Shalini,Y.Sharon,Sheetal,Shefalir,Shilpi,Shweta NSarla,Ms. Anjana Williams, Mrs. Shiwani Verma (2017)** Level of Knowledge Regarding Food Hygiene Among food Handlers Working in Restaurants of Doiwala, Dehradun.*IOSR*

*Journal of Nursing and Health Science (IOSR-JNHS) e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 6, Issue 3 Ver. VII PP 114-118*

**Maria Manuela Camino Feltes, Adriana Pavesi Arisseto-BragottoandJane Mara Block (2016)** Food quality, food-borne diseases, and food safety in the Brazilian food industry *Food Quality and Safety, 13–27 doi:10.1093/fqs/fyx003*

**Mekonnen Haileselassie, Habtamu Taddele, Kelali Adhana, Shewit Kalayou (2013)** Food safety knowledge and practices of abattoir and butchery shops and the microbial profile of meat in Mekelle City, Ethiopia.*Asian Pacific Journal of Tropical Biomedicine · DOI: 10.1016/S2221-1691(13)60085-4 ·*

**Mohammad R (2007):** Rebranding Halal. The Halal Journal, 32: 4

**Mohd. Asif Ansari1, Vikas Kumar, Chhatarapal Singh, Vani Shukla and Rajendra Kumar (2013)** Studies on Food Safety Management and It's Significance in Maximizing the Profit for Food Industry *Internet Journal of Food Safety, Vol.15*

**Monica Woldt and Gerald G. Moy (2015)** Literature Review on Effective Food Hygiene Interventions for Households in Developing Countries, Washington, DC*: Food and Nutrition Technical Assistance III Project (FANTA). Global Food Security, 2(3), 188-194.*

**New Zealand Food Safety Authority (2003).** An Introduction to HACCP. *New Zealand Food Safety Authority's website: www.nzfsa.govt.nz*

**Nhoel m. Hernandez, Caple Jun Lipa. , Catherine r. llave., Aaron Vito M. Baygan, Edcon B. Baccay (2016)** An Assessment of Food Safety, Sanitation and Hygiene Practices in Public High School Canteens in Paranaque City, *European academic research 14*(3), 136-204.

**Nina Bernice Ackah, Elvis Alfred Baidoo, and Alexander Henry Kwadwo Appiah (2018)** Validating a HACCP System for the Production of Vegetable *Shito,* Hindawi.*Journal of Food Quality Volume , Article ID 7146040, 7 pages*

**P. Ramya, E.Tirupathi Reddy, A.Vijaya kumar, N.Krishnaiah (2015).** A Study on Microbiological Analysis of Raw Meat. *International Journal of Institutional Pharmacy and Life Sciences* ISSN): 2249-6807

**P.D. WARRISS (2000).**MEAT SCIENCE an Introductory Text,*CABI Publishing, Wallingford & New York, 312 pp, ISBN: 0 85199 424 5.*

**Pleiter H (2010).** Review of stunning and halal slaughter, meat and livestock, Australia ISBN: 9781741915730

**Rajesh Kumar (2006).**Assessment of awareness and hygienic practices among poultry butchers in Patna city, Bihar'

**Robert Too, Rachael Masake, George Oyoko and Diana Onyango (2015).**The Contribution of Livestock to the Somali Economy, *IGAD Centre for Pastoral Areas and Livestock Development (ICPALD). African Economic History, (17), 81-97.*

**Seiad A. Aghwan and Joe Regenstein (2019).Sluaghter practices of different faith in different countries. J. Anim Sci. Technol. , 61(3): 111-121.**

**Shimshony A. & M.M. (2005**) Slaughter of animals for human consumption Rev. *Sci. tech. off. int. Epiz., 24 (2), 693-710*

**Wilkinson, J. M., & Wheelock, J. V. (2004).** Assessing the effectiveness of HACCP implementation and maintenance in food production plants on the island of Ireland. *Safefood Food Safety Promotion Board, Cork. 5*(5), 101-211.

**Yardimci M (2019);** Comparison of the stunning and non-stunning methods in light of the current Knowledge. *Journal of Veterinary and Animal Research 2(3):302-304*

**APPENDICES: Photos of slaughter activities in Bosaso**

A).The researcher collecting data at a slaughter slab in Bosaso

B). Meat on a slaughter slab in Bosaso

C). Researcher collecting data from a camel
Slaughterhouse worker inBosaso