



**COLLEGE OF AGRICULTURE AND NATURAL RESOURCES  
DEPARTMENT OF ANIMAL PRODUCTION AND TECHNOLOGY**

**ASSESSMENT ON THE MEAT HANDLING PRACTICES AT WOLKITE  
MUNICIPAL ABATTOIR AND BUTCHER HOUSES**

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# APPROVAL SHEET

## WOLKITE UNIVERSITY

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

DEPARTMENT OF ANIMAL PRODUCTION AND TECHNOLOGY

Assessment on the Meat Handling Practice at Wolkite Municipal Abattoir and Butcher Houses

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## List of Abbreviations

CSA	Central Statistical Agency
DCB	Dry Cutting Beef
DFD	Dark Firm Dry
FAO	Food and Agriculture Organization of the United Nations
MB	myoglobin
MBO2	oxymyoglobin
PSE	Pale Soft Exudative

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## **ABSTRACT**

*A study was conducted from April 2019 to June 2019 for slaughtered cattle at municipal abattoir of Wolkite town. Since there is no report on the assessment for quality of meat, the study was conducted with the objectives, to assess the status of quality meat processing in Wolkite town Municipal abattoir and butcher houses. A total of 103 individuals (13 abattoir Worker and 40 butcher houses, 50 meat consumers) were selected and prepared for questioner, observation and conducted for survey. All abattoir workers uses unclean knives while 7 (53.8%) of them do not keep cleaning their clothes. Whilst eight of the respondents responded that unclean hand and equipment's as major causes of carcass contamination, five considered falling on the ground as a major source of contamination. Washing the hands before and after work is practiced by only three (23%) of the interviewees and all of the respondents did not test for medical and take training on the related issue. Among the forty butchers, all of them acquired meat selling skills from observations. Thirty five (87.5%) of the butchers did not use protective clothes and twenty one wash their hands with only water after work. All reported that they use a single knife for cutting meat and edible offal. Thirty six had worn jewelries and twenty three handled money while selling meat. Most butchers cleaned their shop and equipment's every day at end of the selling process by using water and clothes but five of them reported that uses soap in addition to water and clothes. From 50 meat consumers, Most of them 12(24%) reported that they suffered food poisoning of which had medical attention and received antimicrobials and were hospitalized. The symptoms of the cases were loss of appetite, diarrhea and weakness. Most 21(42%) reported that they prefer raw meat than others. While all of them reported that cooked meat is saver than other type of meat (Table 4). Most 26 (52%) of customers prefer meat with low cost than other criteria and 43 (86%) of them thank that meat slaughtered in abattoir is more safe than any other place. Therefore, meat provided to the town was found less hygienic and not safe for human consumption. Thus, urgent intervention program is essential to minimize the risk associated with consumption of meat contaminated with germs and other dirt materials. Finally, the authors recommended that the use of standardized procedures in slaughtering and handling of meat, provision of training on best practice of handling of meat for handlers and raising the level of awareness of people.*

**Key words:** *Abattoir, meat, slaughter, Wolkite*

# 1. INTRODUCTION

## 1.1. Back ground

Ethiopia has the largest cattle population in Africa about 53.99 million heads, 24- million sheep and 18 million goats (CSA, 2013) and contributes 40% to the annual agricultural output and 15% total gross domestic product. Cattle produce a total of 1.5 million tons of milk and 0.331 million tons of meat annually (FAO, 2005). Meat, an excellent source of protein in human diet, is highly susceptible to microbial contaminations, which can cause its spoilage and food borne infections in humans resulting in economic and health losses (Ahmad *et al.*, 2003). It is the most perishable of all important foods since it contains sufficient nutrient needed to support the growth of microorganisms.

The beef meat contains 70-73% of water 20-22% of protein and 4.8% of lipids. This chemical composition exposes beef meat to the contamination by spoilage and pathogenic bacteria when adequate hygienic measures during the preparation transport and, are not respected. In fact, tissue from healthy animals are sterile, however, it has been pointed that during slaughter, dressing and cutting, microorganisms came chiefly from the exterior of the animal and its intestinal tract, but that more added from knives, cloths, air, carts and equipment in general (Pal, 2012). Furthermore, meat is sold in the open markets on tables that are not well cleaned and disinfected. During the slaughtering process, the stages of skinning and the dressing were identified to be the critical points for carcasses microbiological contamination (Gill *et al.*, 2003).

Food safety is a matter of great concern and of public health importance in particular when the environment in which the food handled concern and of public health importance in particular when the environment in which the food handled is heavily contaminated. Contamination of meat can occur in multiple steps along the food production chain including production, processing, distribution, retail marketing and handling or preparation (Zhao *et al.*, 2001). The abattoir environment and slaughtering processes play a vital role in the wholesomeness and meat safety. The Unhygienic practices in abattoirs and post-process handling are associated with potential health risk to consumers due to presence of pathogens in meat and contaminated equipment (Abdullahi *et al.*, 2006). Effluent from slaughter houses are known to contribute in contamination of both surface and ground water since during processing in abattoir blood, fat, manure, urine and meat tissues are discharged to the waste water streams (Bello and K 2009). Spoiled meats and meat products are inedible mainly due to off -odor and flavor, but consumer rejection is also due to discoloration, blown packages, souring, surface slime and other alterations of meat quality.

However, meat may also contain pathogens without showing signs of deterioration (Zamudio *et al.*, 2006). With this regards consumption of contaminated foodstuffs especially from animal products such as meat from infected animals or carcasses contaminated with pathogenic bacteria such as, *Salmonella spp.*, *Staphylococcus spp.*, *Streptococcus spp.* and *E. coli*. Precedes many food borne illnesses with human health consequences ranging from illness to death (Iroha *et al.*, 2011)

Ethiopian meat production and marketing system has been plagued by lack of quality and sanitation, prevalence of disease and unqualified meat production process. There is limited information on the microbial quality or microbial load level of Ethiopian beef that is being retailed in different outlets and this poses a health risk to consumers (Gebeyehu *et al.*, 2013). Food contamination with antibiotic resistant bacteria can be a major threat to public health as the antibiotic resistance determinants can be transferred to other pathogenic bacteria potentially compromising the treatment of severe bacterial infections (Silbergeld *et al.*, 2008). Assessment of Sanitation and hygiene of meat handling practices would help to for hygienic meat handling to reduce meat losses is recommend. Determination of microbial quality of meat would create awareness on the microbial safety of meat and propose mitigation measure to reduce contamination and hence meat losses.

Profitability in any venture has model the meat industry to aim towards producing animals that are efficient feed converters, fast growing and have high lean meat content with minimum production cost. These have also resulted in the production of animals that are much more susceptible to stress and consequently the development of meat quality defects such as Pale Soft Exudative (PSE) and Dark Firm Dry (DFD) meats. Other quality defects such as blood spalh bruising, skin blemish, poultry cyanosis, two-toning, spoilage of meat, broken bones and death (Forrest, 2010) have been identified. However, PSE characteristic meat has been reported in chickens (Swatland, 2008) and cattle (Aalhus *et al.*, 1998) in recent times.

Quantity and quality determine the price consumers are prepared to pay for meat and meat products. As the live animal is converted to meat, and the meat moves along the line of distribution (from slaughter, processors, retailers and finally to the consumer), quality becomes increasingly important and the quality characteristics change (O'Neill *et al.*, 2003). PSE and DFD meats look unattractive and discriminated against by consumers (Viljoena *et al.*, 2002). Vehicles for transporting animals must provide them with enough ventilation and should be well maintained. Provide shade, water and feed for the animals (especially if the animals will keep

long in the market). To avoid long marketing times, Warriss (2000). Overcrowding should be avoided as it increases the incidence of PSE and DFD in meats due to stress (Gua`rdia *et al.*, 2005).

Animals waiting for slaughter can be stressed by factors such as restraint, handling, and novelty of the pre slaughter environment, adverse weather conditions, hunger, thirst and fatigue. At the abattoir animals should be rested enough to recover from stress before slaughtering. Sugar or molasses feeding has been shown to replenish muscle glycogen levels thus helping to prevent DFD. Provide animals with food and water if they will spend more time in the lairage although this must be avoided. Provide beddings or straw on the floor if the animals will keep longer than expected in the lairage. Animals can be sprayed with mist water to cool them down especially when the weather is hot. Lairage time should also be kept short. Nanni Costa *et al.* (2002) also found that lairage time is the most important preslaughter factor contributing to DFD meats among the factors they investigated.

## **1.2. Statement of the problem**

The population of livestock in our country is high. However production of meat and its quality is low, due to poor carcass handling, poor slaughter house practices, longer journey, inappropriate storage of equipments and other factors reduce the meat quality and meat yield of the animals. So, far study will be not carried out in Gurage zone.

## **1.3. Significance of study**

The study is significance to identify the status of quality meat processing and give awareness on the cause of meat contamination and also give how to increase the shelf life of meat for the society. As the result of the research provide various purposes for individuals, NGOs, government and the general public that engaged in quality meat.

## **1.4. Objectives**

### **1.4.1. General Objective**

- To asses status of meat handling practice in Wolkite town Municipal abattoir and butcher houses

### **1.4.2. Specific Objectives**

- To identify influences affecting meat quality at the study area.
- To investigate quality meat processing in Wolkite town Municipal Abattoir and butcher houses

## 2. LITERATURE REVIEW

### 2.1. Meat and Meat quality

Meat can be defined as “the muscle tissue of slaughter animals. Meat which refers to meat flesh, skeletal muscles, connective tissues or fat and it contains high biological value protein and important micronutrients that are needed for good health throughout life (Ikema 2000). Meat is highly nutritious and rich in proteins, consequently serves as a good substrate for microbial growth (Rahmann *et al.*, 2005). Meat is not only rich in protein but also has complete and balanced essential amino acids (Schurgers and Vermeer 2000).

It is composed of water, fat, protein, minerals and a small proportion of carbohydrate. Protein contents and values define the quality of the raw meat material and its suitability for further processing. The beef meat will be damaged more quickly if it has a higher number of initial microbes (Nursiani 2003).

Meat processing includes all the processes that change fresh meat with the exception of simple mechanical processes such as cutting, grinding or mixing (Pearson and Tauber 2012)

Meat quality is important for consumers when it comes to making purchasing decisions, the quality is a combination of chemical, microbial and sensorial attributes (Madruga *et al.*, 2009). Meat from goats has gained acceptance mainly because of its lower fat content than beef and lamb meat. Therefore, it requires low-heat and slow cooking to preserve tenderness and juiciness (Madruga *et al.*, 2008). There is a general conception that goat meat is inferior to other species meat in tenderness (Lee *et al.*, 2008). Compared to sheep, goat meat tends to be less tender, with high shear force values and collagen content (Webb *et al.*, 2005). Carcass composition is another important aspect of meat quality and is normally assessed by amount of physical dissected tissues (muscle, fat and bones) or chemical. Chemical composition of sheep and goats at the same slaughter weight, age or under similar feeding management (Santos *et al.*, 2008).

Generally key determinant of meat quality is pH. The ultimate pH is determined 24 hours post-slaughter, using a pH meter. Good quality meat usually has a pH of 5.4–5.7. The muscle of a living animal has a pH of 7.1. The extent to which pH is lowered after slaughter depends on the amount of glycogen in the muscle prior to the animal's death. And Meat color is an important parameter in meat quality. Color is also greatly affected by muscle pH. Meat color is also affected by diet (Ameha, 2006).

## **2.2. Factor affect meat quality**

Improper and poor pre-slaughter handling of animals during farming, loading, transporting, marketing, unloading, lairaging and stunning have several effects on carcass yield and meat quality. Notably among these are; mortality, low carcass yields, blood splash, bruises, broken bones, skin blemishes, contamination by pathogens and PSE and DFD most common one. (Adzitey & Huda 2012) reported that poor carcass quality reflects in poorer meat quality. Packaging plays an important role in the food industry because it helps to protect the product against environmental effects, communicates with consumers as a marketing tool, and provides them with ease of use and timesaving convenience (Yam *et al.*, 2005).

### **2.2.1. Inappropriate Packaging**

Packaging plays an important role in the food industry because it helps to protect the product against environmental effects, communicates with consumers as a marketing tool, and provides them with ease of use and timesaving convenience (Yam *et al.*, 2005). The shelf-life and quality of fresh meat are strongly influenced by initial meat quality, package parameters, and storage conditions (Zhao *et al.*, 1994). Fresh meat display the color of meat plays a big role as it is always correlated with freshness and quality by the consumer (O'Grady *et al.*, 2000). The package protects products against deteriorative effects, which may include discoloration, off-flavor and off-odour development, nutrient loss, texture changes, pathogenicity, and other measurable factors (Yam *et al.*, 2005). The logistical function of packaging serves mainly to protect the product during movement through distribution channels (Silayoi & Speece, 2007). Meat color changes during display as myoglobin pigments on the meat surface transform on exposure to oxygen from primarily purple deoxymyoglobin to red oxymyoglobin and finally to brown metmyoglobin (Calnan *et al.*, 2014).

### **2.2.2. Poor carcass handling**

The methods of handling of carcasses play an important role in product quality and shelf-life of meat and meat products. (Adzitey & Huda 2012) reported that poor carcass quality reflects in poorer meat quality. Important technological meat quality attributes include colour, marbling, pH, tenderness, juiciness, and flavour; (Muchenje *et al.*, 2009). Should these be affected, profitability would also be influenced negatively Grunert *et al.*, (2004). Faulty meat handling, besides affecting the quality and shelf-life of meat and processed products, may endanger the health of consumers. Any carcass that is not approved for consumption after inspection is condemned, and

does not enter the market (Adzitey & Huda 2012). Condemnation may be partial or total, depending on the extent to which the meat has been affected. Huge economic losses have been experienced in the meat industry owing to the condemning of carcasses (Alton *et al.*, 2010). Many post-slaughter practices contribute significantly to the quality of meat, which in turn affect profits, functional properties, eating qualities and the acceptance of the meat by consumers (Adzitey & Huda, 2012).

### **2.2.3. Impact of stress**

PSE and DFD affect all splinters in meat and this will be dangerous to the consumer if not detected after species although nowadays both conditions have been suggested to occur in all species (Adzitey and Nurul, 2010). PSE and DFD meats are unattractive and more likely to face discrimination by consumers. Pale soft exudative and dark firm meats are very important meat quality problems that continuous to bedevil the meat industry. The determination of PSE, normal or DFD is also achieved subjectively or objectively by measuring meat color, pH and drip loss. Causes of PSE and DFD the most common factor leading to both PSE and DFD in meat is stress ante-mortem. DFD (also known as dark cutting in beef) is when the ultimate pH post mortem measured after 12 – 48 hours is  $\geq 6$ . For example in countries where the incidence of PSE is high a stricter pH value of  $< 5.8$  post mortem at 45 minutes can be used (Warriss 2000). Red, oxidative muscle fibres have relatively low concentration of glycogen which can easily be depleted post mortem. Conversely, white muscle fibres have relatively high glycogen and are prone to PSE. (Warriss 2000) said that for redder muscles especially those found around the neck and shoulder regions, a much higher pH value of  $< 6.3$  can be considered normal.

#### **2.2.3.1. Short term stress**

Exposing animals to acute stress just before slaughtering leads to PSE. Acute or short term stress that can lead to PSE include the use of electric goads, fighting among animal just before sticking, overcrowding in the lairage and beating of animals prior to slaughter (Warriss 2000). Acidification occurs in muscles post-mortem due to the breakdown of glycogen to lactic acid. In PSE meats, the rate of acidification after slaughter is stimulated faster than normal and lower pH values are reached in the muscle when the temperature of the carcass is still high (Bowker *et al.* 2000). The combination of low pH and high temperature in PSE meat causes the denaturation of some muscle proteins leading to reduction in their water holding capacity. This happens because

the myofibrillar components (the myofilament lattice) expel the resulting fluid into the extracellular space which increases in volume (Warriss 2000).

When such meat is cut the fluid is released resulting in the exudates. A large amount of exudates reflects poor water holding capacity as found in PSE meats (Bowker *et al.* 2000). (Warriss 2000) explained that, light scattering from meat surface is probably due to differences in refractive indices of the sarcoplasm and myofibrils. The larger the difference, the higher the scattering and the meat appears Pale, lean and soft texture (Bowker *et al.*; 2000). The shrinkage of my filament lattice increases the amount of light reflected from the meat. The low pH in PSE also promotes the oxidation of haem pigments from purple or red myoglobin (Mb) and oxymyoglobin (MbO<sub>2</sub>) to brown metmyoglobin (met Mb).

#### **2.2.3.2. Long term stress**

When animals are exposed to chronic or long term stress before slaughtering DFD meats can occur. (Warriss 2000) Long term stress prior to slaughter leads to the depletion of stored glycogen, thus less glycogen is available post-mortem affecting the normal process of acidification and leaving the pH of meat high. Exposing animals to chronic or long time stress such long hours of transportation, food and water deprivation and overcrowding of animals in the lairage can cause DFD .Dark firm dry meat looks dark, variations in tenderness, poor functional attributes and prone to spoilage. (Viljoena *et al.*, 2002). In DFD, (Warriss 2000) explained that, the high pH results in relatively little denaturation of proteins, water is tightly bound and little or no exudates is formed. This is because there is little or no shrinkage of the myofilament lattice and the differences in refractive index of the myofibrils and sarcoplasm are reduced. (Swatland 2008) the muscles absorbed light making the meat appear darker. Oxygen penetration is reduced by the closed structure and any oxygen reaching the interior is used up by the high cytochrome activity encouraged by the high pH (Warriss 2000).

#### **2.2.4. Poor transport condition**

Although vehicle transport on tarred roads are replacing common methods such as driving on hooves and gravel road in developing countries, Maria *et al.* (2003) reported that, long transport journeys on tarred roads before slaughter increased the risk of dry cutting beef (DCB). Such defaults can be reduced by resting animals in the lairage for 36hrs (Kuzmanvic and Elabjer, 2000). Most of the vehicles used for transporting animals are not roofed and they expose animals directly to the sun radiation (Menguni 2009). During transportation, animals are exposed to

environmental stress such as heat, cold, humidity, noise and overcrowding. Over speeding, sudden stops, rapid acceleration and long journey times without appropriate rest should be avoided as these will increase the spate of carcass and meat quality defects. Careful loading and unloading conditions has been suggested by (Adzitey and Nurul 2010).

#### **2.2.5. Mixing of different social groups**

Prior to transportation to the slaughterhouse or at the slaughterhouse, cattle from different social groups are gathered to a handling point, if there is any or are just driven to the slaughterhouse as groups from different pens or households (Grandin, 2000). During this period, different social groups from different pens are mixed thus influencing flight zones and individual distances or social distances between and within animal groups (Mnguni, 2009). Poor transport condition Although vehicle transport on tarred roads are replacing common methods such as driving on hooves and gravel road in developing countries, (Maria *et al.* 2003) reported that, long transport journeys on tarred roads before slaughter increased the risk of dry cutting beef (DCB). The mixing of cattle during transport may cause them to fight with each other, which in turn is an important behavioral measure of welfare during transport. Similarly, cattle that were regrouped on a stationary vehicle expressed higher frequencies of exploratory behaviors, sexual behavior, and were head-butting each other more as compared to resting values (Muchenje *et al.*, 2009).

#### **2.2.6. Poor handling and slaughter house conditions**

In most smallholder farming areas, animals in holding pens are stressed due to lengthy durations at market places, during auctioning or at the lairage, poor handling facilities and introduction metabolism on the animal and may be the reason of depleted muscle glycogen pre- and post-mortem thus, less into different social groups resulting in fights, bullying, bruises and mounting Grandin, 2000). Such situation influence cattle well-being Muchenje *et al.*, (2009) and leads to decreases in glycogen levels below the critical threshold levels, thereby raising meat pH Warris, (2000) and consequently imposes detrimental effects such as reduced beef keeping quality and dark cutting. Despite recent reports in Nguni and Bonsmara cattle Voisinet *et al.*, (2009), information on the biochemical changes that take place in relation to stress responsiveness and the depletion of glycogen and its effect on beef quality of most indigenous cattle breeds.

### **3. MATERIALS AND METHODS**

#### **3.1 Description of the study area**

The study was conducted in Wolkite town. The town is located in Gurage zone of Southern Nations, Nationalities and Peoples Regional State (SNNPRS), Ethiopia, which is located at 158 km south west of Addis Ababa. According to the 2007 CSA report, Guraghe Zone has a total population of 1,577,074 (8.5%) people of which 763,643 (48.4%) are males and 813,431(51.6%) are females. The agency also has indicated that 121,603 (9.49%) people living in urban areas. In addition, the study area has a total of 28,856(1.98%) people living in the rural villages, of which 15,068 (52%) males and 13,788 (48%) females. The Wolkite Town is geographically located in the Rift Valley Region at latitude of 8° 17' North and longitude of 37° 47' East; and has an average altitude of 1850m Above Sea Level. It lies in the ranges of 1500-2400m a. s. l. The study area has two periods of rainfall, the main and short rain seasons, which occur during June to September and March to April, respectively (Aynalem, 2007).

#### **3.2 Sample Size and Sampling Methods**

The data was collected both from primary and secondary sources in order to get the accurate information about meat Handling practices in Wolkite town municipal abattoir and butcher houses. Primary source of data were gathered by interviewing abattoir's workers, butcher houses and meat consumers by preparing questionnaire. Then, the numbers of abattoir worker and butcher houses were selected based on simple random technique. The study was carried out by selecting a total of 103 respondents (13 abattoir workers, 40 butcher houses and 50 meat consumers). From this study preparing questioner, observation and survey was conducted.

The secondary data were incorporated by means of different kinds of documents, internet sources, books, different journals.

#### **3.3 Method of Data Analysis and Interpretation**

The collected data was coded and tabulated for analysis by Microsoft office excel sheet. Descriptive statistics such as maximum, minimum, frequency and percentage are used for analyzing data, the interpretation will be expressed in clear, precise and in detail descriptions.

## 4. RESULTS

### 4.1. Questionnaire and observational survey

#### 4.1.1. Abattoir workers

Table 1 shows the knowledge, attitudes and practices of abattoir workers in relation to important parameters that potentially can influence the quality and safety of meat. All workers use unclean knives while other 7 (53.8%) of them do not keep cleaning their clothes.

Table 1 the knowledge, attitudes and practices of abattoir workers

Factors	Values frequency		Percentage (%)
Educational status	Illiterate	4	30.7
	Grade 1-8	6	46.2
	Grade 9-12	2	15.4
	Beyond grade 12	1	7.7
Placement in the abattoir	slaughtering	5	38.5
	loading	4	30.5
	washing stomach	4	30.8
Job related training	yes		
	No	13	100
Job related medical test	yes		–
	No	13	100
Knowing contamination risk	Yes	5	38.5
	No	8	61.5
Clean clothing	Yes	6	46.2
	No	7	53.8
Hand washing	Before work	5	38.5
	After end of work	5	38.5
	Before and after	3	23
Using clean knives	Yes		–
	No	13	100

Whilst eight of the respondents responded that unclean hand and equipments as major causes of carcass contamination, five of them considered falling on the ground as a major source of contamination. Washing the hands before and after work is practiced by only three (23%) of the interviewees and all of the respondents did not test for medical and take training on the related issue. None of them responded that the faces, skin and dirty water could possibly cause carcass contamination. Most of interviewees consider that keeping hygiene is the role of the management while some of them think the role of management is setting standards for hygiene in abattoir and workers role is maintaining standards for hygiene in the slaughterhouse. Direct observations revealed the absence of water, sterilizer and carcass retention room in the abattoir. Knives were placed on the floor, in the (workers) mouth, and in the anus of a slaughtered and hanged animals. The protective clothes were unclean; blood tinged and frequently in contact with carcasses (Annex b). There were no separate compartments for final carcasses and animals to be slaughtered. The latrine is constructed far away from the abattoir and has no water, soap or other cleaning materials (Annex b).

#### **4.1.2. Butchers**

Table 2 shows the knowledge, attitudes and practices of butchers in relation to important parameters that potentially can influence the quality and safety of meat. Among the forty butchers, all of them acquired meat selling skills from observations. Thirty five (87.5%) of the butchers did not use protective clothes and twenty one wash their hands with only water after work. All reported that they use a single knife for cutting meat and edible offal. Most butchers cleaned their shop and equipment's every day at end of the selling process by using water and clothes but five of them reported that uses soap in addition to water and clothes.

Table 2 : attitudes and practices of butchers

Factors	Values	Frequency	Percentage
Educational status	Illiterate	15	37.5
	Grade 1-8	12	30
	Grade 9-12	8	20
	Beyond grade 12	5	12.5
Received job related training	No	40	100
Apron (protective clothes )	Yes	5	12.5
	No	35	87.5
Jewellery materials	Yes	36	90
	No	4	10
Hand washing	Before work	8	20
	After work	21	52.5
	During work	8	20
	Not washed	3	7.5
Manner of washing hands	Rinsing with water only	35	87.5
	Using detergents and water	5	12.5
	Not wash	-	-
Handling money	Butcher with bare hand	23	57.5
	Cashier	17	42.5
Cleaning Equipment's and Shop	Every days	-	-
	Every two days		
Use disinfectants	Yes	5	12.5
	No	35	87.5
Cutting Knife	Single	40	100

### 4.1.3. Consumers

The demographic characteristic of the 50 Meat consumers is presented in (Table 3) while the knowledge attitude and practice of the respondents is shown in table 4. 36% of them learned to high school and above while 10% of the respondents were uneducated and 84% of them were males (Table 3). Most of the respondents 12(24%) reported that they suffered food poisoning of which had medical attention and received antimicrobials and were hospitalized. The symptoms of the cases were loss of appetite, diarrhea and weakness. Most 21(42%) reported that they prefer raw meat than others.

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While all of them reported that cooked meat is safer than other type of meat (Table 4). Most 26 (52%) of customers prefer meat with low cost than other criteria and 43 (86%) of them think that meat slaughtered in abattoir is more safe than any other place.

Table 3 Demographic characteristic of the 50 meat consumers

Variable	Values	Frequency	Percentage (%)
Sex of respondents	Male	42	84
	Female	8	16
Age	9-28	12	24
	29-50	25	50
	51-90	13	26
Educational status	Illiterate	5	10
	Primary school	12	24
	Secondary school	18	36
	University	15	30

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Table 4 Knowledge, attitude and practice of the consumers

Variable	Values	Frequency	Percentage (%)
Priority criterion to purchase meat	Freshness	13	26
	Low cost	26	52
	Low fat content	6	12
	Healthiness	5	10
How to use meat	Fried	14	28
	Cooked	13	26
	Raw	21	42
	All type	2	4
Consume raw meat	Yes	32	64
	No	18	36
Think cooked meat is always safe to eat	Yes	50	100
	No		
History of food poisoning	Yes	12	24
	No	38	76
Meat slaughtered in abattoir is always safe to eat	Yes	43	86
	No	7	14

## 5. DISCUSSION

In the present study more than 46.2% of slaughter house workers and butchers had only a primary school education. Similarly all (100%) of slaughter house workers and butchers did not have job related training as regards to food hygiene but acquired their respective skills from observations. The results are in agreement with reports of (Mekonnin *et al.*, 2013) and (Endale and Hailay, 2013) who reported a primary school education and lack of job relating trainings in more than half of the slaughter house workers and butchers in Mekele town, Ethiopia. However training of meat handlers regarding the basic concepts and requirements of personal hygiene plays an integral part in ensuring safe products to the consumers (Adams and Moss, 1997) and food handlers should have the necessary knowledge and skills to enable them to handle food hygienically (FAO, 1990).

The majority of the abattoir workers proposed unclean hand and equipment as the major causes of carcass contamination, but none of them responded that the faces, skin and dirty water can cause carcass contamination. Besides, most consider that keeping hygiene is the role of the management while some of them think the role of management is setting standards for hygiene in abattoir and workers role is maintaining standards for hygiene in the slaughterhouse. It is well documented that, the fecal wastes from animal and humans are important source of bacterial contamination of the environment and foods chain (Ponce *et al.*, 2006), and many bacteria are widely distributed in the environment and in them intestinal tract of animals (Anjum *et al.*, 2011). Thus, this research result indicates that most of the abattoir workers does not know source of meat contamination and their responsibility in hygienic management of meat accurately. Therefore, they can contaminate meat with such source of contamination unknowingly. The workers could not know how to minimize the risk of meat contamination if they do not know the source of meat contamination properly and their role in hygiene of the slaughter environments.

Ill persons will often be carriers of more microorganisms (pathogenic microorganisms) than is usually the case. These microorganisms may then be transmitted to the meat/food with the risk of causing disease to the consumers. Illness must always be reported to the manager and/or the meat inspector of the slaughterhouse who will decide if the worker can stay or has to leave (Skaarup, 2011). Contradictory, this study result specify that among the respondents from abattoir house workers All (100%) of them reported that they never experienced job related medical test while 40% of them taken job related medical test once only in their work duration. In addition the

respondents complained that even when they get ill the managers do not allow them to leave and to take rest and they complained that the managers were not professionals. The managers also indicated this problem occurrence is due to the demand of meat and the manpower in the slaughtering house for the area is not equivalent as a result every worker forced to work twenty seven days per month. This problem could be major source of meat contamination due to inappropriate processing of carcass and from ill persons working in the abattoir, which could be risk for the consumers.

Furthermore, every worker accountable in slaughtering activity allowed slaughtering about forty to sixty five cattle per day and every process from cutting the throat to final carcass preparation was covered by few personnel. As a result majority of the respondents complain that in the abattoir working quickly is preferred than slaughtering hygienically. Therefore, the workers worry is only to finish that all rather than slaughtering hygienically. This could be result in occurrence of high cross contamination of carcass which might be a risk for the consumers. This problems could be because of the managers are not professionals, to solve such problems they them self do not have the knowledge of food safety and hygiene.

The slaughtering process was unhygienic and unsanitary. There was no hot water, sterilizer and retention room and equipment rest on dirty surfaces. However, (Akafete and Haileleul, 2011), reported that eviscerating knife significantly associated with carcass contamination and specific attention must be given to sterilization of knives. (Motsoela *et al.*, 2002) also indicated that, it is salutary to note that knives must be immersed in water for two minutes at 82 °C to reduce the number of contaminating microorganisms. Contradictory to these facts, in current study site the same knife was used without sterilizing to slaughter different cattle, for evisceration, cutting throat and skinning process. This could cause high carcass contamination with different food borne pathogens unless it is solved.

Correspondingly, it was found that the equipment used for slaughtering process was rested on dirty surface (Annex B) during working, for instance they put their knife on ground, in their mouth own, on skin of other killed animal and in the anus of the hanged carcass and use it as it is, use the material they putted on the ground to collect water for washing carcass repeatedly, their protective clothes were full of blood and dirty and were in contact with carcass while they take the finalized carcass to the final rail and loading. In summery this type of area and slaughtering

process can cause cross contamination of ready to eat meat at different stage. In the same way (D'Aoust, 1997) expressed that, all food that is produced or processed in a contaminated environment may become contaminated with germs and be responsible for outbreaks or separate cases of disease as a result of faults in transport, storage, or preparation. Therefore the risk of carcass contamination might be increasing until it reaches the consumers at different stage due to above listed predisposing factors such as in contact with dirt clothes while loading, transportation, contaminated water in use of contaminated materials repeatedly and moving from one rail to another rail.

The hygienic practices at the butchereries are unhygienic. Almost all butchers handle money with bare hands while processing meat and do not put appropriate protective clothes. (Endale and Hailay, 2013) reported that 91.7% of the butchers in Mekelle city handle money while processing the meat. In addition other study indicates that, Handling of foods with bare hands may also result in cross contamination, hence introduction of microbes on safe food. Because meat handlers are probable sources of contamination for microorganisms, it is important that all possible measures be taken to reduce or eliminate such contamination (Muinde and Kuria, 2005). As the paper money circulates among different individuals it could be contaminated with several pathogens including *Salmonella* and handling carcasses with bare hands that also handle such items may result in cross contamination. In addition most butchers wash their hands after the selling process and use only water with no detergents and use single knife for edible offal's and meat types and a single cutting board for all products without cleaning and sterilizing. The overall butchery practices are favorable for the contamination of meat.

Besides, all (100%) of the butchers reported that they clean their shop and equipment's every day at the end of selling process using water and clothes, except single person who uses soap in addition to water and clothes. Contradictory, documented data indicates problems in cleaning with water and cloth alone as follows; blood proteins can create particular problems on porous surfaces, often giving rise to green/brown. Aged protein deposits can be quite hard, normally not scraping off easily with a fingernail. In addition to this, soil deposits in a food plant would be bad enough if problem was simply their rather unsightly appearance. But the fact that they harbor, nourish and protect spoilage or pathogenic microorganisms that are invisible to the naked eye makes the job somewhat harder. The soil must, of course, be removed as completely as possible

by effective cleaning using the detergent. Water alone does not sufficiently wet to displace many types of soils or even to displace air from water- repellent or hydrophobic surfaces. In this case the water curls up under its own surfaces tension into droplets. Lack of wetting will prevent cleaning taking place. To achieve wetting of such surfaces, chemical agents who have particular surface properties are employed: ‘surfactants’ or ‘wetting agents’ (Gracey *et al.*, 1999).

In addition, 86% of the consumers interviewed from the study area considered that meat slaughtered in abattoir is always safe to eat and prefers to buy observing the stump and 76% of them do not know that meat as source of contamination. Therefore, consumers of this contaminated meat could be predisposed to contamination unknowingly without taking care during preparation and processing due to lack of information.

Respondents those reported history of food poisoning was specified that the symptom of their event were mostly loss of appetite, diarrhea and weakness. Correspondingly, (Reda *etal.*, 2011) reported that among 244 diarrheal stool samples collected from Hiwot Fana and Misrak Arbegnoch referral hospitals located in Harar which is closer to Dire Dawa, 28 (11.5%) of the case were found to be contaminated with bacteria. Therefore, symptom of their event could be associated with bacteria’s specially salmonellosis which might be transmitted to them from contaminated meat and other foods.

## 6. CONCLUSION AND RECOMMENDATIONS

The present study results revealed that improper handling of meat, presence of poor personal hygiene and sanitation, low level of public awareness about contamination of meat with bacteria's and the associated probable risk in the study area. Consequently, cattle meat provided to the consumers in the town was found to be poor quality and not safe for human consumption calling for urgent intervention. Based on the above conclusion the following recommendations are forwarded:

- Training programs must be provided on best practice of handling of meat for handlers and raising the level of awareness of people.
- The manager of the abattoir should be professionals who were well equipped with the concept of food quality and food safety.
- The number of abattoir works should be proportional with number of cattle slaughtered per day.
- Further study ought to be conducted to identify the source of contamination.
- The degree of the risk of consumption of meat contaminated with germs should be assessed.
- The use of standardized procedures and applications like hazard analysis and critical control point in slaughtering and handling of meat in the abattoir should be applied.

## REFERENCES

- Aalhus, J. L., Best, D. R., Murray, A. C. and Jones, S. D. M. 1998. A comparison of the quality characteristics of pale, soft and exudative beef and pork. *Journal of Muscle Foods* 9: 267-280.
- Abdullahi, I., V. Umoh, J. Ameh and M. Galadima, 2006. Some hazards associated with the production of a popular roasted meat (tsire) in Zaria, Nigeria *Journal of Food Control*, 17: 348-352.
- Adzitey, F. & Huda, N., 2012. Effects of post-slaughter carcass handling on meat quality.
- Adzitey, F. and Nurul, H. 2010. Pale Soft Exudative (PSE) and Dark Firm Dry (DFD) Meats: Causes and measures to reduce these incidences. *International Food Research Journal*.
- Ahmad, M., A. Sarwar, M. Najeeb, A. Nawaz, M. Anjum and N. Mansur, 2013. Assessment of microbial load of raw meat at abattoirs and retail outlets. *Journal of Animal and Plant Sciences*, 23: 745-748.
- Alton, G.D., Pearl, D.L., Bateman, K.G., McNab, W.B. & Berke, O., 2010. Factors associated with whole carcass condemnation rates in provincially inspected abattoirs in Ontario 2001-2007: Implications for food animal syndromic surveillance. *BMC Vet. Res.* 6, 42.
- Ameha Sebsibe. 2006. Meat quality of selected Ethiopian goat genotypes under varying nutritional conditions. Ph.D. Thesis. University of Pretoria, South Africa.
- Bello, M. and K. Son, 2009. Assessment microbiological load from meat contact surfaces, isolation of entero-pathogenic. *E. coli* at a meat processing plant, Russia. *Nigeria Veterinary Journal*, 30: 1-8.
- Calnan, H. B., Jacob, R. H., Pethick, D. W., & Gardner, G. E. 2014. Factors affecting the colour of lamb meat from the longissimus muscle during display: The influence of muscle weight and muscle oxidative capacity. *Meat Sci.* 96, 1049-1057.
- CSA, (2013) Central Statistical Agency of Federal Democratic Republic of Ethiopia, Agricultural sample survey Report on Livestock and Livestock Characteristics, Addis Ababa, Ethiopia.
- FAO (Food and Agriculture Organization of the United Nations), 2005. Production Year, Book. Food and Agriculture Organization, Rome, Italy, Pp. 32-40.

- Forrest, J. 2010. Meat Quality Problems. Download from [http://ag.ansc.purdue.edu/meat\\_quality/meat\\_quality\\_problems.html](http://ag.ansc.purdue.edu/meat_quality/meat_quality_problems.html) on 11/06/2010.
- Gallo, C., Lizondo, G. and Knowles, T.G. 2003. Effects of journey and lairage time on Steers transported to slaughter in Chile. *Veterinary Record* 152:361-364 s.
- Gebeyehu, A., M. Yousuf and A. Sebsibe, 2013. Evaluation of microbial load of beef of Arsi cattle in Adama town, Oromia, Ethiopia. *Journal of food Process Technology*, 4: 6-10.
- Gill, C., J. Bryant and C. Landers, 2003. Identification of critical control points for control of microbiological contamination in processes leading to the production of ground beef at a packaging plant. *Journal of Food Microbiology*, 20: 641-643.
- Grunert, K. G., Bredahl, L. & Brunsø, K., 2004. Consumer perception of meat quality and implications for product development in the meat sector: A review. *Meat Sci.* 66, 259-272.
- Gua`rdia, M. D., Estany, J., Balasch, S., Oliver, M. A., Gispert, M. and Diestre, A. 2005. Risk assessment of DFD meat due to pre-slaughter conditions in pigs. *Meat Science* 70: 709-716.
- Ikema AI (2000) Meat science and technology. A comprehensive approach. African-FEB Publishers Ltd. Onitsha, Nigeria, pp. 29-65.
- Iroha, I., E. Ugbo, D. Ilang, A. Oji and T. Ayogu, 2011. Bacterial contamination of raw meat sold in Abakaliki, Ebonyi State, Nigeria. *Journal of Public Health and Epidemiology*, 3: 49-51.
- Kuzmanvic Z, Elabjer I (2000). Influence of pre slaughter resting time on bulls on Meat temperature, color and pH value. *Czech J. Anim. Sci.* 45: 511-518.
- Lee, J. H., G. Kannan, K. R. Eega, B. Kouakou and W. R. Getz. 2008. Nutritional and quality characteristics of meat from goats and lambs finished under identical dietary regime. *Small Rumin. Res.* 74:255-259.
- Mahlangu D (2009). ANC joins row over bull-killing ritual. TimeLIVE. Available Online <http://www.timeslive.co.za/news/article218055.ece>. Accessed On 6 December 2009.
- Maria GA, Villarroel M, Sanudo C, Olleta JL, Gebresenbet G (2003). Effects of transport time and ageing on aspects of beef quality. *Meat Sci.* 65: 1335-1340. *Meat Science* 81: 653-657.

- Meng, 2001. "Prevalence of *Campylobacter* spp., *Escherichia coli* and *Bacillus cereus* serovars in retail chicken, turkey, pork and beef from the Greater Washington, D.C., area. *Journal of Applied Environmental Microbiology*, 67: 5431-5433.
- Muchenje, V., Dzama, K., Chimonyo, M., Strydom, P. E. and Raats, J. G. 2009. Relationship between preslaughter stress responsiveness and beef quality in three cattle breeds.
- Nanni Costa, L., Lo Fiego, D. P., Dall, O. S., Davoli, R., and Russo, V. 2002. Combined effects of pre-slaughter treatments and lairage time on carcass and meat quality in pigs of different halothane genotype. *Meat Science* 61: 41-47.
- Nursiani. (2003) Bacteriological Condition of Microbial Load in Beef Meat at Karombasan Traditional Market. Politeknik Kesehatan, Manado.
- O'Grady, M. N., Monahan, F. J., Burke, R. M. & Allen, P. 2000. The effect of oxygen level and exogenous  $\alpha$ -tocopherol on the oxidative stability of minced beef in modified atmosphere packs. *Meat Sci.* 55, 39-45.
- O'Neill, D. J., Lynch, P. B., Troy, D. J., Buckley, D. J., Kerry, J. P. 2003. Influence of the time of year on the incidence of PSE and DFD in Irish pigmeat. *Meat Science* 64: 161-164.
- Pakistan. *Vet. J.* 32, 161-164.
- Pal, M., 2012. Raw meat poses public health risks. *The Ethiopian herald*, May, 15: 2-3.
- Pearson and Tauber 2012. Characterization of Cattle Meat Production, Processing and Marketing System in Metema District, Ethiopia. Msc Hawassa University, Awassa.
- Rahmann MS, Salman Z, Kadim IT, Mothershaw A, Al Riziqi MH, (2005) Microbial and physico-chemical characteristics of dried meat processed by different methods. *Int J of Food Engineering* 1(1): 1-14.
- Santos, V. A. C., Silva S. R. and Azevedo J. M. T. 2008. Carcass composition and meat quality of equally mature kids and lambs. *J. Anim. Sci.* 86:1943-1950.
- Schurgers, L. and Vermeer, C. (2000) Determination of phylloquinone and menaquinones in food. Effect of food matrix on circulating Vitamin K concentrations. *Haemostasis*, 30(6): 298-307.
- Silayoi, P. & Speece, M., 2007. The importance of packaging attributes: a conjoint analysis approach. *Eur J. Mark.* 41, 1495-1517.

- Silbergeld, E., L. Price and J. Graham, 2008. Antimicrobial Resistance and Human Health. Retrieved from Pew Commission on Industrial Farm Animal Production available
- Soyiri, I., H. Agbogli and J. Dongdem, 2008. A Pilot microbial assessment of beef in the Ashaima Market, a suburb of Accra Ghana. *African Journal of Food Agriculture Nutrition and Development*, 8: 91-93.
- Swatland, H. J. 2008. How pH causes paleness or darkness in chicken breast meat. *Meat Science* 80: 396-400.
- Viljoena, H. F., de Kocka, H.L. and Webbb, E.C. 2002. Consumer acceptability of dark, firm and dry (DFD) and normal pH beef steaks. *Meat Science* 61: 181- 185.
- Viljoena, H. F., de Kocka, H.L. and Webbb, E.C. 2002. Consumer acceptability of dark, firm and dry (DFD) and normal pH beef steaks. *Meat Science* 61: 181185.
- Warriss, P. D. 2000. *Meat science: An introductory text*. CAB-International: Wallingford.
- Webb, E. C., Casey N. H. and Simela. L. 2005. Goat meat quality. *Small Rumin. Res.* 60:153-166. USAID, 2011. Ethiopia FY 2011- 2015 Multi-Year Strategy. Rep. Feed the Future (FTF). [feedthefuture.gov](http://feedthefuture.gov)>
- Yam, K. L., Takhistov, P. T. & Miltz, J., 2005. Intelligent packaging: Concepts and applications. *J. Food Sci.* 70: R1-R10
- Zamudio, M., Y. Hui, I. Guerrero and M. Rosmini, 2006. Microorganisms' pathogens alternate, in *Ciencia the Technologies of Carnes*, NoriegaEditores, Mexico City, Mexico, pp: 342-355.
- Zhao, C., B. Ge, J. DeVillena, R. Sudler, E. Yeh, D. White, D. Wagner and J. Meng, 2001. "Prevalence of *Campylobacter* spp., *Escherichia coli* and *Bacillus cereus* serovars in retail chicken, turkey, pork and beef from the Greater Washington, D.C., area. *Journal of Applied Environmental Microbiology*, 67: 5431- 5433.
- Zhao, Y., Wells, J. H. & McMillin, K. W., 1994. Applications of dynamic modified atmosphere packaging systems for fresh red meats: review. *J. Musc. Foods.* 5,299328.

## APPENDIX

QUESTIONER SURVEY FORMAT AND OBSERVED HYGIENE PRACTICE RECORD FOR KNOWLEDGE, ATTITUDE AND PRACTICE ANALYSIS OF DIFFERENT KEY INFORMANTS ALONG THE MEAT PATHWAY.

### A.ABATTOIR WORKERS

Date-----Questionnaire number-----

1. Name of slaughter house-----
2. Name of respondent -----
3. Educational status: **a)** Illiterate **b)** Grade 1-5 **c)** Grade 6-8 **d)** Grade 9-12 **e)** Grade >12
4. Placement in slaughterhouses process:  
a) Stunner b) cutting the throat c) flayer d) Eviscerator e) Splitter f) Carcass washer g) All h) other (specify)

#### I. Knowledge

1. How do you handle animals presented for slaughter? \_\_\_\_\_
2. Did you receive any job related training? **a) Yes** **b) No**
3. If yes for Q<sub>2</sub>; where were you trained? -----
4. If there was no formal training have you received informal training? -----
5. Have you undergone any job related medical tests to work in the abattoir? **a) Yes** **b) No**
6. When was your last medical test done? a) one month b) two month c) three month  
d) six month e) one year
7. What would cause carcass contamination? **a.**Faeces**b** Dirty water **c.** handling with dirty equipment and hands **d.** Other (specify).....
8. If carcass was contaminated by faeces, what would you do? (Open question)  
a) Nothing **b.** Wash the carcass **c.** Call the meat inspector for advice  
**d.** Other (specify).....
9. In your opinion, does contamination pose any health risk to meat consumers? **a) Yes**  
**b) No**
10. If No, why? -----

## II. Attitude

I will read you some statements about hygiene in the slaughter process. Please indicate whether you agree or disagree. Key: SA= strongly agree, A =agree, D=Disagree, SD=strongly disagree, and DK= don't know

	Question	SA	A	D	SD	DK
1	In this job, it is important to work quickly than keep the Carcasses clean.					
2	People doing this job are more likely to get sick					
3	In this type of working environment keeping clean is Easy					
4	A small amount of dirt on clothing or utensils will not cause any harm					
5	Health is more important than wealth					
6	Ensuring hygiene is mainly the role of management					
7	If meat is well-cooked then it is always safe to eat					

### Practices (Butcher observation checklist)

Questions	Response
Cuts/wounds covered with an appropriate waterproof dressing.	Yes                      No
Smoking or eating or chewing while working	Smoking----- chewing-----
Clothes clean and completely free from any dirty or blood	Yes-----No----- ---
Hand washing before after and during cutting meat	Before -----After --- ----- During -----
How washed? Running water or bucket? Hot or cold? Brush or cloth? Soap?	Running water----bucket-- ----Hot----- cold----- Brush-----cloth----- Soap-----
All knives are completely clean and free from dirt and cracks and damages	Clean -----undamaged ---- --
Knives are cleaned before after and during use	before -----after----- during use----- -

How often and when do you wash the equipment?	Every day at end of the process----- Once per week-----once per month----- other(specify)-----
Is any disinfectant used? Write name of disinfectant	Yes-----No-----
The source of water used in abattoir	Tap---Well---Water vendor---- other---
Latrine has water soap paper towels for hand washing	Water----soap----paper---- towel-----tissu----- paper-----
Equipments rested in dirty surface during working	Yes-----No-----
Strict separation between clean and dirty areas	Yes-----No-----
Veterinary inspectors present to examine the meat to be sold.	Yes-----No-----

### III. Perceptions

1. What constraints do you experience in your work? -----
2. Do they affect your ability to achieve high levels of hygiene? -----
3. If Yes, in what way? -----
4. In your opinion, what role do you think the management should play in: -----
  - a. Setting standards for hygiene in the slaughterhouse? -----
  - b. Maintaining those standards? -----
5. In your opinion, what role do you think the workers should play in? -----
  - c. Maintaining standards for hygiene in the slaughterhouse? -----
  - d. Doing their work as much as possible quickly? -----

### B.BUTCHER HOUSE

1. Date completed: \_\_\_\_\_ Questionnaire number-----  
 Respondent Name: \_\_\_\_\_ Address: \_\_\_\_\_ Occupation: \_\_\_\_\_
2. Name of butcher shops -----
3. Educational status: a) Illiterate b) Grade 1-5 c) Grade 6-8 d) Grade 9-12  
e) Grade>12
4. Did you receive any job related training? a) Yes b) No
5. If yes for 4; where were you trained? -----
6. If there was no formal training have you received informal training? -----

7. How many carcass you receive per day? -----
8. What is your selling capacity per day? \_\_\_\_\_
9. If the meat is not sold in a given day what will you do/ how do you handle? \_\_\_\_\_
10. How many knife you have and you use per day a) one b) two c) three  
d) four e) more (Specify )-----
11. How often and when do you wash the equipment?  
a) Every day at end of the selling b) Once per weak c) Once per month d) other (specify)
12. Who are most of your customers? \_\_\_\_\_
13. What would cause meat contamination? (Open question) a) Faeces b) Dirty water  
c) Handling with dirty equipment and hands d) other  
(specify).....In your opinion, does
14. Contamination poses any health risk to meat consumers? a) Yes b) No
15. If No, why? -----
16. Propose way to meat contamination? -----

### C.MEAT CONSUMERS

**Date completed:** \_\_\_\_\_ **Questionnaire number**-----

1. Respondent Name: \_\_\_\_\_ Sex: \_\_\_\_\_ Age:  
\_\_\_\_\_ Address: \_\_\_\_\_ Occupation: \_\_\_\_\_
2. Educational status: a) Illiterate b) primary school c) high school d) university e) Master and PhD
3. From where you buy/ goat meat mostly? \_\_\_\_\_
4. What is your priority criterion to purchase meat? a) Freshness b) low cost(cheapness) c) low fat content d) healthiness
5. Which type of red meat you prefer? a) beef b) sheep c) goat d) camel e) all of them
6. How do you consume red meat? a) boiled b) fried c) cooked d) raw e) cooked in oven
7. Do you consume raw goat meat? a) Yes b) No
8. Do you think that cooked meat is always safe to eat? a) Yes b) No
9. How often do you consume meat? a) every day b) once in a week c) 1-3 times in a week  
d) 3-5 times in a week e) once per month f) most of the time
10. When do you consume meat most of the time? \_\_\_\_\_
11. History of food poisoning? a) Yes b) No
12. If yes symptoms? \_\_\_\_\_
13. Do you know any food poisoning/GIT disturbance associated with consuming of raw meat? \_
14. What are the symptoms? \_\_\_\_\_

15. Do you think that meat slaughtered in abattoir is always safe to eat? a) Yes b) No
16. How do you handle meat? \_\_\_\_\_
17. Do you have refrigerator? **a) Yes** **b) No**
18. Have you ever heard about Salmonella as food borne disease? a) Yes b) No
19. Do you know that Salmonella can be transmitted through meat consumption **a) Yes** **b) No**

A. Figure 1 picture during sample collection

