



Public Awareness on Goat Meat Handling Practices and Its Public Health Implication in Dire Dawa Town, Eastern Ethiopia

Beshatu Ferede

Wollega University, School of Veterinary Medicine, P.O. Box 395, Nekemte, Ethiopia

Abstract

A cross-sectional study was conducted from January, 2014 to April, 2014 following apparently healthy slaughtered goats at Dire Dawa municipal abattoir to assess the knowledge, attitude and practice of abattoir workers, butchers and consumers on meat hygiene and food safety. A total of 20, 15 and 50 abattoir workers, butchers and goat meat consumers were respectively interviewed and observed during the work purposively following the slaughtered carcass. All abattoir workers use unclean knives while 18 (90%) of them keep equipments in unhygienic places. While 11(55%) of them consider that keeping meat hygiene is the role of the management. Among the 15 butchers interviewed, 13(86.7%) acquired meat selling skills from observations and 2(13.3%) of them from informal training. 14(93.3%) of the butchers did not use protective clothes and 12(80%) wash their hands merely with water after work. All butchers reported that they use a single knife for cutting meat and edible offal. Seven had worn jewelry and 14(93.3%) handled money while selling meat. Among the consumers interviewed, 28(56%) reported that they suffered food poisoning of which 22(78%) had medical attention as well as received antimicrobials and 2 (7%) were hospitalized. In general, this study result revealed that presence of poor personal hygiene, sanitation and high trouble of hygienic meat handling practice and awareness gap on foodborne disease, food hygiene and sanitation practice at different level of meat handling. Finally, authors recommended that the use of standardized procedures in slaughtering and handling of goat meat, provision of training on best practice of meat handling for handlers and raising the level of awareness of people

Article Information

Article History:

Received: 10-12-2016

Revised: 24-02-2017

Accepted: 06-03-2017

Keywords:

Abattoir, butcher, Consumers, goat, hygiene, meat

***Corresponding Author:**
Beshatu Ferede,

E-mail:
Basheef@yahoo.com

Copyright©2017 STAR Journal, Wollega University. All Rights Reserved.

INTRODUCTION

Food safety remains a critical issue with outbreaks of foodborne illness resulting in substantial costs to individuals, the food industry and the economy (Kaferstein *et al.*, 1997). Despite advances in food science and technology, foodborne diseases remain one of the major public health and economic problems all over the world (WHO, 1995;

Legnani *et al.*, 2004). The risk of foodborne illness has increased markedly over the last 20 years, with nearly a quarter of the population at higher risk for illness (CDC, 2003; CDC, 2004). Foodborne diseases occur commonly in the developing countries due to the predominant poor food handling and sanitation practices, inadequate food safety laws, weak regulatory

systems, lack of financial resources to invest in safer equipment, and lack of education for food-handlers (Subratty & Gurib, 2003). There is a strong relationship between meat consumption and foodborne disease outbreaks (Holt & Henson, 2000). Contaminated raw meat is one of the main sources of foodborne illnesses (Bhandare *et al.*, 2007). The types of microorganisms and extent of contamination present on the final product are influenced by sanitation procedures, hygienic practices, application of food safety interventions, type and extent of product handling and processing, and the conditions of storage and distribution (Sofos, 2005).

Slaughtering procedures potentially involve many risks of both direct and cross contamination of carcasses and meat surfaces. During slaughter, faecal contamination of edible organs with subsequent contamination of the carcass may occur. This can be carried through all slaughter procedures up to the processing of the raw products, which are important sources of *Salmonella* in the human food chain (Edwards *et al.*, 1997). Contamination of equipment, utensils and hands of workers can spread *Salmonella* to uncontaminated carcasses and parts, which can occur in subsequent handling, processing, transport, storage, distribution and preparation for consumption (Ejeta *et al.*, 2004). Although, little study has so far been undertaken to isolate *Salmonella* from goat's meat in Ethiopia (Molla *et al.*, 1999; Woldemariam *et al.*, 2005; Wassie, 2004; Akafete & Haileleul, 2011) from central part of the country and export abattoirs, there was no report regarding goat meat handling practices from Dire Dawa municipal abattoir.

Thus, the objective of the study was to assess the meat hygiene and food safety knowledge, attitude and practice of abattoir workers, butchers and consumers of the study area.

MATERIALS AND METHODS

Study site

This study was conducted between January, 2014 and April, 2014 at Dire Dawa Administration (DDA). DDA is located in the eastern part of Ethiopia and lies between 90° 27' and 90° 49'N latitudes and between 41° 38' and 42° 19'E longitudes, 515 Km from Addis Ababa, the capital city of Ethiopia. Its altitude ranges from 960 meters above sea level (m.a.s.l) in the northeast to 2450 m.a.s.l in the South West. The monthly mean maximum and minimum temperature ranges from 28.1°C to 34.6°C and. Likewise, the monthly mean minimum temperature varies from 14.5°C to 21.6°C in June (DDAC and Agricultural Bureau, 1998). Dire Dawa city administration is a large town in Ethiopia and is situated along the Addis Ababa to Djibouti corridor, an asphalt road and railway that link the country to neighbouring Djibouti. The town hosts many truckers, long- and medium-distance intercity bus drivers, and cross-border businessmen. Dire Dawa has numerous economic and social institutions with a large number of permanent and temporary employees, including the Ethio-Djibouti railway station, textile and food factories, and higher-education institutions with a large number of students. Also, there are many hotels and bars in the town (Amare, 2009).

Study population

The study population were all goat meat handlers (abattoir workers, butchers and consumers).

Sample size determination

The sample size was determined purposively based on the willingness of the interviewees, easy for follow up and the chain of goat meat from abattoir to consumer. Accordingly, 85 participants consisting of 20 abattoir workers, 15 butchers and 50 consumers were included in the study.

Study design

A cross-sectional study design involving questionnaire and observational survey was employed. Structured questionnaire was developed and administered based on the willingness of the interviewees, easy for follow up and the chain of goat meat from abattoir to consumer.

Data management and analysis

The data collected from the questionnaire and observational survey were entered into Microsoft Excel and prepared for analysis. Descriptive statistics were performed using SPSS version 20 statistical.

RESULTS

Abattoir workers

All workers use unclean knives while 18 (90%) of them keep equipments in unhygienic places. Whilst eight of the respondents responded that unclean hand and equipments as major causes of carcass contamination, six considered falling on the ground as a major source of contamination. Washing the hands before and after work is practiced by only three of the interviewees and eighteen did not regularly put on clean protective clothing at work (Table 1). None of them responded that the faeces, skin and dirty water could possibly cause carcass contamination. Most (55%) interviewees consider that keeping hygiene is the role of the management while some (45%) 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.

Table 1: The knowledge, attitudes and practices of abattoir workers

Factors	Values	Frequency	Percentage (%)
Educational status	Illiterate	2	10
	Grade 1-8	10	50
	Grade 9-12	6	30
	Beyond grade 12	2	10
Placement in the abattoir	Slaughtering ^a	11	55
	Loading	4	20
	Washing stomach	3	15
	Washing the intestine	2	10
Job related training	Yes	6	30
	No	14	70
Job related medical test	Yes	8	40
	No	12	60
Know contamination as risk	Yes	16	80
	No	4	20
Clean clothing	Yes	2	10
	No	18	90
Hand washing	Before work	5	25
	At the end of the work	12	60
	Before and after work	3	15
Knives are clean	Yes	0	0
	No	20	100
Unhygienic equipments placing	Yes	18	90
	No	2	10

^a =Cutting the throat, flaying eviscerating, splitting the carcass and carcass washing

Direct observations revealed the absence of hot water, sterilizer and carcass retention room in the abattoir. During slaughtering equipments

were placed on unclean surfaces. Knives were placed on the floor, in their (workers) mouth, on the skin of killed and in the anus of a

slaughtered and hanged animals. The protective clothes were unclean, blood tinged and frequently in contact with carcasses. 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.

Butchers

Among the fifteen butchers, thirteen acquired meat selling skills from observations and two

of them from informal training. Fourteen of the butchers did not use protective clothes and twelve wash their hands with only water after work. All reported that they use a single knife for cutting meat and edible offal. Seven had worn jewelries and fourteen handled money while selling meat. All butchers cleaned their shop and equipments every day at end of the selling process by using water and clothes but one reported that uses soap in addition to water and clothes (Table 2).

Table 2: Demography and meat handling practices of butchers

Factors	Values	Frequency	Percentage (%)
Educational status	Illiterate	2	13.3
	Grade 1-8	8	53.3
	Grade 9-12	4	26.7
	Beyond grade 12	1	6.7
Received job related training	Yes	2	13.3
	No	13	86.7
Apron (protective clothes)	Used	1	6.7
	Not used	14	93.3
Jewellery materials	Worn	7	46.7
	Not worn	8	53.3
Hand washing	Before work	-	-
	After work	12	80
	During work	-	-
	Not washed	3	20
Manner of washing hands	Rinsing with water only	12	80
	Using detergents and water	-	-
	Not wash	3	20
Handling money	Butcher with bare hand	14	93.3
	Cashier	1	6.7
Cleaning equipment's and shop	Every day at end of work(retailing) using water	15	100
Use disinfectants	Yes	1	6.7
	No	14	93.3
Cutting table	Single	14	93.3
	Separate for different organs and meat types	1	6.7

Consumers

The demographic characteristic of the 50 goat meat consumers is presented in Table 3 while the knowledge attitude and practice of the respondents is shown in table 4. Only 36% of

them learned to high school and above while 30% of the respondents were uneducated and 62% of them were females (Table 3).

Table 3: Demographic characteristic of goat meat consumers

Variable	Values	Frequency	Percentage (%)
Sex of respondents	Male	19	38
	Female	31	62
Age	9-28	21	42
	29-50	24	48
	51-90	5	10
Educational status	Illiterate	15	30
	Primary school	17	34
	Secondary school	10	20
	University	8	16

Most of the respondents 28(56%) reported that they suffered of food poisoning of which 22(78%) had medical attention and received antimicrobials and 2 (7%) were hospitalized. The symptoms of the cases were loss of

appetite, diarrhea and weakness. Most 31(62%) reported that they prefer goat meat to other meat types. While 62%, 28% and 8% of them prefer to eat cooked, fried and raw meat respectively (Table 4).

Table 4: Knowledge, attitude and practice of the consumers

Variable	Values	Frequency	Percentage (%)
Priority criterion to purchase goat meat	Freshness	16	32
	Low cost	5	10
	Low fat content	18	36
	Healthiness	5	10
	Mixed	6	12
How to use goat meat	Fried	14	28
	Cooked	31	62
	Raw	4	8
	All type	1	2
Consume raw goat meat	Yes	11	22
	No	39	78
Think cooked meat is always safe to eat	Yes	48	96
	No	2	4
History of food poisoning	Yes	28	56
	No	22	44
Meat slaughtered in abattoir is always safe to eat	Yes	45	90
	No	5	10
Have refrigerator	Yes	31	62
	No	19	38

Direct observations revealed the absence of hot water, sterilizer and carcass retention room in the abattoir. During slaughtering equipments were placed on unclean surfaces. Knives were placed on the floor, in their (workers) mouth, on the skin of killed and in the anus of a slaughtered and hanged animals. The

protective clothes were unclean, blood tinged and frequently in contact with carcasses. There were no separate compartments for final carcasses and animals to be slaughtered (Annex 8). The latrine is constructed far away from the abattoir and has no water, soap or other cleaning materials.

DISCUSSION

In the present study more than 60% of slaughter house workers and butchers had only a primary school education. Similarly, more than 70% 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 result is in agreement with reports of Mekonnen *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 city, Ethiopia. Therefore, these workers could cross contaminate and not handle meat hygienically due to lack of knowledge regarding hygiene, sanitation, risk of contamination and personal hygiene. However, training of food handlers regarding the basic concepts and requirements of personal hygiene plays an integral part in ensuring safe products to the consumers (Adams & Moss, 1997) and food handlers should have the necessary knowledge and skills to enable them handle food hygienically (FAO, 1990).

The majority 8(40%) of the abattoir workers proposed unclean hand and equipment as the major causes of carcass contamination but none of them responded 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. Contradictory, it is well documented that, the faecal wastes from animal and humans are important source of bacterial contamination of the environment and foods chain (Ponce *et al.*, 2008), and members of *Salmonella enterica* subspecies *enterica* are widely distributed in the environment and in the 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 goat meat accurately. Therefore, they can contaminate meat with such source of contamination unknowingly. Moreover, 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.

Good health is important for workers in the meat industry. 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 specifies that among the respondents from abattoir house workers 60% 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, in this research every worker accountable in goat slaughtering activity allowed slaughtering about twenty to thirty-five goat and sheep per day and every process from cutting the throat to final carcass preparation was covered by single person. 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 goats and sheep 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 problem 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 equipments rest on dirty surfaces. However, Akafete and Haileleul (2011) report 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 goats for evisceration, cutting throat and skinning process. This could cause high carcass contamination with different foodborne pathogens unless it is solved.

Correspondingly, it was found that the equipment used for slaughtering process was rested on dirty surface 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 reedy 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 *Salmonella* 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 wile loading, transportation, contaminated water in use of contaminated materials repeatedly and moving from one rail to another rail.

Removal of hides should be carried out in a manner that avoids a contact between the skin and the carcass and contact between the carcass and workers' hands, tools or equipment, which had previously contacted the hide. Knives and steels used in the de-hiding operation should be sterilised in water at 82°C (McEvoy *et al.*, 200). In contrast to this information this research result indicates that, there was no separation between final carcasses and live goats those going to be killed. Consequently, there was high contact between skin of live goat with final carcass, since there was no separate room for final carcass and live animals. McEvoy *et al.*, (2000) expressed that, contamination can occur by direct contact between the hide and the carcass or by indirect transfer, i.e. from workers' hands, clothes, tools or factory equipment which has had previous contact with the hide.

During the life of the animal, the hide becomes contaminated with large numbers of microorganisms derived from a wide range of sources such as faeces, soil, water and vegetation, including pathogens such as *E. coli* O157:H7 and *Salmonella*. Many of these organisms are present on the hide of animals presented for slaughter. There is a positive relationship between the level of dirt on the hide and bacterial numbers on the carcass. The relationship is evident at sites on the carcass that are subjected to manual skinning during hide removal. Reduction of the bacterial

loading on the hide of animals entering the slaughter process would limit the impact and scale of pathogen transfer from the hides to the carcass (McEvoy *et al.*, 2000).

The hygienic practices at the butcherries were unhygienic. Almost all butchers 14 (93.3%) 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 & Kuria, 2005). As the paper money circulates among different individuals it could be contaminated with several pathogens 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 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 goat meat. Besides, all (100%) of the butchers reported that they clean their shop and equipments 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, and very resistant staining. Aged protein deposits can be quite hard, normally not scraping off easily with a fingernail (Gracey *et al.*, 1999).

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).

Direct observations revealed the absence of hot water, sterilizer and carcass retention room in the abattoir. During slaughtering equipments were placed on unclean surfaces. Knives were placed on the floor, in their (workers) mouth, on the skin of killed and in the anus of a slaughtered and hanged animals. The protective clothes were unclean, blood tinged and frequently in contact with carcasses. 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. However, during food handling and preparation pathogenic organisms may be transferred to food items by the handler both directly or by cross contamination through hands, surfaces, utensils and equipment that have been inadequately clean and disinfected between the preparation of different types of food (Linda du & Irma, 2005). Therefore, consumers of this contaminated meat could be predisposed to food borne disease 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 *et al.*, (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 *Salmonella* which are resistant to commonly used antibiotics including ampicillin, amoxicillin and tetracycline. Therefore, symptom of their event could be associated with salmonellosis which might be transmitted to them from contaminated meat and other foods.

CONCLUSION AND RECOMMENDATIONS

This study results revealed that presence of poor personal hygiene, sanitation and high trouble of hygienic meat handling practice and awareness gap on foodborne disease and food hygiene and sanitation practice at different level of meat handling. In this research every worker accountable in goat slaughtering activity allowed slaughtering about twenty to thirty-five goat per day and every process from cutting the throat to final carcass preparation was covered by single person. Furthermore,

low level of public awareness about contamination of goat meat with microorganism during processing and consumption and the associated risk factor in the study area. Consequently, goat meat provided to the consumers in the city was contaminated and meat handlers and abattoir manager found to be not aware of and poor in meat personal hygiene 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 the community.
- The manager of the abattoir should be professionals who is well equipped with the concept of food quality and food safety
- The number of abattoir works should be proportional with the number of goats to be slaughtered per day
- Further study ought to be conducted to identify the source of contamination
- The use of standardized procedures and applications like hazard analysis and critical control point in slaughtering and handling of goat meat in the abattoir should be applied.

REFERENCES

- Adams, M. R. & Moss, M. O. (1997). *Food Microbiology*. Cambridge: The Royal Society of Chemistry.
- Akafete, T. & Haileleul, N. (2011). Assessment of risk factors and prevalence of *Salmonella* in slaughtered small ruminants and environment in an export abattoir, Modjo, Ethiopia. *American-Eurasian J. Agric. Environ. Sci.*, 10, 992-999.
- Amare, D. (2009). *Distribution of most-at-risk population groups and their perceptions towards HIV/AIDS: A baseline survey in Dire Dawa for the implementation of mobile HIV counselling and testing*. Bethesda, MD: Private Sector Program-Ethiopia, Abt Associates.
- Anjum, M. F., Choudhary, S., Morrison, V., Snow, L. C., Mafura, M., Slickers, P., Ehricht, R. & Woodward, M. J. (2011). Identifying antimicrobial resistance genes of human clinical relevance within *Salmonella* isolated from food animals in Great Britain. *J. Antimicrob. Chemoth.*, 66, 550-559.

- Bhandare, S. G., Sherikarv, A. T., Paturkar, A. M., Waskar, V. S., & Zende, R. J. (2007). A comparison of microbial contamination on sheep/goat carcasses in a modern Indian abattoir and traditional meat shops. *Food Control*, 18, 854-868.
- CDC (2003): *Multistate outbreak of Salmonella serotype Typhimurium infections associated with drinking unpasteurized milk*. Illinois, Indiana, Ohio, and Tennessee.
- CDC (2004). Preliminary Food Net data on the incidence of infection with pathogens transmitted commonly through food. *Selected sites, United States*, MMWR, 53, 338.
- D'Aoust, J. Y. (1997): *Salmonella* species. In: Doyle, M. P., Beuchat, L. R. and Montville, T. J. (Eds.). *Food Microbiology Fundamentals and Frontiers*, ASM Press, Washington D. C., Pp. 129-158.
- DDAC & Agricultural Bureau. (1998). *Land use development potential study of the Dire Dawa Administrative Council*, Pp: 1-23.
- Edwards, D. S., Johnston, A. M. & Mead, G. C. (1997). Meat inspection: an overview of present practices and future trends. *Vet. J.*, 154, 135-147.
- Ejeta, G., Molla, B., Alemayehu, D. & Muckle, A. (2004). *Salmonella* serotypes isolated from minced meat beef, mutton and pork in Addis Ababa, Ethiopia. *Revue Méd. Vét.*, 155, 547-551.
- Endale, B. G. & Hailay, G. (2013). Assessment of bacteriological quality of meat Contact surfaces in selected butcher shops of Mekelle city, Ethiopia. *J Environ Occup Sci.*, 2, 61-66.
- FAO (1990). Street foods: Report of FAO expert consultation. Jogjakarta, Indonesia. *FAO Nutr.*, 46, 3-30.
- Gracey, J. F., Collins, D. S. & Huey, R. G. (1999). *Meat hygiene* (10th ed). Harcourt Brace and Company, 143-174.
- Holt, G. & Henson, S.J., (2000). Quality assurance management in small food manufacturers. *Food Control*, 11 (4), 319-326.
- Kaferstein, F. K., Motarjemi, Y. & Bettcher, D. W. (1997). Foodborne disease control: A transnational challenge. *Emerg. Infect. Dis.*, 3, 503-510.
- Legnani, P., Leoni, E., Berveglieri, M., Mirolo, G. & Alvaro, N. (2004). Hygienic control of mass catering establishments, microbiological monitoring of food and equipment. *Food control*, 15, 205- 206.
- Linda du, T. & Irma, V. (2005). Food practices associated with increased risk of bacterial foodborne disease of female students in self-catering residences at the Cape Peninsula University of Technology. *J. Fam. Ecol. Consum. Sci.*, p. 33.
- McEvoy, J. M., Doherty, A. M., Sheridan, J. J and McGuire, L. (2000). Contamination of beef carcasses during hide removal and use of a test bacterial decontamination system on beef hide. *The National Food Centre: Research and training for the food industry, research report no.*, 25.
- Mekonnen, H., Habtamu, T., Kelali, A. & Shewit, K. (2013). Food safety knowledge and practices of abattoir and butchery shops and the microbial profile of meat in Mekelle City, Ethiopia. *Asian Pac J Trop Biomed.*, 3,407-412.
- Molla, B., Kleer, J., & Sinell, H. J. (1999). Antibiotic resistance pattern of foodborne *Salmonella* isolates in Addis Ababa (Ethiopia). *Berl Munch Tierarztl Wochensh*, 112, 41-3.
- Motsoela, C., Collison, E. K. and Gashe, B. A. (2002). Prevalence of *Salmonella* in two Botswana abattoir environments. *J. Food protection*, 65, 1869-1872.
- Muinde, O. K. & Kuria, E. (2005). Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *African J Food Agri Nutr Development*, 5, 1.
- Ponce, E., Khan, A. A., Cheng, C. M., Summage, W. C. & Cerniglia, C. E. (2008). Prevalence and characterization of *Salmonella* enteric serovar Weltevreden from imported seafood. *Food Microbiol.*, 25,29-35.
- Reda, A. A., Seyoum, B., Yimam, J., Andualem, G., Fiseha, S., & Vandeweerd, J. (2011). Antibiotic susceptibility patterns of *Salmonella* and

- Shigella* isolates in Harar, Eastern Ethiopia. *J. Infect. Dis. Immun.*, 3,134-139.
- Skaarup, T. (2011). Slaughterhouse cleaning and sanitation. *FAO animal production and health paper 53*. M-20, ISBN 92-5-102296-8.
- Sofos, J. N. (2005). *Improving the safety of fresh meat*. Wood head publishing in *Food Science and Technology*. CRC Press, New York.
- Subratty, A. H., & Gurib, F.B.H., (2003). Consumers' concern about the meat product quality offered for sale in Mauritius. *Nutrit Food Sci.* 33(2), 80–83.
- Wassie, M. A. (2004). *A cross-sectional study on Salmonella in apparently healthy slaughtered sheep and goats at Addis Ababa and Modjo abattoirs, Ethiopia* (Master thesis), AAU, FVM, Bishoftu, Ethiopia.
- WHO (1995). Hazard analysis critical control point system concept and application. *Report of a WHO consultation with the participation of FAO, Geneva, and document WHO/ FNU/FOS/95/7*, Pp: 1-25
- Woldemariam, E., Molla, B., Alemayehu, D. & Muckle, A. (2005). Prevalence and distribution of *Salmonella* in apparently healthy slaughtered sheep and goats Bishoftu, Ethiopia. *Small Ruminant Res.*, 58,19-24.

Annex. Pictures Taken from the Abattoir to Demonstrate Observational Survey Result



Equipment's rested in dirty surface during working and cloths full of dirty (a= dirty cloths, b= knife rested on the ground)



Equipment used for water collecting from another container and knife rested on the ground



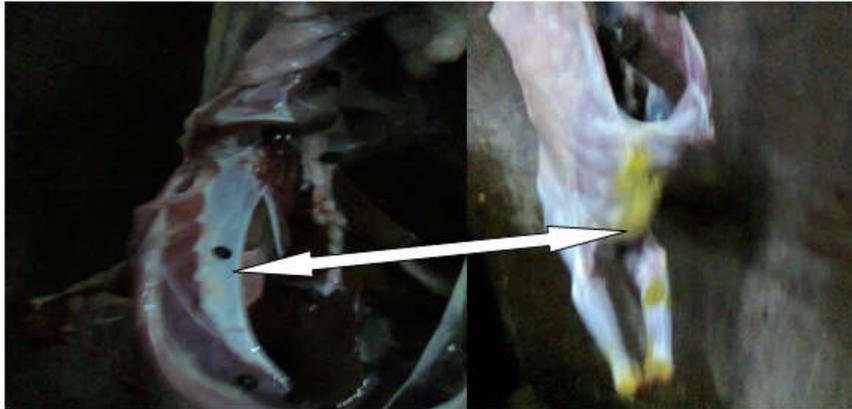
Knife rested in dirty surface (a= in their mouth, b= on skin of other killed goat)



(a= Smoking during work and b= kneel on the ground)



No separation of live sheep and goat carcass being dressed
(A= Final goat carcass, B= live sheep to be killed and C= carcass to be dressed) all in the same area.



Contaminated carcass with çecal contents (arrow indicates contaminated site with çecal content)



No separation of skin and carcass (for Christian slaughter section), thus carcass and skin transported together



VIII. Close contact of workers cloth and final carcass during loading