



**ASSESSMENT OF OPERATIONAL FACILITIES AND HYGIENIC PRACTICES OF
SELECTED ABATTOIRS AND BUTCHER SHOPS IN EASTERN SHEWA ZONE,
OROMIA REGION, ETHIOPIA**

MSc THESIS

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PUBLIC HEALTH**

JUNE, 2022

BISHOFTU, ETHIOPIA

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**A Thesis Submitted to the College of Veterinary Medicine and Agriculture of Addis
Ababa University in partial fulfillment of the requirements for the degree of Master
of Veterinary Science in Veterinary Public Health**

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ACKNOWLEDGEMENTS

Without the will of almighty God, my research and my entire life's accomplishment would not have been possible. This work would not have been possible without the help of a large number of people who deserve to be acknowledged. Dr. Bedasso Mamo, my advisor, deserves special thanks for his continuous encouragement, guidance, encouragement, and mentorship throughout my thesis.

Dr. Muhaba Yemane and other classmate deserve special recognition for their continued support and assistance during my studies, as well as their valuable comments that improved the thesis.

Next, I would like to express my gratitude to individuals who generously provided and supported me with information during my research. I would want to express my gratitude to everyone who took part in the survey. My thanks also go to the local agriculture authorities and municipalities of Bishoftu, Mojo, and Adama for their assistance during the research.

My sincere thanks go to Addis Ababa University for their support. It was their financial support and guidance that made my dream of pursuing a master's program, and this research a reality. Finally, I owe a great heartfelt thanks to my beloved wife, Hayat Oumer, and parents for their prayers, encouragement, tremendous sacrifices, and persistent support for my studies and research.

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LIST OF ABBREVIATIONS

CAC	Codex Alimentarius Commission
DARD	Department of Agriculture and Rural Development
FAO	Food and Agriculture Organizations
FBD	Food Borne disease
KAP	Knowledge, Attitude and Practices
KBS	Kenya Bureau of Standards
Mm	millimeter
RCP	Recommended Code of Practices
RMAA	Red Meat Abattoir Association
VTEC	Verocytotoxic Escherichia Coli
WHO	World Health Organization

ABSTRACT

Most meat-borne bacterial outbreaks are usually attributed to contamination of the meat supply chain due to poor handling practices and incomplete operational facilities. Foodborne diseases (FBD) continue to pose significant public health, economic, and social burden around the world. As a main part of meat supply chain, investigations of risky hygienic practices and operational facilities on abattoirs and butcher shops are low in Eastern Showa Ethiopia. A cross-sectional study carried out in abattoirs and butcher shops found at Bishoftu, Mojo, and Adama towns from December 2021 to May 2022, to assess the hygienic practices of meat handlers and the operational facilities in the area. Three municipal abattoirs and two hundred thirty six butcher shops were selected for the assessment. And a total of 286 respondents (n=50, from abattoirs and n=236, from butcher shops) were interviewed face to face with observational checklists employed to assess operational facilities and hygienic practices of the meat handlers. Inadequate operational facilities and poor conditions of abattoirs (Bishoftu, Adama and Mojo) were observed in all the study areas. Particularly, the municipal abattoir in Bishoftu town was less equipped with facilities and located between residential and industry. In this abattoir slaughtering process was conducted on floor. Still municipal abattoirs in Mojo and Adama towns were also not in a condition to ensure production of safe meat. With regard to hygienic practices of meat handlers in butcher shops and abattoirs, 64% of them had a poor practices. A multivariable and univariable logistic regression in this study indicated trained meat handlers from abattoirs (n=15, 95% CI=1.203-15.605), and from butcher shops (n= 41, 95% CI=1.21-4.79) were 4 times and 2 times more likely to be involved in good meat handling practices respectively. Unhygienic practices and insufficient facilities in the abattoirs and butcher shops identified in this study, might predispose consumers to meat-borne diseases and potential public health risks. Therefore, awareness creation on hygienic practices of meat handlers and improving operational facilities standard are essential for production of safe meat and to reduce meat borne pathogens in meat supply chain.

Key words: *Abattoirs, Butcher shops, Hygienic practices, Meat handlers, Operational facilities*

1. INTRODUCTION

The need for safe, healthy, and nutritious meat and related products with improved taste and extended shelf life is rising globally. Microbial safety is one of the most important priorities in meat because meat and meat products provide an excellent environment for the growth of microorganisms, particularly pathogenic bacteria. The presence of these microorganisms can cause product quality to deteriorate, resulting in food-borne diseases when consumed by humans (Sohaib *et al.*, 2016).

So hygienic procedures should be followed to produce safe and wholesome meat. Adequate and proper abattoir operations such as ante-mortem inspection, slaughtering, bleeding, evisceration, post-mortem inspection, and waste disposal are important in the production and supply of wholesome meat for human consumption (Alhaji and Baiwa, 2015; Richard *et al.*, 2015). This can only be achieved by the presence of adequate, standard, and functional operating facilities, proper sanitary conditions and good hygiene practices in the abattoir (Alhaji and Baiwa, 2015). An abattoir has defined as a place of registered by the controlling authority for hygienic slaughtering, an inspection of animals, and processing of meat products for human consumption (Akpabio *et al.*, 2015). A standard abattoir should have the following components; lairage, slaughter hall, gut and tripe section, detained meat section, offal section, condemned meat section, water supply, and cold room. Others are; hide and skin section, veterinary inspection section, sanitary section, veterinary office, laboratories, and wastes disposal facilities (Gali *et al.*, 2020).

Most meat-borne bacterial outbreaks are usually attributed to contamination along the supply chain due to poor handling practices (Chepkemoui *et al.*, 2015). The microbiological quality of meat and meat products is strongly influenced by the conditions of hygiene and sanitation practices prevailing during their production and handling. Several studies conducted in Ethiopia (Mengistu *et al.*, 2017; Adugna, *et al.*, 2018; Zerabruk *et al.*, 2019) show a relatively high prevalence of bacterial pathogens which include *E. coli O157:H7*, *Salmonella*, and *S. aureus* are observed in meat and its products. The Abattoirs and butchereries are potential sources of bacterial contamination that have significant effects on the meat shelf life, public

health, and economic loss (Abdi Hassen *et al.*, 2021; Gutema *et al.*, 2021). Several attributes can be taken for this, like poor facilities, adequate knowledge for hygienic practices, and less attention from the administration. Lack of adequate standard facilities coupled with non-adherence to good manufacturing practices, good hygienic practices, and sanitary practices in slaughterhouses in developing countries, attributed to meat contamination and poor waste disposal with resultant effects on the environmental and human health in general (Alhaji and Baiwa, 2015; Richard *et al.*, 2015). According to Mammed and Webb (2015) and Birmaduma *et al.* (2019) in Ethiopia abattoirs facilities, which are considered a pre-requirement for hygienic meat production, are very few, and there is a reasonable gap in food safety knowledge abattoirs and butcher shop workers (Haileselassie, Menghistu, *et al.*, 2013). Furthermore, there are unhygienic practices both at the slaughterhouses and butcher shops that can predispose the public to meat-borne infections (Abdi Hassen *et al.*, 2021; Gutema *et al.*, 2021).

The unhygienic meat handling practices coupled with the consumption of raw or undercooked meat which is a common habit in Ethiopia (Seleshe *et al.*, 2014) could serve as suitable pathways for meat-borne pathogens to enter the food chain. Slaughterhouses and butcher shops in Eastern Shewa zone takes the lion's share in producing and processing meat due to the tourism and urbanization of the towns, which create a high demand of meat consumption. Hence, standardized facilities and good meat handling practices are necessary to provide safe and wholesome meat for the consumers.

Previous studies conducted on the microbial load of beef from abattoir (Gebeyehu *et al.*, 2013; Bersisa *et al.*, 2019) and butcher shops (Bersisa *et al.*, 2019) in this study area showed a bacterial load that was higher than the acceptable limit of the standard. Although (Webb, 2015; Birmaduma *et al.*, 2019) assessed the operational facilities of abattoirs and hygienic practice of slaughter house and butcher shops (Gutema *et al.*, 2021) in Ethiopia, a combined study that investigate hygienic practice and operational facilities in abattoir's and butcher shop's which contribute for contaminated meat in the food chain are limited. Given that abattoirs and butcher shops are main part of the meat supply chain, attentions should be given in these two main part meat supply chain to assure meat hygiene and safety. For that reason, investigating the risky practices and sub-standard operational facilities that contribute for low quality and

contaminated meat in the chain should be identified to provide a base line for monitoring and regulatory measures. Therefore, the objectives of this study were: -

- To assess the meat hygienic handling practices and facilities at the abattoirs and butcher shops
- To evaluate the association of Sociodemographic characteristics of meat handlers with their hygienic practice in meat production and process.

2. LITERATURE REVIEW

2.1. Abattoir operational facilities

In abattoir operation, certain prerequisite programs have to be considered to provide basic environmental and operating conditions that are necessary for the production of safe food. These prerequisite programs include good manufacturing practices, good hygiene practices, and standard operating procedures (Adonu *et al.*, 2017). Hence, in considering these prerequisite programs, certain fundamental factors have to be considered in the construction of an abattoir and components of an abattoir. A suitable site in the construction of a conventional abattoir should have the following: main potable water and electricity, main sewage, proximity with not crowded road and rail system, proximity with public transport, proximity to supply of varied labor, freedom from pollution from other industries, odors, dust, smoke, ash (Gracey *et al.*, 1999). In addition are the needs for remoteness from local housing and other developments to avoid complaints about noise and smell, good quality stock nearby, soil suitable for good foundations including piling, freedom from flooding, and sufficient space for possible expansion are important factors (Gracey *et al.*, 1999). The components of an abattoir and other services should include the following; lairage, slaughter hall, gut and stomach room, detained meat room, offal room, condemned meat room, hide and skin room. Others include cutting room, refrigeration room, supply of hot and cold water under pressure, veterinary inspection room, disinfection facilities, personnel welfare room, veterinary office, and facilities for condemned meat offal or carcass disposal; incinerator, chemical treatment, and disposal. Substandard and unmaintained abattoir infrastructures seriously hamper standard operations for the production of safe and wholesome meat and meat products human consumption, thereby, posing problems of meat hygiene and thus, endangering human health (Lawan *et al.*, 2013).

Different abattoirs in Ethiopia have different facilities, especially when it comes to private and municipal abattoirs (Webb, 2015). Abattoirs in Ethiopia were not performing to their full capacity due to a lack of instruments and facilities, as well as a lack of attention from the administration (Gadisa *et al.*, 2019).

2.1.1. Site selection for abattoir

Site selection requires consideration of a comprehensive set of factors and balancing of multiple objectives in determining the suitability of a particular area for defined land use. The selection of abattoir sites involves a complex array of critical factors drawing from physical, demographical, economic, policies, and environmental disciplines (Collins *et al.*, 2001). The slaughterhouse should be situated away from residential areas. Access for animals - either by road, rail, and/or stock route - must be assured. The slaughterhouse should be located in areas where flooding is impossible. An abundant supply of potable water, as well as adequate facilities for treatment and disposal, is important. The land acquired for the proposed slaughterhouse should be sufficient to permit future expansion as overcrowding of facilities may give sanitation problems. If the slaughterhouse consists of regular buildings the ground should be free of shrubbery or vegetation close to the structure (Skaarup, 1985).

2.1.2. Buildings

Cleaning and sanitation are essential components of meat slaughtering and processing, and should be considered at the planning and building stages of slaughterhouses (Birhanu and Menda, 2017). Clean and unsanitary operations and materials should not be mixed in buildings or facilities. The floor must be hard, smooth, and impervious, and it must slope sufficiently towards a drain to allow for water cleaning. If there are any walls, they may be fashioned of local building materials. Walls are not required in certain arid environments. Stone, lava blocks, bricks, or concrete are examples of materials that can be cleaned with water. Roofs, if any, can be made out of whatever materials are available (tiles, corrugated iron, or aluminum). Roofing is recommended to cover and allow the slaughter process to be weather-independent, to offer shade and keep the internal temperature down, and to allow rainwater to be collected in water tanks. Commercial abattoirs in developing countries have advanced machinery (Gregory, 2005) aside from the fact that most municipal abattoirs have inadequate handling facilities (Ndou *et al.*, 2011).

2.1.3. Water and energy supplies

If adequate potable water is available, it will be possible to organize processing and cleaning methods in such a way that hygienic products are produced. The water supply could come from the premises well or from the public system. Working routines should be designed to reduce water consumption due to wastewater disposal. If the slaughterhouse is more or less automated, energy supplies will be required. Windmills, biogas production, gasoline, and electricity could all be used to provide energy for automatic cleaning, and solar energy could also be used to heat the water. If water and energy supplies are adequate, the slaughterhouse's management will be responsible for ensuring that they are used efficiently and that sufficient water is available. Because water is used to wash working surfaces, carcasses, meat blood, equipment, and workers' hands, the quality of water used in meat processing at butcher shops plays a significant effect in limiting or increasing meat contamination. Using water at any point throughout the slaughter process can be hazardous to one's health, as moist slaughter has a higher chance of bacteria developing in the moist environment around the carcass (Helps *et al.*, 2002).

2.2. Good hygienic practice

Good Hygiene Practices aim to implement the essential principles of food hygiene applicable throughout the food chain (including primary production through to the final consumer), to achieve the goal of ensuring that food is safe and suitable for human consumption (Banjul, 2017). A well-planned, well-executed, and controlled cleaning and sanitation program for rooms, machines, and equipment are very important to achieve a hygienic standard. Cleaning and sanitation alone, however, will not assure a hygienic standard in production where process hygiene, as well as personal hygiene, are important factors. Well-planned working routines may assure a better cleaning standard during processing. For example, cleaning during processing, removal of solid waste and sufficient space in processing rooms are factors that facilitate cleaning. Adequate personal hygiene assures the overall cleaning process. Deterioration of the cleaning standard may occur if microorganisms are transmitted to well-cleaned surfaces from unwashed hands before processing starts. Neither process hygiene, personal hygiene nor cleaning and sanitation alone can assure a sufficient hygienic standard

but together, if carried out optimally, they will guarantee a complete hygienic standard (Malik *et al.*, 2018). Meat contamination in abattoirs and retail meat outlets results from the use of contaminated water, unhygienic practices like poor handling, use of contaminated tables to display meat intended for sale, and the use of contaminated knives and other equipment in cutting operations (Fasanmi *et al.*, 2010).

2.2.1. Equipment

The basic principle for equipment like tables, hooks, and machines, for example, should be that it is easy to disassemble or remove for cleaning and that it is built of non-corrosive materials. Equipment for hoisting carcasses when slaughtered is essential for the hygienic handling of carcasses and meat. When possible, hoists should be used instead of working tables. Procedures that ensure that hoists are cleaned on a regular or continuous basis are advised. Because of the complex structure of machines, cleaning and disinfection will frequently be difficult or impossible. When selecting and purchasing machines, sanitary production and cleaning and disinfection capabilities must be considered (Skaarup, 1985). Knives, wooden boards, and weighing scales from retail shops are sources of bacterial contamination, particularly *Staphylococcus aureus* and *Shigella* species (Ali *et al.*, 2010).

2.2.2. Personnel

Many commercial slaughterhouses use permanent employees who are responsible for all aspects of the operation. The structure will be determined by the nature of production. A few training in process hygiene, personal hygiene, cleaning and disinfection may be offered to permanent workers. Personnel should ideally be organized so that cleaning and disinfection occupy a portion of their time. Cleaning and disinfection methods, as well as general hygiene, must be taught and practiced by this group of employees. In developing countries, when the slaughterhouse/slaughter facilities meet the need for slaughtering in large areas, the slaughterhouse is generally owned by towns and run by a manager with no permanent personnel. Slaughtering is carried out by local butchers and a team of butchers, making it impossible to provide them with adequate hygiene instruction and training. As a result, it is advised that the slaughterhouse/slaughter facilities manager appoint a team to be in charge of

maintaining a sanitary standard. During slaughtering hours, this team should clear and clean, or order the butchers and staff to do so during and after slaughtering. This group will be in charge of cleaning and disinfecting the workspace at the end of the day, as well as maintaining the hygiene standard (Skaarup, 1985). Contamination of meat can result from contaminated working surfaces, equipment, and the workers' hands used in the processing (Lues *et al.*, 2007).

2.2.3. Processing hygiene

Depending on the type of processing, the aspects of hygiene will vary. There will be considerable variances in the cleanliness standards necessary in a plant that produces meat products that are sold as sliced, prepared meat products versus the hygiene standards required in a slaughterhouse. The separation of clean and dirty operations is the most important hygiene principle in processing. This necessitates a well-thought-out plant layout, with the goal of any building being to prevent the products from unintentional contamination (Skaarup, 1985).

2.3. Hazards associated with meat

Physical, chemical, and biological hazards can all be attributed with animal-source food products.

2.3.1. Physical hazards

Physical hazards include objects which are not part of food, never were meant to be food, but somehow are found in food. Examples are pieces of glass or metal, toothpicks, cigarette butts, pebbles, hair, staples, jewelry. A physical hazard can contaminate meat or its products at any point in the manufacturing process, causing injury but rarely death (Stopforth *et al.*, 2011). Physical hazards can be introduced into meat products through a variety of sources, including contaminated raw materials, improperly constructed or maintained facilities and equipment, improper processing procedures, and insufficient employee training and practices (Das *et al.*, 2019).

2.3.2. Chemical hazards

Chemical hazards refer to the contamination of food by chemicals. Thousands of non-nutritive feed components, both natural and man-made, are constantly exposed to food animals. Animals that are exposed to certain harmful substances, either directly or indirectly, cause injury (toxic effects) and may leave residues in meat, milk, or eggs if they are not eliminated (Smith and Kim, 2017). Accordingly, during any stage of production and processing, meat and meat products can be contaminated with a wide range of chemicals and/or additives. Consumers have become more health-conscious, and they have expressed concern over the presence of various chemicals, toxicants, adulterants, or residues of pesticides, antibiotics, drugs, antimicrobials, heavy metals, and hormones in animal-sourced foods (Tilahun *et al.*, 2016).

Smith and Kim (2017) divided chemical hazards (contaminants and residues) in meat and meat products into nonagricultural environmental contaminants (dioxins, polychlorinated phenols, and brominated flame retardants), agricultural residues and contaminants (pesticides), natural products (mycotoxins and plant toxins), toxic metals, and veterinary drugs. Despite several international regulations, drug residues in meat and meat products are a possible source of chemical contamination, resulting in a variety of health problems in humans (Das *et al.*, 2019).

2.3.3. Biological hazard

Meat and meat products have been contaminated with a wide range of biological hazards such as bacteria, parasites, viruses, and prions due to unhygienic and unwholesome production practices (Das *et al.*, 2019). The carcass surfaces are exposed to varying degrees of contamination during the long chain of slaughtering, transport, and storage, even though healthy animals' muscles do not contain microorganisms (or contain only a few microorganisms) (Eze and Ivuoma, 2012; Sofos, 2014). The carcass surface could adhere to dirt and dust throughout slaughter processing, notably skinning, cutting, and deboning, and these could be a source of microbial of various types.

Meat is a perishable food. Spoilage of meat can be caused by a variety of microorganisms which include both Gram negative or Gram positive such as: *Pseudomonas* spp.,

Enterobacteriaceae spp., *Acinetobacter* spp., *Aeromonas* spp., *Alcaligenes* spp., *Moraxella* spp., *Flavobacterium* spp., *Staphylococcus* spp., *Micrococcus* spp., *Serratia* spp., lactic acid bacteria, *Clostridium* spp., *Bacillus* spp., coliforms, yeasts and molds also (Ercolini *et al.*, 2009; Ajiboye *et al.*, 2011; Dave and Ghaly, 2011; Sofos, 2014). Other microorganisms in meat such as *Bacillus cereus*, *Campylobacter* spp., *Clostridium perfringens*, *C. botulinum*, *C. difficile*, *Escherichia coli*, *Listeria monocytogenes*, *Salmonella* spp., *Staphylococcus aureus*, *Aeromonas*, *Brucella*, *Enterobacter*, *Shigella*, *Yersinia enterocolitica*, etc. are pathogenic (Mataragas *et al.*, 2008; Akhtar *et al.*, 2009; Sofos, 2014). Because a simple heat treatment does not guarantee complete inactivation of *B. cereus*, it can pose a major threat to the meat sector (Antolinos *et al.*, 2011).

Although it's difficult to pinpoint exactly when meat becomes infected with a virus, it's thought that inadequate evisceration and unhygienic actions by diseased meat handlers during processing are two of the most common reasons. The viruses can't grow in food and are often sensitive to heat (Sofos, 2014). the risk level is high when norovirus, hepatovirus A, and orthoreovirus A-infected meat is transmitted to people and causes illnesses including gastroenteritis, hepatitis A, and hepatitis E (Smulders *et al.*, 2013).

2.4. Food-borne infections

Ingestion of bacteria, their toxins, or viruses, which may be present in previously contaminated food, or obtained during processing from other foods via cross-contamination (from surfaces, equipment, or food workers' hands), or, less likely, from carriers, results in food borne diseases (Lahr, 1996). Foodborne diseases (FBD) continue to pose significant public health, economic, and social burden around the world. In 2015, the World Health Organization (WHO) released the first estimates of global and regional illness burden linked to 31 foodborne risks, recognizing the need to evaluate the burden and distribution of FBD and encourage evidence-based policies. (WHO, 2015). According to the findings, one out of every ten individuals becomes ill each year as a result of food contaminated with microbiological or chemical agents, resulting in 600 million illnesses, 420 000 deaths, and the loss of 33 million healthy years of life worldwide (Havelaar *et al.*, 2015).

2.5. Possible sources of meat contamination

Freshly slaughtered animal meat is typically sterile unless diseased. The presence of microorganisms on post-slaughter carcasses is thus blamed on contamination occurring immediately before, during, and after slaughter. Frequently, contamination occurs due to inadequate hygienic conditions and handling in slaughterhouses (Lues *et al.*, 2007), moreover, the attachment properties and the biofilm formation of bacteria on surfaces facilitate cross contamination (Khelissa *et al.*, 2017)). The microbiological hazards associated with meat originate from live animals and the environment. The major sources of contamination are the animal itself, tools and equipment used in slaughter, the workmen, and the condition of the slaughterhouse environment (Nørrung and Buncic, 2008).

Food animals act as healthy carriers of pathogens, which are subsequently transmitted to people through the production, handling, and consumption of meat and meat products, according to the most prevalent chain of events that leads to meat-borne illness. *Salmonella spp.*, *C. jejuni/coli*, *Y. enterocolitica*, and *VTEC* prevalence in fresh red meat varies, but is typically between 1% and 10%, depending on a variety of factors such as the organism, regional factors, farming, and/or meat production procedures (Nørrung & Buncic, 2008). In slaughterhouses, the surfaces, air (aerosols), and liquids also involve bacteria. Therefore, carcasses and cuts after animals are slaughtered can be contaminated by animal and slaughterhouse environment microbiota (Rouger *et al.*, 2017). Meat contamination in abattoirs and retail meat outlets results from the use of contaminated water, unhygienic practices like poor handling, use of contaminated tables to display meat intended for sale, and the use of contaminated knives and other equipment in cutting operations (Fasanmi *et al.*, 2010). Knives, wooden boards, and weighing scales from butcher shops are sources of bacterial contamination, particularly *Staphylococcus aureus* and *Shigella* species (Ali *et al.*, 2010). The potential source of contamination of bovine meat is shown in figure 1.

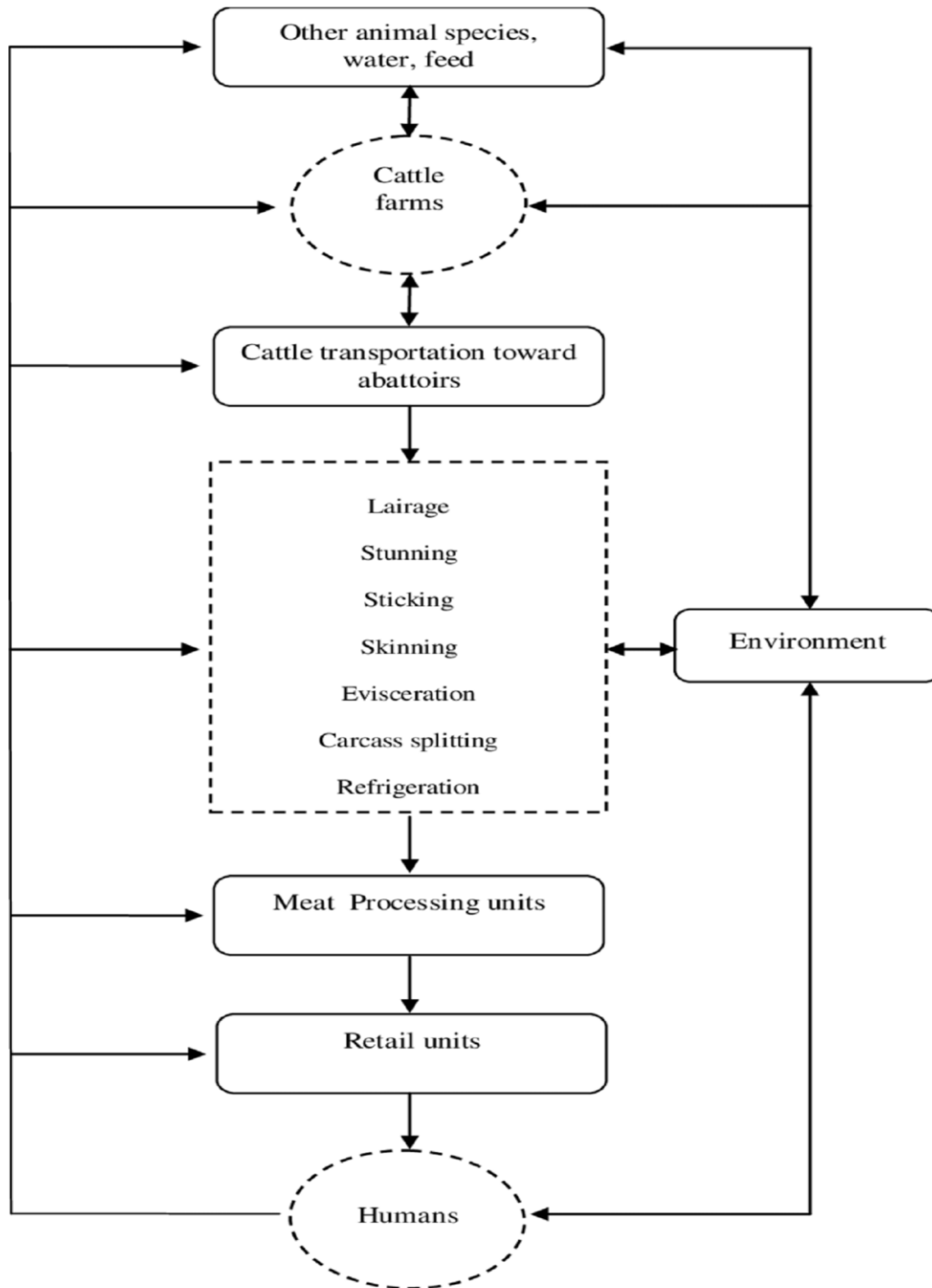


Figure 1: Potential sources and pathways for microbial contamination of bovine meat.

Source: (Niyonzima *et al.*, 2015)

2.6. The Status of Meat Safety and meat handling practices in Ethiopia

Meat is the most important livestock product, and many people prefer it over other animal proteins because it contains all of the required amino acids and minerals in optimal proportions for humans. But, of all the major foods, meat is the most perishable. Meat contains an abundance of all nutrients essential for the growth of bacteria, yeast, and molds, and fresh meats possess a suitable amount of these elements (Tafesse *et al.*, 2014). Meat consumption in Ethiopia has been linked to cultural traditions. It is an important part of special occasions, and its cultural symbolic value is just much larger than that of most other foods. Domestic meat demand is expected to rise as the population, urbanization, and economic levels rise, since people prefer to consume meat. Beef is Ethiopia's most common meat, and butcheries, restaurants, bars, hotels, and cafeterias frequently sell it (Seleshe *et al.*, 2014). As a result of this circumstance, there is a strong demand for meat, which leads to intensive animal production and processing, as well as mass production and distribution. During this time, there could be improper processing procedures at any point along the farm-to-fork chain, increasing the risk of contamination and the spread of food-borne diseases (Dhama *et al.*, 2013; Heredia and García, 2018).

Food-borne illnesses cover a wide range of illnesses that are widespread in underdeveloped nations like Ethiopia. Poor food handling and sanitation practices, insufficient food safety regulations, weak regulatory systems, a lack of financial resources to invest in safer equipment, and a lack of education for food handlers all contribute to their occurrence. Furthermore, because Ethiopians have a long cultural tradition of eating raw or undercooked meat (e.g., "Kitfo" and "Kurt"), meat safety is an important issue (Beyi *et al.*, 2017). But food-borne illness incidences in Ethiopia are rarely studied in detail and inadequately reported (Ayana *et al.*, 2015).

2.6.1. Knowledge, attitude and practices of meat handlers

Meat handling protocols play an important part in improving the quality and safety of meat (Rani *et al.*, 2017). Knowledge of hygienic meat handling procedures during meat production, processing, and distribution is necessary for developing preventive measures to reduce meat's

contribution to foodborne infections (Havelaar *et al.*, 2013). Meat borne disease is caused by cross-contamination from raw meat due to inadequate handling as a result of meat handlers' lack of knowledge and practices. Meat handlers must have adequate knowledge and practice in order to prevent the spread of food-borne disease and contamination of raw meat (Taye, 2021). Previous research in Ethiopia on food handlers' knowledge, attitudes, and practices (KAP) in relation to food safety has primarily focused on public food businesses such hotels, restaurants, cafeterias, butcheries, and juice shops (Azanaw *et al.*, 2019; Mekasha *et al.*, 2016; Chekol *et al.*, 2019). Studies that have evaluated the KAP of abattoir and butcher shops workers have been conducted in in different parts of the country (Tegegne and Physo, 2017; Yenealem *et al.*, 2020; Zelalem *et al.*, 2021).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in three municipal abattoir and butcher shops, located in Bishoftu, Adama, and Mojo towns, in the Eastern Shewa zone of Oromia Region, Ethiopia. All municipal abattoirs provide a slaughtering service for their respective town according to the customer's order or market conditions. Mostly butcher shop owners buy food animals from the open market and bring them to municipal abattoirs for slaughter service.

3.1.1. Adama town

Adama is a town located 99 kilometers to the southeast of Addis Ababa. The town is placed at a latitude and longitude of 8.54°N 39.27°E, at a height of 1,712 meters above sea level. The settlement is on the road that connects Addis Ababa with Dire Dawa-Djibouti. There are several resorts in and around Adama, such as Sodore, as well as many live animal export farms. As a result, there are numerous population shifts among humans and animals.

3.1.2. Bishoftu town

Bishoftu is a large town in the east Shewa zone of the Oromia regional state. It is 45 kilometers to the south-east of Addis Ababa, the capital city of the country, at 9°N latitude and 40°E longitude. It is at a height of 1,850 meters above sea level. The average annual temperature is 20.2°C, with 1,800mm of rainfall on average (Abebe, 2017). In the city, there are three exporting abattoirs, one private abattoir and one municipal abattoir. A substantial number of privately owned intensive and extensive dairy, poultry, and swine farms are also present. This highly populated town is the principal supply of livestock, poultry, and swine meat for Addis Ababa stores, as well as related things like milk, eggs, and other dairy products. Bishoftu is noted for its natural attractions, including lakes, which draw tourists and are frequently visited by national and international visitors.

3.1.3. Mojo town

Mojo town is located 70 kilometers from Addis Ababa and 25 kilometers from Adama town. Mojo town is located between 1730 and 1890 meters above sea level, with an average annual temperature of 16-17 ° C, and an average annual rainfall of 896 mm. It is located at a latitude of 08° 37' North and a longitude of 39° 07' East.

3.2. Study design

A cross-sectional study which comprises of detailed semi-structured questionnaires to assess hygienic practices of raw meat handlers in abattoirs and butcher shops, and a checklist of the observational survey to evaluate facilities, and some practices of meat handlers in abattoirs and butcher shops was conducted from December 2021 to May 2022.

3.3. Sample Size

Sample size was determined using Cochran's formula given by (Glen, 2021)

$$n_0 = Z^2 pq / e^2$$

Where:

e= desired level of precision (i.e. the margin of error),

p = (estimated) proportion of the population which has the attribute in question,

q = 1 – p.

The z-value is found in a Z table corresponding to 95% CI, and commonly it is 1.96²

Therefore, considering 66.4 % good hygienic practices level of meat handlers in butcher shops in Gondar, Ethiopia (Yenealem *et. al*, 2020) as estimated proportion of the population, at 95 % confidence interval (CI) and required precision level of 5%, the estimated sample size was 343. But the number of the currently estimated meat handlers (using estimated 1070 meat handlers in butcher shops, abattoirs, and in the selected areas) doesn't met the required numbers used for the above formula. So it needs an adjusted sample size which was calculated using a modified Cochran's formula for small population (Glen, 2021), $n = n_0 / 1 + (n_0 - 1) / N$, where n_0 is Cochran's sample size recommendation, N is the study population size, and n is the new adjusted sample size. This gave us a minimum sample size of 260. But considering the non-response rate of 10% of adjusted sample size, the final total sample becomes 286. Then, the

sample size for respondents was proportionally allocated as follows based on the rate in which each of the abattoirs and butcher shops contribution to the total study population: Bishoftu butcher shops (80), Bishoftu municipal abattoir (15), Mojo butcher shops (38), Mojo municipal abattoir (16), Adama butcher shops (118), and Adama municipal abattoir (19). So a total of 236 respondents from butcher shops and 50 respondents from abattoirs were included in this study.

3.4. Sampling Method

Multi-stage sampling method was followed to select respondents. First, the three towns in (Bishoftu, Mojo and Adama) were selected purposely from East showa zone. These town are well known in high meat production to supply meat for high population who are resident and guest as tourist. From these town the three municipal abattoirs were also selected purposively. This is because of there was only one municipal abattoir per town and as compared to private abattoirs, there is less regulation in municipal abattoirs. Butcher shops from these town were selected using simple random sampling method. Finally respondents from each butchers and abattoirs were also selected using simple random sampling method.

3.5. Methods of Data Collection

To evaluate the meat hygienic handling techniques at abattoirs and butcher shops, data was obtained through face-to-face interviews and direct personal observation using pre-tested semi-structured questionnaires and checklists. The questionnaires and checklist were derived from related recent studies in Ethiopia (Webb, 2015; Gadisa *et al.*, 2019; Tadesse *et al.*, 2021) and other study out of Ethiopia (Lawan *et al.*, 2013) with some modification. The questionnaires were structured into 1) general characteristics of individuals in both abattoir and butcher shops which includes age, sex, working experience, educational level and training received by meat handlers 2) questions for face-to-face interview to evaluate hygienic practices of meat handlers in abattoirs and butcher shops. 3) Observational checklists for both butcher shops and abattoirs. The facilities of the abattoirs were assessed based on their availability and functionality. The questionnaire, originally prepared in English and interview was carried out through translating

orally into in Amharic or Affan Oromo depending on the respondent interest, the commonly spoken local languages in the study area.

Before beginning the questions, the assessor introduced himself to the respondent and described the objective of the questionnaire, assuring the respondent that the information would be handled confidentially. The interviewer also insisted the respondent understood the study objective and significance. The method of contact for butcher shops was informal, with the participant orally introducing himself to the owner or the person handling the meat and inviting them to participate in the interview. After getting permission to participate in the study, the face to face interview continued.

Categorical variables were used to analyze the response (right or wrong answer) of questions. The correct answer received a one-point score, while the incorrect one received a zero. When there were more than two answers, the most correct option received a score of one, while the other received a zero. Out of the total questions indicated in the (Annex 1) of this paper only twenty-three questions and fourteen questions related to hygienic practices were included to evaluate meat handlers hygienic practice level for butcher shops and abattoirs respectively. Respondents who scored less than 70% on the right answer were considered to have a "poor level of practices," while those who scored greater than or equal to 70% were considered to have a "good level of practices (Soares *et al.*, 2012)".

3.6. Ethical declaration

The study was conducted after ethically approved by the Addis Ababa University, College of Veterinary Medicine and Agriculture ethical review committee (Ref.No:VM/ERC/16/02/14/2022) and all study work was conducted according to research ethics.

3.7. Data management and analysis

The collected data were entered in a Microsoft Excel spreadsheet. The statistical software STATA version 14 was used to import and analyze the data. Descriptive statistics such as frequency and percentage are used to summarize the data from each questionnaires and check lists. The association of respondents' Sociodemographic factors with meat handling habits was

analyzed using univariable logistic regression analysis. The odds ratio with a 95 % confidence interval was used to show the strength of the associated factors. Statistical significance was defined as a p-value of less than 0.05. Text, figure and tables were used to present the compiled data.

4. RESULTS

4.1. Hygienic practices and operational facilities of abattoirs

4.1.1. Description of observational assessment of slaughter sites and facilities

According to the findings of the abattoirs assessment, the majority of their facilities were not available and not in good condition. All abattoirs were not free from dust this was a result of connecting to the road which was not asphalt. They have drained lairage which was slightly separated within a few distances from the slaughtering area. In all abattoirs, lairage had fences that take the animal to a place of slaughter. Isolation pen for sick animals was not available in Bishoftu, and Adama municipal abattoirs. The drainage system in Adama municipal abattoir and Bishoftu municipal abattoir was open and grated trench that trap blood and other solid material drained with it and form bad smell (Figure 3). The surfaces of material were not resistant to wear out and corrosion. Since surface of wall and floor have groove and grated part it didn't ease cleaning process. . In all abattoirs source of water was municipal/city (tap water). They had also borehole water but not functional. Even though there was a place for a foot bath in all abattoirs they didn't used it at time of operation. Separate rooms for handling hides and skins, for the cleaning and treatment of intestines and offal, inedible and condemned animals, carcasses, and meat were not available in Bishoftu municipal abattoir. In addition to this, there was no veterinary laboratory in all abattoirs. Adama municipal abattoir had a cooling facility but it was nonfunctional (Figure 2). But there were no cooling facilities in Mojo municipal abattoir, and Bishoftu municipal abattoir. As a result, meat was stay at room temperature before it was transported to butcher shops. Details about observed slaughter sites and facilities is shown in Table1 below.

Table 1: Summary of observation on abattoirs location and facilities

Assessment criteria	Municipal Abattoirs		
	Mojo (Yes/No)	Adama (Yes/No)	Bishoftu (Yes/No)
Abattoir location/ Site			
Far from residential area	Yes	Yes	No
Far from Industry	Yes	No	No
Far from crop farms	No	Yes	Yes
Free from dust	No	No	No
Free access to the road connecting to it	Yes	Yes	Yes
Lairage			
Drained lairage	Yes	Yes	Yes
Fence that takes the animal to the place of slaughter	Yes	Yes	Yes
Separated from the slaughter area	Yes	Yes	Yes
Slaughters have isolation pens for sick animals.	Yes	No	No
Rooms in slaughter houses			
Hides and skins room	Yes	Yes	No
Room for cleaning and treatment of intestines and offal.	Yes	Yes	No
Room for storage, disposal, and treatment of inedible and condemned animals, carcasses, and meat.	Yes	Yes	No
Surfaces of walls, and floor			
Impervious to water	Yes	Yes	Yes
Can be easily cleaned	No	No	No
Resistant to wear and corrosion.	No	No	No
Other facilities			
Presence of cooling facilities	Yes *	No	No
Well drainage system	Yes	No	No
Good lighting	Yes	Yes	Yes
Footbath	No	No	No
Veterinary laboratory	No	No	No
Veterinary office	Yes	Yes	No
Vehicle for transport of carcasses	Yes	Yes	Yes

*=non functional



Figure 2: Nonfunctional cooling room in Adama municipal abattoir



(A)



(B)

Figure 3: Open and grated drainage trench (A) Bishoftu municipal abattoir drainage trench, (B) Adama municipal abattoir drainage trench

4.1.2. Description of observational assessment of slaughter process and use of protective material in abattoirs

Each abattoir has a veterinarian in charge of regulating the slaughtering process and meat inspection. The animals were stunned by piercing them in the foramen magnum with a sharp-edged knife, which was followed immediately by bleeding and the removal of the head and feet while the carcass lay horizontally on the floor. After mechanically hanging the carcass with hooks and sliding it over the rail system, the following slaughter processes (de-hiding,

evisceration, and post-mortem inspection) were undertaken in a vertical position in Adama, and Mojo abattoirs. However, in the Bishoftu municipal abattoir, most processes were carried out in a horizontal position on the floor (Figure 4), and when each quarter of a carcass is sliced, it was manually hung on hooks for post-mortem inspection. The carcasses in all abattoirs were washed with water after evisceration, but not with pressurized water. Finally, it was reserved at room temperature and transported to butcher shops. There was a sink for hand washing in all abattoir but it was not at all appropriate distance of slaughtering process. In addition to this there was no barrier between clean and dirty area of slaughter hall. The majority of respondents in these abattoirs did not employ protective equipment as observed. None of them wore a white coat, a head cover, and gloves.



Figure 4: Slaughtering process on the floor and without use of protective material in Bishoftu municipal abattoir

4.1.3. Sociodemographic characteristics of participants in abattoirs

As shown in Table 2 below all respondents from Mojo abattoirs were male. But only 8% of all abattoir participants were female, and adults 36 (72%) were the most common age group, ranging from 17 to 40 years old with an average age of 28 years. Only 14% of the participants have worked in abattoirs for more than three years. Meat handlers, with the exception of the

municipal abattoir in Mojo, have no principal position and are involved in the entire meat slaughtering process. Butcher shops that receive abattoir service send their personnel to these municipal abattoirs to execute the entire slaughtering process. As a result, they didn't have a primary role. More than two-thirds of abattoir workers (70 %) had no training on how to handle meat in a hygienic manner.

Table 2: Sociodemographic characteristics of participant in abattoirs

Variables	Frequency (%)			
	Bishoftu (n=15)	Mojo (n=16)	Adama (n=19)	Total (n=50)
Age in years				
17-40	11 (73.3)	12(75)	13 (68.4)	36 (72)
>40	4(26.7)	4(25)	6 (31.6)	14(28)
Gender				
Male	13 (86.7)	16 (100)	17(89.5)	46 (92)
Female	2 (13.3)	0 (0)	2 (10.5)	4 (8)
Level of education				
Informal	3 (20)	2 (12.5)	5 (26.3)	10 (20)
Primary	10 (66.7)	11(68.8)	12 (63.2)	33 (66)
Secondary	2 (13.3)	3 (18.7)	2 (10.5)	7 (14)
Main role at the abattoir				
Stunning and bleeding	NR	2 (12.5)	NR	NR
De-hiding	NR	NR	NR	NR
Evisceration	NR	NR	NR	NR
Experience at an abattoir				
1-3	13 (86.7)	13 (81.3)	17 (89.5)	43 (86)
>3	2 (13.3)	3 (18.7)	2(10.5)	7 (14)
Training received				
Yes	0 (0)	7 (43.8)	8 (42.1)	15 (30)
No	15 (100)	9 (56.2)	11 (57.9)	35 (70)

NR-There was no clear role per individual and they were involved in the whole slaughtering process.

4.1.4. Participant's responses to hygienic practices at abattoirs

This section explains abattoir worker hygiene practices, as well as activities connected to personal hygiene, the source of water in the abattoir, and evaluating whether they handle meat while having health problems at abattoirs. According to their responses, all respondent washed their hands following risky activities such as after handling meat, going to the toilet, and handling waste. They also used soap to wash their hand. Furthermore, participants did not disclose some potential contaminating practices in the workplace, such as smoking, eating, or drinking. However, as they stated in their response, 60% of participants do not washed their hands before handling meat, handle meat while they were ill (46%), and did not removed their rings and watches before handling meat (72 %). Almost two-thirds of the abattoir workers in this study (60 %) have not had medical checkups before working in the abattoir and the remaining had irregular medical checkup. Detail of responses of respondents are indicated in Figure 5 below.

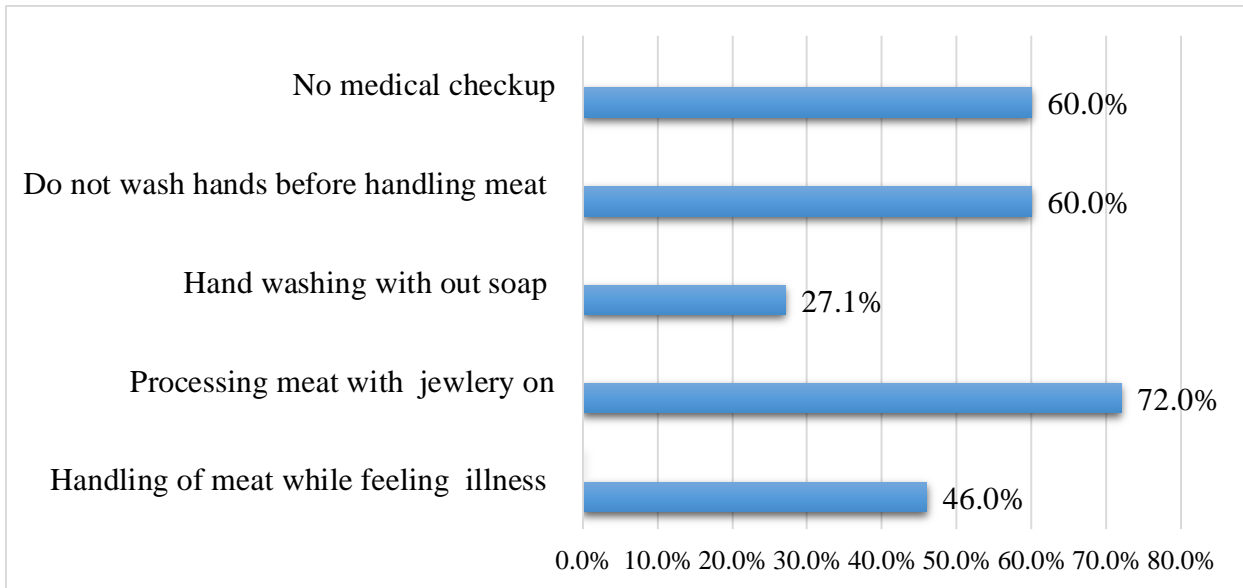


Figure 5: Poor Hygienic practices of abattoirs respondents

4.1.5. Factors associated with meat handling practice in the abattoir.

Educational level and training received by the participant were the factors significantly associated with the hygienic practice of workers in abattoirs with a p-value of 0.04, and 0.025 in univariable logistic regression respectively.

Table 3: Univariable logistic regression of factors associated with the practice of meat handlers working at abattoirs.

Variable	Meat handling practice		OR (95% CI)	P value
	Poor (n=32)	Good (n=18)		
Age in years				
17-40	25	11	Ref	Ref
>40	7	7	2.27 (0.641-8.053)	0.20
Town				
Bishoftu	15	0	Ref	Ref
Mojo	6	10	2.29 (0.587-8.942)	0.23
Adama	11	8	0.43 (0.111-1.702)	0.23
Education level				
Primary	25	8	Ref	Ref
Informal	4	6	4.7 (1.05-20.89)	0.043
Secondary	3	4	0.89 (0.125-6.310)	0.91
Duration of working at abattoir in years				
1-3	29	14	Ref	Ref
> 3	3	4	2.76 (0.542)	0.22
Receiving of training				
No	26	9	Ref	Ref
Yes	6	9	4.33 (1.203-15.605)	0.025

NB. Ref-reference category

As shown in Table 3 above only training received was found significantly associated with a p value of $P < 0.05$ in univariable logistic regression and it indicates that trained meat handlers

(OR=4.33, (95% CI=1.203-15.605) are 4 times more likely to be involved in good meat handling practices.

4.2. Hygienic practices and operational facilities of butcher shops

4.2.1. Description of observational assessment of butcher shops facilities and hygienic practices

In all butcher shops, the meat was displayed without a cover. Their walls were painted white, allowing to observe the cleanliness of the butcher shops' walls, which revealed that 70.8 % of the butcher shops' walls had sign of dirty. They utilized a bulb in the display case. Because there were no cooling facilities, the meat was displayed at room temperature. Plastic cutting boards were used by 43.2%, of butcher shops, while wood, and marble cutting board was used by approximately the same percentage of butchers (29.7% and 27.1%), respectively. Hot water was not available in all butcher shops for dipping of knives, and 83.5 % of them had no hand washing basins in butcher shop. None of the butcher shop workers who took part in this survey wore gloves, and more than half of the respondents 58.3%, and 77.5 %, respectively, did not wear an apron, or a head cover.

Table 4: Hygienic practices and facilities observed in butcher shops

Variables	Frequency (%)			
	Bishoftu n=80	Mojo (n=38)	Adama (n=118)	Total (n=236)
Floor is made of				
Concrete	48 (60)	21 (55.3)	64 (54.2)	133 (56.4)
Tile	28 (35)	14 (36.8)	48 (40.7)	90 (38.1)
Wood earthen material	4 (5)	3 (7.9)	6 (5.1)	13 (5.5)
Sign of dirty on the wall				
Yes	18 (22.5)	11 (28.9)	40 (33.9)	69 (29.2)
No	62 (77.5)	27 (71.1)	78 (66.1)	167 (70.8)
Ventilation status of the display and butchery				
Fair	67 (83.75)	32 (84.2)	76 (64.4)	175 (74.2)
Poor	13 (16.25)	6 (15.8)	42 (35.6)	61 (25.8)
Wear of Apron/White coat				
Yes	29 (36.25)	16 (42.1)	54 (45.8)	99 (41.9)
No	51 (63.75)	22 (57.9)	64 (54.2)	137 (58.1)
Wearing of head cover				
Yes	15 (18.75)	9 (23.7)	29 (24.6)	53 (22.5)
No	65 (81.25)	29 (76.3)	89 (75.4)	183 (77.5)
Presence of a sink for hand washing				
Yes	13 (16.25)	7 (18.4)	19 (16.1)	39 (16.5)
No	67 (83.75)	31 (81.6)	99 (83.9)	197 (83.5)
Material to wrap meat for sale				
Plastic bag	70 (87.5)	34(89.5)	93(78.8)	197 (83.5)
News paper	10(12.5)	4 (10.5)	25 (21.2)	177 (16.5)
Kind of cutting board				
Wood	21 (26.25)	12 (31.6)	37 (31.4)	70 (29.7)
Marble	24 (30)	10 (26.3)	30 (25.4)	64 (27.1)
Plastic	35 (43.75)	16 (42.1)	51 (43.2)	102 (43.2)

4.2.2. Sociodemographic characteristics of respondents in butcher shops

Respondents from butcher shops were totally male, adults (89%) with a range of 17-40 years old, and had less than three years' experience (59.7%). Many of them (58.9%) attained primary education level, but 82.6% didn't take training on meat handling practices.

Table 5: Sociodemographic characteristics of respondents in butcher shops

Variables	Frequency (%)			
	Bishoftu (n=80)	Mojo (n=38)	Adama (n=118)	Total (n=236)
Age				
17-40	71 (88.8)	36(94.7)	103 (87.3)	210(89)
>40	9(11.2)	2(5.3)	15 (12.7)	26 (11)
Level of education				
Secondary	24 (30)	13 (34.2)	48 (40.7)	85 (36)
Primary	53 (66.25)	22(57.9)	64 (54.2)	139 (58.9)
Informal	3 (3.75)	3 (7.9)	6 (5.1)	12 (5.1)
Experience in years				
<3	46 (57.5)	21 (55.3)	74 (62.7)	141 (59.7)
3-5	24 (30)	8 (21.1)	36 (30.5)	68 (28.8)
>5	10 (12.5)	9 (23.6)	8 (6.8)	27 (11.5)
Training received				
Yes	13 (16.25)	9 (23.7)	19 (16.1)	41 (17.4)
No	67 (83.75)	29 (76.3)	99 (83.9)	195 (82.6)

4.2.3. Respondent's response on meat handling practices at butcher shops.

According to participants' responses, practices such as washing hands after going to the toilet, after handling waste or garbage were practiced by all workers in butcher shops. Almost all (97.9%) of them also wash their hand after handling meat. Their source of water for washing and cleaning was municipal (tap water). They didn't smoke inside butcher shops.

The majority of respondents eat and drink (60.6%) at the workplace, display offal and meat in the same cabinet (50.8%), and use the same equipment while handling meat and offal. Out of the 236 respondents from butcher shops included in this study process meat while they wore the ring and, or watch (41.9%), while they are ill (48.7%), and while they have cuts, wounds, and injuries on their hands (41.1%). Although many of the respondents wash their hand before handling meat (84.7%), wash their hand with soap (72.9%) , use refrigerator for storage of leftover meat from daily sale (80.9%), a considerable respondent didn't wash their hand before handling (15.3%) , wash their hand without soap (27.1%), and didn't use refrigerator for storage of it (19.1%). Seven percent of the workers in butcher shops collect money while they handling meat.

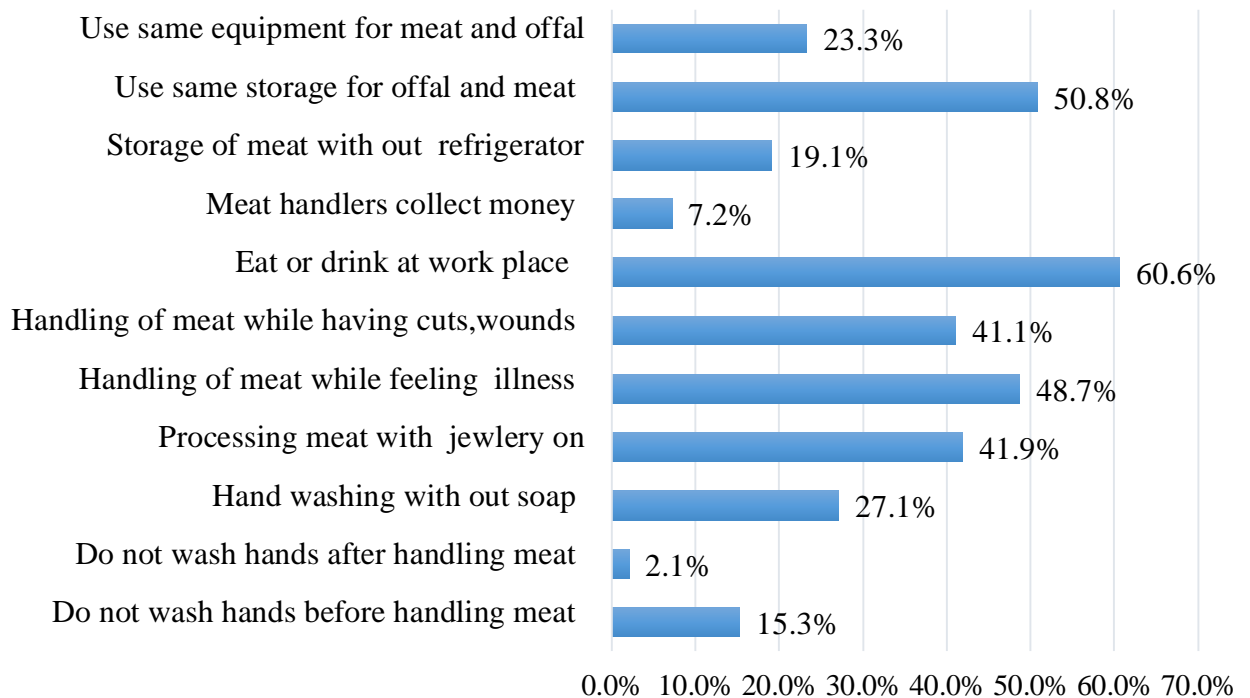


Figure 6: Butcher shop respondents' poor hygienic practices

As shown in table 6 below, one out of five butcher shops (21.6%) disposes waste material to open spaces nearby. In 19.9% of the butcher shops meat left over from the daily consumption stay for two days in butcher shops, Out of the total butcher shops included in this survey 7.6% didn't use flies control method.

Table 6: Respondents' response on other hygienic practices in butcher shops

Variables	Frequency (%)			
	Bishoftu (n=80)	Mojo (n=38)	Adama (n=118)	Total (n=236)
Methods used to control flies				
Horsetail fly swatter	53 (66.25)	28 (73.7)	72 (61)	153 (64.8)
Roach killer	8 (10)	3 (7.9)	14 (11.9)	25 (10.6)
Fumigation and roach killer	6 (7.5)	6 (15.8)	11 (9.3)	23 (9.7)
No control	6 (7.5)	1 (2.6)	11 (9.3)	18 (7.6)
Horse tail fly swatter and fumigation	7 (8.25)	0 (0)	10 (8.5)	17 (7.1)
Place where waste material dispose				
Soak pit	45 (56.25)	22 (57.9)	59 (50)	126 (53.4)
Municipal sewer	20 (25)	9 (23.7)	30 (25.4)	59 (25)
Open space near by	15 (18.75)	7 (18.4)	29 (24.6)	51 (21.6)
Meat stays in butchery for maximum				
one day	63 (78.75)	29 (76.3)	88 (74.6)	180 (76.3)
Two days	14 (17.5)	7 (18.4)	26 (22)	47 (19.9)
Less than 12hours	3 (3.75)	2 (5.3)	4 (3.4)	9 (3.8)

Washing of equipment or surfaces frequently is important to minimize contamination. Many of butcher shops (83.1%) used hot water with soap to wash butchery equipment and 16.9 % used cold water with soap. Nearly half of the participants (44.9%) washed their white coats every two days but the rest washed every day. Out of the three washing frequency options (more than twice per day, twice per day, and once per day) given to butcher shop respondents, 66.5 %, 72 %, and 67.4 % said they wash their butchers Knife, cutting board, and saw or axes once per day, which was the least frequent of the three options. Only once every two days, 32.6 %, 25.5 %, and 41.1 % of the 236 butcher shops wash their display cabinet, hooks, floors, and walls. One-fourth of the respondents in butcher shops had never had a medical check-up to work in butcher shops and the rest had medical check-up once per year (5.5%), every six months (13.6%), every three months (55.9). The details is shown in Table 7 below.

Table 7: Frequency of washing equipment of butcher shops.

Variables	Frequency (%)			
	Bishoftu (n=80)	Mojo (n=38)	Adama (n=118)	Total (n=236)
Frequency of washing equipment/ surfaces				
Knife				
Once every day	59 (73.8)	30 (78.9)	68 (57.6)	157 (66.5)
Twice per day	15 (18.8)	6 (15.7)	31 (26.3)	52 (22)
More than twice per day	6 (7.5)	2 (5.3)	19 (16.1)	27 (11.5)
Cutting boards				
Twice per day	22 (27.5)	7 (18.4)	30 (25.4)	59 (25)
Once every day	54 (67.5)	30 (79)	86 (72.9)	170 (72)
More than twice per day	4 (5)	1 (2.6)	2 (1.7)	7 (3)
Saw/axes				
Once every two days	13 (16.25)	8 (21)	25 (21.2)	46 (19.5)
Once every day	53 (66.25)	25 (65.9)	81 (68.6)	159 (67.4)
Twice per day	14 (17.5)	5 (13.2)	12 (10.2)	31 (13.1)
Display cabinets				
Once every two days	27 (33.75)	13 (34.2)	37 (31.4)	77 (32.6)
Once every day	53 (66.25)	25 (65.8)	81 (68.6)	159 (67.4)
Hooks				
Once every two days	22 (27.5)	9 (23.7)	29 (24.6)	60 (25.5)
Once every day	58 (72.5)	29 (76.3)	89 (75.4)	176 (74.5)
Floor and walls				
Once every two days	36 (45)	15 (39.5)	46 (39)	97 (41.1)
Once every day	44 (55)	23 (60.5)	72 (61)	139 (58.9)

4.2.4. Factors affecting hygienic practices of meat handlers in butcher shops

Training received by the participant was the only factor significantly associated with the hygienic practice of workers in butcher shops with a p-value of 0.02 in univariable logistic regression. The trained meat handlers (OR; 2.412 (95% CI=1.21-4.79) are 2 times more likely

to be involved in good meat handling practice which showed statistically significant ($P<0.05$) as compared to individuals not trained ones.

Table 8: Univariable logistic regression of Sociodemographic characteristics with meat handling practices in butcher shops.

Variables	Meat handling practice		OR (95% CI)	P value
	Poor (n=151)	Good (n=85)		
Age				
17-40 years	134	76	Ref	Ref
>40 years	17	9	0.93 (0.39-2.19)	0.88
Town				
Bishoftu	49	31	Ref	Ref
Mojo	23	15	1.03 (0.46-2.27)	0.94
Adama	79	39	0.78 (0.43-1.40)	0.41
Education level				
Informal	7	5	Ref	Ref
Primary	92	47	0.72 (0.21-2.37)	0.58
Secondary	52	33	0.89 (0.26-3.03)	0.85
Duration of selling meat in years				
<3	87	54	Ref	Ref
3-5	45	23	0.82 (0.44-1.51)	0.53
>5	19	8	0.68 (0.27-1.65)	0.39
Receiving training				
No	132	63	Ref	Ref
Yes	19	22	2.412 (1.21-4.79)	0.012

5. DISCUSSION

In food and drinking facilities, proper hygienic standards are top of the agenda, while proper handling is required to produce fresh and healthy meat for public consumption (Khanal and Poudel, 2017). Meat available in butcher shops has been comes through a long chain of slaughtering and handling, with each stage posing a risk of microbial contamination. The hygienic conditions of abattoirs and the environment in which they operate are key contributors to meat contamination from bacteria (Brown *et al.*, 2000). The abattoir, according to Roberts and de Jager, (2004), is one of the food retailers that play a significant role in potential food-borne diseases and health risks linked with food if food hygiene issues are not addressed. This study was focused on assessment of hygienic practices and operational facilities in abattoirs and butcher shops. The following discussion focuses on the major meat handling practices and operational facilities found, as well as their possible public health implications. Since Ethiopia is a member of the Codex Alimentarius Commission, and the Codex standards serve as basic reference materials for standard setting and as enforcement mechanisms for food safety in Ethiopia where defined standards do not exist the following discussions are in the light of this codex standards on general principles of food hygiene, code of hygienic practice for meat and other proclamation of Ethiopia such as Meat Inspection Proclamation (No. 274/1970), Public Health Proclamation (No. 200/2000), and Food, Medicine, and Health Care Administration and Control Proclamation (No. 661/2009), which allow for the control of food safety in Ethiopia.

Inappropriate location of abattoirs, absence or poor operational facilities, and unhygienic meat production process were observed in this study. While absence of hot water baths for hand washing and knife dipping, ignorance of hand washing before and after activities, insufficiently trained workers, lack or irregular medical check-ups, lack of cooling facilities, handling of meat having health problem and with wearing jewelry, and infrequent washing of equipment and surfaces were all found to be unsatisfactory practices at both municipal abattoirs and butcher shops in the present investigation.

According to the findings of the abattoirs assessment in this study, the majority of the facilities present were not in good condition. Abattoirs should be built outside of residential areas for the sake of the environment and the community. Meat processing activities can produce large amounts of wastewater, solid waste, foul odors, and fuel incineration emissions, all of which can adversely affect the health of those who live nearby (DARD, 2009). As observed during study period municipal abattoirs were not separated from industrial area, Bishoftu municipal abattoir and Adama municipal abattoir; crop farms, Mojo municipal abattoir; and residential buildings, Bishoftu municipal abattoir. This is in contrast with the Meat Safety Act.2000 and (KBS, 2017) requirements that abattoirs or meat plants be located in an area that is reasonably free of undesirable odors, smoke, and dust. High microbial load in the study conducted by (Haileselassie *et al.*, 2013) from the street meat sales was linked with the dust from environment. But, all abattoirs mentioned in this finding were prone to dust.

Following transportation, all food animals experience stress. As a result, it is important that a lairage provide a comfortable environment in order to relieve stress in the animals. In addition, to relieve stress, abattoir should have a lairage with an isolation pen for sick animals. But isolation pen for sick animals was not available in Bishoftu, and Adama municipal abattoirs. After having rest in lairage animals are transferred to slaughtering hall and stunned before slaughtering. Mechanical stunning devices can be penetrating or non-penetrating in nature. Non-penetrating guns look to be an acceptable option. Buncic *et al.* (2002) showed in an experiment that using a penetrating captive bolt (PCB) in sheep can lead to microbial contamination of stunned animals through the stunning area. But in abattoirs included in this assessment animals were stunned by piercing them in the foramen magnum with a sharp-edged knife.

Following stunning, all abattoirs accomplished bleeding on the floor in a horizontal position. Horizontal bleeding, while it increases faster bleeding rates RMAA (2011), is less hygienic than vertical bleeding. Furthermore, evisceration and flaying of skin were done on the dirty floor of the Bishoftu municipal abattoir. This could expose the carcasses to blood and dirty from the skin. This would also contaminate the carcasses and compromise the meat's quality.

The separation of clean and dirty operations is the most important hygiene principle in processing. Working processes should be designed so that employees can work in either a clean or dirty area. Personnel may eventually be allowed to go from clean to unclean tasks, but only when they have changed their working clothing and washed their hands. But in this study, except Mojo municipal abattoir, meat handlers in abattoir were involved in the whole meat production process and had no specific work in slaughtering line.

There was no attachment for cold room at these abattoirs. Cooling facilities in Mojo municipal abattoir, and Bishoftu municipal abattoir were not available. Adama municipal abattoir also had a nonfunctional cooling facility. This absence of attachment to cooling facility, may be due to animals were slaughtered, carcasses are quartered, and dispatched to butcher shops on the same day. But, when number of the slaughtered animals is high slaughtering process start early in the night and meat stay hanging for several hours at room temperature until the night is over. In addition to abattoirs, all butcher shops had no cooling facilities for display. As a result in slaughterhouses, carcasses were preserved at room temperature and delivered to butcher shops through vehicles without refrigeration. Subsequently, the meat was displayed without out cover and cooler in all butcher shops, subjecting it to dust particles and flies. The meat could also be stored this way for hours until it is sold. The study area's mean annual temperature is estimated to be 20.2 °C (range: 10.9–29.5 °C) (Abebe, 2017), which is the optimum temperature for a wide range of spoilage and pathogenic organisms to develop to potentially hazardous levels. This has a significant impact on meat product quality and shelf life. In order to ensure the quality and safety of meat and meat products, cold chain management in meat storage and supply is necessary (Sani and Siow, 2014; Nastasijević *et al.* 2017).

Besides public health effects, abattoir threats include the possibility of pollution of the environment. In this study, the drainage system in Adama municipal abattoir and Bishoftu municipal abattoir was open and grated trench that trapped blood and other solid material drained with it and form a bad smell. In addition to this 21.6 % of butcher shops dispose waste material to open spaces nearby butcher shops. This is in agreement with other studies (Muinde

and Kuria, 2005; Haileselassie *et al.*, 2013) who revealed that appropriate waste collection and disposal were lacking, forcing vendors and abattoirs to dispose of garbage in their own place.

Production of safe and wholesome meat is the overall sum of facilities in abattoir and meat processing outlets, butcher shops, and meat handlers' practices in the meat production chain. Meat handling practices play an important part in improving the quality and safety of meat (Rani *et al.*, 2017). But this study indicated that 63.9 % of respondents from butcher shops and 64 % of respondents from abattoirs have poor hygienic practices. Males are most likely involved in meat processing, unlike other food industry (Adesokan and Raji, 2014; Jianu and Goleț, 2014). This is also true in this study. Only 8% of all abattoir participants were female, the rest participants from abattoirs and butcher shops were male. A univariable logistic regression in this study indicates trained meat handlers from abattoirs with (OR= 4.33, (95% CI=1.203-15.605), and from butcher shops with (OR; 2.412 (95% CI=1.21-4.79) are 4 times and 2 times more likely to be involved in good meat handling practices respectively. However, the majority of the respondents in this survey, (70%) from abattoirs and (82.6%) from butcher shops did not receive any training on how to handle meat in a hygienic way. Previous studies in Ethiopia have also found that a substantial proportion of meat handlers in abattoirs and butcher shops (Haileselassie *et al.*, 2013; Birhanu *et al.*, 2017; Gutema *et al.*, 2021) did not receive basic training on the hygienic handling of meat. Food safety training should be provided to employees in food establishments such as slaughterhouses and butcher shops (Sun and Ockerman, 2005). The Food and Agriculture Organization (FAO) also recommends it as an essential intervention to improve their skills (FAO, 2019). In addition to this, a certificate of competence from the official organ is also required for everyone working in the food serving industry (Federal Negarit Gazeta No. 9 13th January 2010).

Hot water, which is required for hand and knife rinsing to eliminate any surface pathogens and avoid further cross-contamination of meat (Codex Alimentarius Commission. General Principles of Food Hygiene. CAC/RCP 1-1969., 2013) was not available in abattoirs and butcher shops included in this study. This was in agreement to a study conducted by Gutema *et al.* (2021). Despite Ethiopia's membership in CAC, the current findings revealed a lack of compliance with CAC's requirements, which require the presence of an adequate and easily

accessible supply of hot and cold potable water at all times during meat handling for effective sanitizing of equipment and hand washing (Codex Alimentarius Commission. Code of Hygienic Practice for Meat CAC/RCP58-2005.1-51).

Hand and equipment washing with soap and water, storing leftover meat in refrigerators (80.9 %), concrete/tile floors (95.5 %), and white painted walls were good practices identified in butcher shops. These are in line with the requirements of Ethiopian proclamations and can improve with hygienic meat handling (Federal Negarit Gazeta No. 9 13th January, 2010; Codex Alimentarius Commission. General Principles of Food Hygiene. CAC/RCP 1-1969., 2013). However, displaying offal and meat in close proximity (39.4%), wrapping meat in either plastic bags or newspapers (53.5%), using plastic or wooden cutting boards (72.9%), and infrequent washing equipment and floors were all observed to be substandard practices that can lead to carcass contamination (Federal Negarit Gazeta No. 9 13th January, 2010; (Codex Alimentarius Commission. Code of Hygienic Practice for Meat CAC/RCP58-2005.1-51).

More than half of meat handlers (60 %) and a quarter of butchers (25 %) said they had not undergone a medical check-up in the preceding 6 months of the interview date, contradicting the Ethiopian regulatory body's requirement. Gutema *et al*, (2021) also showed irregular medical checkup of meat handlers in slaughterhouses and retail shops. Regular medical examinations would help to restrict the transmission of pathogens from sick or potentially carrier individuals to meat consequently to consumers (Gopinath *et al.*, 2012). Furthermore, stringent requirements regulation in the consistency of check-up frequency, as specified by the Oromia Health Bureau's requirements recommending the need for medical check-ups of all personnel in the food industry every three months is critical.

Overalls should be advisable to wear over other clothing because the purpose of wearing them is to protect both the food product and the meat handler from cross-contamination (Muinde and Kuria, 2005). More than half of respondents in butcher shops not wore apron (58.3%) and head cover (77.5%). The majority of participants from abattoir also did not wear, apron (70%), boots (58 %) and no one wore head cover. Moreover, none of the workers at slaughterhouses or butcher shops wore hand gloves. These proportions were found high than reported by Gurmu

and Gebretinsae (2013) who showed that 41.7 % of butcher workers did not wear aprons, and 58.3 % did not cover their hair in Mekelle city.

Frequent glove changes are not financially viable, such as Ethiopia. Therefore, frequent hand washing is a good practice to minimize cross-contamination and it also protects the worker from direct infection by microorganisms including *E. coli* and *Salmonella spp* (Gomes-Neves *et al.*, 2012). However, more than half of those interviewed (60%) at abattoirs and 15.3% in butcher shops said they didn't wash their hands before handling meat. This approach is also in noncompliance with the CAC's requirements, which mandate that food handlers should wash their hands at all stages of food processing to protect consumers from foodborne illnesses (Codex Alimentarius Commission. Code of Hygienic Practice for Meat CAC/RCP58-2005.1-51). The reason for high percentage of participant from butcher shops not washing hand before handling meat could be absence of hand washing basin in 83.5% of butcher shops, indicated in this study. According to Laban *et al* (2021) swabs taken from workers' hands had high bacterial counts , with the highest levels coming from a slaughterhouse.

The basic important requirements for ensuring the continued effective control of food hazards likely to contaminate food include frequent and scheduled cleaning of equipment and working surroundings in food facilities (Codex Alimentarius Commission. Code of Hygienic Practice for Meat CAC/RCP58-2005.1-51). But in this study equipment, floor, wall, and display cabinets were cleaned once per day in the majority of butcher shops (more than 58 %). According to the findings of this study, 7% of butchers collect money while serving meat. This is hardly distinguishable from earlier studies. Many butchers handled money while selling meat, according to Zerabruk *et al* (2019). As indicated by Gurmu and Gebretinsae (2013a), 91.7 % of handlers frequently handled money while handing out food. As it's full of microorganisms money cross-contamination can occur when foods are handled with bare hands, resulting in the introduction of microorganisms into safe foods.

There are some limitations to the study. As a data collection tool, the study used several questionnaires, which rely primarily on the responses of the respondents, which may or may not match to the actual situation. For example, 100% of the respondents at butcher shops and

abattoirs, wash their hand after going to the toilet, and after handling waste materials. Other operational facilities and hygienic practices that may affect the final finding are overlooked in the questionnaire and checklist for operational and hygienic practices. This was done to keep the respondent from becoming bored throughout the interview.

6. CONCLUSION AND RECOMMENDATIONS

This study showed that standard operational facilities, which support the production and processing of safe and wholesome meat in abattoirs and butcher shops were inadequate. Furthermore, the meat handling practices score regarding personal hygiene, frequency of cleaning equipment and surfaces, and regular medical checkups were low. Financial constraints may be a factor in developing countries like Ethiopia in providing the necessary facilities for food industries, however the poor hygienic practices found in abattoirs and butcher shops of this study, were probable to implement at a lower cost. Thus, frequent hand washing, proper wearing of available personnel protective materials, and proper allocation of abattoirs are applicable in all costs. Trained meat handlers in abattoirs and butcher shops employed in a good hygienic practices than the untrained and majority of respondents in this study were untrained. This study's findings of poor meat handling practices, and in adequate and nonfunctional facilities in abattoirs and butcher shops exacerbates pathways for meat borne pathogens to enter the meat supply chain which could lead to food borne diseases in human.

Based on this study findings the following recommendations are forwarded:-

- Abattoirs should take strong treatment measures against by products polluting environment as relocating these abattoirs might require large financial resource.
- Site selection and abattoir design should take into account of expansion and urbanization and to ease cleaning of premises.
- Abattoirs and butcher shops should be equipped with facilities that highly determine the hygienic production of meat such as cooling facilities, facilities for carcass dressing and processing.
- Awareness creation on hygienic practices of meat handlers through trainings on personnel hygiene and general meat handling practices to enhance production of safe meat and reduction of meat borne pathogens in meat supply chain

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8. APPENDICES

Annex 1 Questionnaire and check lists

I. Abattoirs

A. Observational Assessment of abattoir sites and facilities

Date_____

Name of abattoir_____

Table 1 Observational Assessment of slaughter sites and facilities

S.no	Assessment criteria	Abattoirs		
		Mojo Municipal abattoirs (Yes/No)	Adama Municipal abattoir (Yes/No)	Bishoftu Municipal Abattoirs (Yes/No)
	Abattoir location/ Site			
1.	Far from the residential area			
2.	Far from Industry			
3.	Far from crop farms			
4.	Free from Dust			
5.	Free access to the road connecting to it			
6.	Lairage			
	Abattoirs has drained lairage			
7.	Abattoirs have fencing that leads the animal to the slaughterhouse.			
8.	Abattoirs has slightly separated within a few distances from the slaughter area			
9.	Isolation pens for sick animals are available at abattoirs.			
	Rooms in slaughterhouses			

10.	Abattoir have the necessary equipment to handle hides and skins.			
11.	Separate facilities exist in abattoir for cleaning and treating intestines and offal.			
12.	Inedible and condemned animals, carcasses, and meat are stored, disposed of, and treated separately in abattoir.			
	Surfaces of walls, and floor			
13.	Surfaces of walls and floor are impervious to water			
14.	can be easily cleaned			
15.	Surfaces are resistant to wear and corrosion.			
	Other facilities			
16.	Before the meat is dispatched to the market, the abattoir contains cooling facilities that can decrease the temperature of the meat.			
	Well drainage system			
17.	During slaughtering and inspection, the abattoir has adequate lighting.			
18.	The abattoir has a fence that can be used to keep anyone from entering the compound.			
19.	Is there any footbath			
20.	Is there Veterinary laboratory			
21.	Is there Veterinary office			
22.	Is there a vehicle available to transport carcasses to the market or butcher shops?			

B. Hygienic handling practices at the slaughterhouse

Table 2 Questions for interview hygienic handling practices at the abattoirs

No.	Questions	Answers	Skip to
-----	-----------	---------	---------

iii.	Socio-demographic characteristics of individuals																						
1.	Age	Year completed-----																					
2.	Sex	Male [] Female []																					
3.	Level of Education:	Illiterate [] Informal Education [] Primary Education [] Secondary Education [] Other (Specify).....																					
4.	Your main role at the abattoir?	Stunning and bleeding [] De-hiding [] Evisceration [] Meat inspector []																					
5.	Duration of working at the abattoir (in years)																						
6.	Have you ever received training on meat handling?	Yes [] No []																					
iv.	Checklist for observations in the slaughter process																						
7.	Stunning before slaughter	Yes [] No []	8																				
8.	If yes, the method of stunning	----- -----																					
9.	Waiting time to start flaying after stunning?	Min----- ---																					
10.	Method of carcass dressing:	Vertical (hanging) Horizontal (on the floor):																					
11.	Is carcass washed after evisceration?	Yes [] No []																					
12.	Presence of sink for washing hands in the slaughterhouse:	Yes [] No []																					
13.	Use of the following protective materials while working in the abattoir? (observe)																						
	<table border="1"> <thead> <tr> <th rowspan="2">Protective materials</th> <th colspan="2">Response</th> </tr> <tr> <th>yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>Apron</td> <td></td> <td></td> </tr> <tr> <td>white coat</td> <td></td> <td></td> </tr> <tr> <td>Headcover</td> <td></td> <td></td> </tr> <tr> <td>Gloves</td> <td></td> <td></td> </tr> <tr> <td>Boots</td> <td></td> <td></td> </tr> </tbody> </table>		Protective materials	Response		yes	No	Apron			white coat			Headcover			Gloves			Boots			
Protective materials	Response																						
	yes	No																					
Apron																							
white coat																							
Headcover																							
Gloves																							
Boots																							
v.	Questions for face-to-face interviews																						
1.	Do you wash your hands before handling meat?	Yes [] No []																					
2.	Do you wash your hands after handling meat?	Yes [] No []																					

3.	Do you wash your hands after handling waste/garbage?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4.	Do you wash your hands after using the toilet?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5.	Do you wash your hands with soap?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
6.	Source of water for use in the abattoir?	City/Municipal council <input type="checkbox"/> borehole <input type="checkbox"/> rain collected water <input type="checkbox"/> River <input type="checkbox"/> others (specify) <input type="checkbox"/>	
7.	Do you smoke inside meat production areas?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
8.	Do you remove your rings, and watch while producing meat?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
9.	Do you handle/process meat while you are ill?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
10.	Do you handle meat when you have cuts, wounds, or injuries on your hands?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
11.	Do you eat or drink at your workplace?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
12.	Do you replace knives or sterilize them after meat processing?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
13.	Have you gone for medical checkups in the last 6 months?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
14.	How frequently do you go for medical checkups?	Once per year <input type="checkbox"/> Every three months <input type="checkbox"/> Every six months <input type="checkbox"/> others(specify)----- ---	

II. Butcher shops

Study area_____

1. Basic information

1.1.Date_____

1.2.Questionnaire Code_____

Table 3 Questions for a face-to-face interview and a checklist for direct observation at butcher shops to assess hygienic meat handling practices

	Questions	Response	Skip to
i. General characteristics of individuals			
1.	Age	Years completed---- ----	
2.	Sex	Male [] Female []	
3.	Level of Education:	Illiterate [] Informal Education [] Primary Education [] Secondary Education [] Other (Specify)...	
4.	Duration of selling meat in retail (butcher) outlet?	Years completed---	
5.	Have you ever received any training on the hygienic handling of meat	Yes [] No []	
ii. Checklist for Observations of butcher shops			
1.	Is there any cover on the display case?	Yes [] No []	
2.	The Butcher shop floor is made of?	Tile [] wood earthen material [] concrete[] others(specify)	
3.	Wall painted with white color	Yes [] No []	

4.	If yes, is there a sign of dirt on the wall?	Yes [] No []															
5.	What is the ventilation status of the display case and butchery	Good [] Fair [] Poor []															
	Good ventilation allows airflow into the butchery but sieves off dust and other particles [] Fair ventilation allows airflow but does not sieve dust or other particles or allows very little airflow [] Poor ventilation does not allow airflow at all []																
6.	Is there use of bulbs in the display case	yes [] No []															
7.	Presence of a meat cooling facility at the display cabinet	Yes [] No []															
8.	Do you use the following protective materials while selling or handling meat?																
	<table border="1"> <thead> <tr> <th rowspan="2">Protective material</th> <th colspan="2">response</th> </tr> <tr> <th>Yes</th> <th>no</th> </tr> </thead> <tbody> <tr> <td>Apron/white coat</td> <td></td> <td></td> </tr> <tr> <td>Headcover</td> <td></td> <td></td> </tr> <tr> <td>Gloves</td> <td></td> <td></td> </tr> </tbody> </table>	Protective material	response		Yes	no	Apron/white coat			Headcover			Gloves				
Protective material	response																
	Yes	no															
Apron/white coat																	
Headcover																	
Gloves																	
9.	There is a sink for washing hands	Yes [] No []															
10.	Type/kind of cutting board used	Wood [] plastic [] Metal [] concrete [] Marble []															
11.	Presence of hot water baths for dipping knives?	Yes [] No []															
12.	Material to wrap meat for sale.	New paper [] Plastic [] Used paper [] Others []															
iii.	Questions for face-to-face interviews																
1.	What are the means of transporting meat from the abattoir to the retail shop?	Open vehicle [] Closed vehicle [] Animal transport (Cart horse) []															

2.	How frequently do you wash the protective (white coat and Apron)?	Once per day <input type="checkbox"/> Twice per day <input type="checkbox"/> once after every two days <input type="checkbox"/> once per week <input type="checkbox"/> others <input type="checkbox"/>				
3.	Do you wash your hands before handling meat?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
4.	Do you wash your hands after handling meat?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
5.	Do you wash your hands after handling waste/garbage?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
6.	Do you wash your hands after using the toilet?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
7.	Do you smoke inside meat processing areas?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
8.	Do you remove your rings, and watch while processing meat?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
9.	Do you handle/process meat while you are ill?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
10.	Do you handle the meat when you have cuts, wounds, or injuries on your hands?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
11.	Do you eat or drink at your workplace?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
12.	Do you wash your hand with soap	Yes <input type="checkbox"/> No <input type="checkbox"/>				
13.	What is your source of water for use in the butchery?	City/Municipal council <input type="checkbox"/> borehole <input type="checkbox"/> rain collected water <input type="checkbox"/> River <input type="checkbox"/> others (specify) <input type="checkbox"/>				
14.	How often do you wash the following butchery surfaces and equipment?					
	Knife	Cutting boards	Saw/Axes	Display cabinet	Hooks	Floors
Once per day						
Twice per day						
More than twice						

Once every two days						
Others (specify)						
15.	Ways of cleaning butchery equipment	Cold water only <input type="checkbox"/> , cold water with soap <input type="checkbox"/> hot water only <input type="checkbox"/> hot water with soap <input type="checkbox"/> wiping with pieces of fabrics <input type="checkbox"/> others (specify).....				
16.	Do you have routine control of flies in your butcher?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				
17.	If "Yes" what are the methods used to control flies?	Horsetail flies wetter <input type="checkbox"/> Roach killer <input type="checkbox"/> Fumigation <input type="checkbox"/> Fumigation and roach killer <input type="checkbox"/> Horsetail fly swatter and fumigation <input type="checkbox"/> No control				
18.	Where do you dispose of waste material?	Open space nearby <input type="checkbox"/> Municipal sewer <input type="checkbox"/> Soak pit <input type="checkbox"/>				
19.	How long does the meat stay in your butchery before it is over?	Less than 12 hours <input type="checkbox"/> one day <input type="checkbox"/> Two days <input type="checkbox"/>				
20.	Do you use a refrigerator for storage of the meat that remains from a daily sale?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
21.	Do you collect money while handling or selling meat?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
22.	Have you ever received any training on the hygienic handling of meat?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
23.	Have you gone for medical checkups in the last 6 months?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
24.	Do you go for a medical check-up?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
25.	How frequently do you go for a medical checkup?	Once per year <input type="checkbox"/> every three months <input type="checkbox"/> every six months <input type="checkbox"/>				

26.	Do you have different storage and display cabinets for offal and meat?	Yes [] No []	
27.	Do you use the same equipment while handling meat and the offal?	Yes [] No []	