

# Research & Reviews: Journal of Zoological Sciences

## Major Causes of Organs and Carcass Condemnation in Small Ruminants Slaughtered at Elfora Export Abattoir, Bishoftu, Ethiopia

Addisu Demeke\*, Aayalew Taye, Asmelash Tassew and Dereje Bantigegn

Department of Microbiology, Immunology and Public Health, College of Veterinary Medicine and Agriculture, Addis Ababa University, Debre Zeit, Ethiopia

### Case Report

Received date: 23/12/2015

Accepted date: 10/10/2016

Published date: 13/10/2016

#### \*For Correspondence

Addisu Demeke, Department of Microbiology, Immunology and Public Health, College of Veterinary Medicine and Agriculture, Addis Ababa University, Debre Zeit, Ethiopia, Tel: +251111239752

**E-mail:** ademeke16@yahoo.com

**Keywords:** Small Ruminants, Organs, Carcass, Condemnation, ELFORA Export abattoir, Bishoftu

#### ABSTRACT

The study was conducted from December 2013 to April 2014 in ELFORA export abattoir, at Bishoftu. The aim of this study was to identify the significant causes of organs and carcass condemnation and to estimate the magnitude of the direct economic losses attributed to the condemned organs and carcasses from sheep and goats slaughtered in the abattoir. Standard antemortem and postmortem inspection procedures were followed throughout the study. Ante mortem inspection was carried out on arrival and in the lairage and abnormalities encountered were recorded, followed by postmortem examination through their identification number to detect gross abnormalities and aesthetic reasons that rendered each organ to be rejected from international and domestic market. During the study a total of 430 sheep and 430 goats Organs and Carcass were examined. The study revealed that out of 860 shoats examined in both species 419 (48.7%) livers, 318 (37.0%) lungs, 50 (5.8%) heart, 94 (10.9%) kidney and 53 (6.2%) carcass were rejected due to various causes. Hepatitis 115 (13.4%), stelesia hepatica 142 (16.5%), pneumonia 190 (22.1%) pericarditis 26 (3.0%) nephritis 33 (3.8%), and bruising 21 (2.4%) were found to be the major causes responsible for rejection of respective organs and carcass. Liver condemnation due to parasites such as Stilesia hepatica, fasciolosis, hydatid cyst and *Cysticercus tenuicollis* contributed to 142 (16.5%), 20 (2.3%), 14 (1.6%) and 51 (5.9%) respectively. There was statistically significance difference ( $p < 0.05$ ) among causes of liver condemnation between young and adult as well as between sheep and goats. The annual economic loss due to the rejection of organs and carcass of shoats slaughtered I n the ELFORA export abattoir was estimated approximately 16,007,448.2 ETB (827,686.05 USD). Monitoring animal disease conditions and management practices which lead to the condemnation of organs and carcasses during slaughtering of animals is basic and essential.

### INTRODUCTION

Livestock systems in developing countries are characterized by rapid change, driven by factors such as population growth, increases in the demand for livestock products as incomes rise, and urbanization <sup>[1]</sup>. Livestock currently contribute about 30 percent of agricultural gross domestic product in developing countries, with a projected increase to about 40 percent by 2030 and is becoming the fastest growing sub-sector of agriculture <sup>[2]</sup>. Livestock are an important component of nearly all farming systems. Ethiopia and provide draught, power, milk, meat, manure, hides, skins and other products <sup>[3]</sup>. Currently, the population of livestock found in Ethiopia is estimated to be 53.4 million cattle, 25.5 million sheep and 22.78 million goats <sup>[4]</sup>.

Small ruminants are important domestic animals in the tropical animal production system <sup>[5]</sup>. Live stock and livestock

products also constitute one of the major export resources of the country and play a vital role in the country's economy<sup>[6]</sup>. Ethiopia owns huge number of small ruminants, estimated to be 48 million heads of sheep and goats<sup>[7]</sup>.

Sheep and goats cover more than 30% of all domestic meat consumption and generate cash income from export of meat carcass, edible organs, live animals and skin<sup>[8]</sup>. Hence, an increase in small ruminants production could contribute to the attainment of food self-sufficiency in the country particularly in response to protein requirement for the growing human population as well as to enhance the export earnings<sup>[9]</sup>. Each year a significant economic loss results from mortality, poor weight gain, condemnation of edible organs and carcasses at slaughter. This production loss in the livestock industry is estimated at more than 900 million USD annually<sup>[10-12]</sup>. The significant economic losses incurred each year in the different abattoirs in Ethiopia are due to mortality, inferior weight gain and condemnation of edible organs at slaughter<sup>[11,12]</sup>.

A thorough meat inspection procedure requires two steps (ante mortem and postmortem inspections). The importance of ante mortem inspection in the abattoir has long been recognized to avoid the introduction of clinically diseased animals into the slaughter hall and should be done within 24 hours of slaughter and repeated if slaughter has been delayed over a day<sup>[13,14]</sup>. The purposes of meat inspection, comprising of antemortem and postmortem examination, are to remove gross abnormalities from meat and its products, prevention of distribution of contaminated meat that could result to disease risk in man and animals and assisting in detecting and eradication of certain diseases of livestock<sup>[15]</sup>. It is necessary to be aware of the extent to which the public is exposed to certain zoonotic diseases detected in abattoirs and the financial losses through condemnation of affected organs and carcass<sup>[16]</sup>.

As meat is the main source of protein to man, it should be clean and free from diseases of particular importance to the public such as tuberculosis, hydatidosis, cysticercosis, and fasciolosis<sup>[17]</sup>. A proper antemortem inspection of the animal makes the task of routine postmortem inspection simpler and straight forward procedure<sup>[13]</sup>. Postmortem inspection is the center around which meat hygiene revolves since it provides information indispensable for the scientific evolution of clinical signs and pathological processes that affect the wholesomeness of meat<sup>[13,18]</sup>.

All gross lesions should be identified at least in a general way. A routine postmortem inspection of an organ or carcass should be carried out as soon as possible after completion of dressing. The main purpose of post mortem examination is to detect and eliminate abnormalities, including contamination, thus ensuring that only meat fit for human consumption is passed for food<sup>[13]</sup>. It is necessary to be aware of the extent to which the public is exposed to certain zoonotic diseases detected in abattoirs and the financial losses through condemnation of affected organs and carcasses<sup>[16]</sup>. Various investigations have been conducted through abattoir surveys to determine the economic importance of organs and carcass condemnation in Ethiopia<sup>[19-24]</sup>.

Recently, several modern abattoirs like HELMEX, ELFORA, Metehara, Modjo and Luna have been established in Ethiopia. This increase number of abattoirs shows increase in demand of organs and carcass, but the supply is decreasing due to disease and production problems. In view of this, proper evaluation of economic losses due to organs and carcass condemnation resulting from various diseases at abattoirs is needed.

Therefore, the objectives of this study were:

- To identify the significant causes of organs and carcass condemnation in sheep and goats slaughtered at ELFORA export abattoir.
- To estimate the magnitude of direct economic loss attributed to the condemned organs and carcasses.

## **MATERIALS AND METHODS**

### **Study Location**

The study was conducted from December 2013 to April 2014 in ELFORA export abattoir at Bishoftu. The abattoir is situated in Bishoftu town which is located at 9°N latitude and 40°E longitudes, at altitude of 1850 meter above sea level, central highlands of Ethiopia, 47 kms South East of Addis Ababa<sup>[25]</sup>. It had a total population of 99,928, of whom 47,860 were men and 52,068 were women. The area has an annual rainfall of 1151.6 mm, of which 84% is in the long rainy season (June to September). The dry season extends from October to February. The mean annual maximum and minimum temperatures are 26 and 14°c respectively, with mean relative humidity level of 61.3%<sup>[26]</sup>.

### **Study Animals**

The small ruminants destined for slaughter were all males originated from different parts of the country including Arsi, Afar, Somali and Borena. They were transported to the abattoir using vehicles and on foot. A total of 860 shoats destined for slaughter were inspected during antemortem and post mortem inspections with their specific identification numbers and recorded accordingly on a format prepared for this purpose (Annex 1).

### **Sampling Technique and Study Design**

A cross sectional study was conducted in sheep and goats slaughtered in the abattoir. In this study, animals were grouped

into young (under 1 year of age in goats and 1 year and 3 months in sheep) based on eruption of one or more incisor teeth according to Gatenby<sup>[6]</sup> and Steele<sup>[27]</sup> (Annex 2). The sample size determined using the formula given by Thrusfield<sup>[28]</sup>.  $N = \frac{1.962 \times P \times (1-P)}{d^2}$  Where, (N=number of sample size, P= expected prevalence of organs/carcass condemned and, d=desired precision level). Assuming the expected prevalence of organs/carcass condemned in respective prevalence to be 50%, since there was no previous survey conducted in this abattoir, the sample size required was 384 for each species at 95% confidence interval and at a desired precision level of 5%<sup>[29]</sup>. But in order to increase the precision level of the study, the sample size was increased to 430 for each species (a total of 860 shoats) of small ruminants were examined. Animals belonging to a group of young and adult were systematic random sampling method by using individual identification number (Annex 3) and examined by ante mortem and postmortem examination.

## Abattoir Survey

### Ante mortem inspection

Pre slaughter examinations of small ruminants were conducted in the lairage by grouping the animals based on species, age and place of origin. The age grouping was performed based on arbitrary classification according to Steele and Gatenby (Annex 2)<sup>[27]</sup>. The age grouping was based on dentition. Those which have not erupted permanent incisor teeth, were classified as young, while those with one pair or more permanent incisor teeth were classified as adults<sup>[6,27]</sup>. Antemortem inspections were conducted on individual animals while the animals were entering into the lairage and after they entered in to the lairage in mass. Both sides of the animals were inspected at rest and in motion. Moreover, the general behavior of the animals, nutritional status, cleanliness, sign of diseases and abnormality of any type were registered according to the standard ante mortem inspection procedures<sup>[13]</sup>. Following the judgments passed by FAO<sup>[30]</sup>, animal fit for human consumption were allowed for slaughter.

### Post mortem examination

During postmortem inspection liver, lungs, heart, kidneys, and carcass were thoroughly inspected by visualization, palpation and making systemic incisions where necessary for the presence of cysts, parasites and other abnormalities. Pathological lesions were differentiated and judged according to guidelines on meat inspection for developing countries and the results were recorded and the decisions at postmortem inspection are classified in to the following categories of judgment such as approved as fit for human consumption, conditionally approved as fit for human consumption, totally condemned as unfit for human consumption and partially condemned as fit for human consumption<sup>[30]</sup>.

## Assessment of Direct Economic Loss

All affected organs and carcasses were rejected from international/domestic market since partial approval was not practiced in the abattoirs and the analysis was based on the annual slaughter capacity of the abattoirs considering market demand, average market prices in international and local market and the rejection rates of specific organs and carcass. An average market price of each organ and carcass was determined from interviews made with personnel of the abattoir marketing department. The annual slaughter rates were estimated from retrospective abattoir record. The economic loss due to condemnation was estimated by the formula set by Ogunrinade and Ogunrinade<sup>[31]</sup> as follows.

$EL = \sum sr_x \times Coy \times Roz$ , Where:

EL=Annual economic loss estimated due to organs and carcass condemnation from international /domestic market.

$\sum sr_k$ =Annual sheep/ goats slaughter rate of the abattoir

Coy=Average cost of each sheep or goat's liver/ lung/ heart/ kidney and carcass

Roz=Condemnation rates of sheep/goats/liver/lung/heart/kidney and carcass.

## Data Management and Statistical Analysis

Data collected during inspection were entered into Microsoft office Excel (2007). Descriptive statistics were used to determine organs and carcass condemnation rates, defined as proportion of condemned organs and carcasses to the total number of organs and carcasses examined. The variability between condemnation rates of specific organs and carcass, by risk factors of age and species were evaluated by Pearson's chi-square ( $X^2$ ) and differences were regarded statistically significant if p-value was less than 0.05 ( $p < 0.05$ ) using SPSS statistics version 20. To evaluate the economic losses, only the direct monetary losses due to rejection of liver, lung, heart, kidney and carcass were considered. The analysis was based on annual slaughter capacity of the abattoir considering market demand, average market prices on international and domestic markets, and the rejection rates of specific organs and carcass. The annual slaughter rates were estimated from retrospective data recorded in the past two years. Financial losses were then computed mathematically by adapting the formula of Ogunrinad and Ogunrinade<sup>[31]</sup>.

## RESULTS

### Abattoir survey

#### Ante mortem examination

The ante mortem findings were summarized in **Table 1**. Out of a total of 860 shots (430 sheep and 430 goats), 88 (20.5%) sheep and 80 (18.6%) goats showed one or more signs of abnormality with nasal discharge being the highest (5.8%) in sheep and (8.1%) in goats. However, these animals were passes for slaughter with precaution of thorough postmortem examination as judged by meat inspectors. There was no statistically significant difference ( $p>0.05$ ) between condemnation rate of sheep and goats and also between the young and adult age groups of both species (**Table 1**).

**Table 1.** Abnormalities/conditions encountered during ante mortem examination.

Abnormalities/conditions	Animal species and Age groups, n (%)						
	Sheep= (430)			Goats= (430)			Total Shoats
	Young (n=215)	Adult (n=215)	Total (n=430)	Young (n=215)	Adult (n=215)	Total (n=430)	
Local swelling	7 (3.3)	12 (5.6)	19 (4.4)	1 (0.5)	4 (1.4)	5 (1.2)	24 (2.8)
Emaciation	6 (2.8)	1 (0.5)	7 (1.6)	3 (1.4)	3 (1.4)	6 (1.4)	13 (1.5)
Depression	8 (3.7)	8 (3.7)	16 (3.7)	6 (2.8)	6 (2.8)	12 (2.8)	28 (3.3)
Nasal discharge	6 (2.8)	19 (8.8)	25 (5.8)	14 (6.5)	21 (9.8)	35 (8.1)	60 (7.0)
Coughing	9 (4.2)	5 (2.3)	14 (3.3)	9 (4.2)	9 (4.2)	18 (4.2)	32 (3.7)
Lameness	3 (1.4)	4 (1.9)	7 (1.6)	1 (0.5)	3 (1.4)	4 (0.9)	11 (1.3)
Total Shoats	39 (18.1)	49 (22.8)	88 (20.5)	34 (15.8)	46 (21.4)	0 (18.6)	168 (19.5)

Species:  $X^2=11.892$ ,  $p=0.064$  Age:  $X^2=28.453$ ,  $p=0.055$

#### Post mortem examination

Out of 860 shots slaughtered, 419 (48.7%), 318 (37.0%), 50 (5.8%), 94 (10.9%), and 53 (6.3%) of liver, lungs, heart, kidneys and carcass were totally condemned (**Table 2**).

**Table 2.** Organs/carcass condemnation rates of sheep and goats.

Animal Species and Age groups	Organs/ Carcass condemned, n (%)					
	Examined	Liver	Lung	Heart	Kidney	carcass
Sheep	Young (215)	94 (43.3)	78 (36.3)	9 (4.2)	25 (11.6)	11 (5.1)
	Adult (215)	129 (60.0)	76 (35.3)	16 (7.4)	28 (13.00)	14 (6.5)
Goats	Total (430)	223 (51.9)	154 (35.8)	25 (5.8)	53 (12.3)	25 (5.8)
	Young (215)	88 (40.9)	69 (32.1)	9 (4.2)	23 (10.3)	12 (5.6)
	Adult (215)	108 (50.2)	95 (44.2)	16 (7.4)	18 (8.3)	16 (7.4)
Total (430)		196 (45.6)	164 (38.1)	25 (5.8)	41 (9.5)	28 (6.5)
Total Shoats (860)		419 (48.7)	318 (37.0)	50 (5.8)	94 (10.9)	53 (6.3)

Parasites (*stilesia hepatica*, *cysticercus tenuicollis*, *haydatid cyst* and *fasciola spp.*) were found to be the major causes of liver condemnation (**Table 3**). Hepatitis with the rate of 27.4% and calcification with 12.6% were also found to be significant causes of liver condemnation. There was statistically significant difference ( $p<0.05$ ) between condemnation rate of organs of sheep and goats and also between the young and adult age groups of both species (**Table 3**).

**Table 3.** Causes of liver condemnation.

Abnormalities	Animal species and Age groups, n (%) of cause of condemnation						
	Sheep (n=430)			Goats (n= 430)			Total Shoats
	Young (n=215)	Adult (n=215)	Total (n=430)	Young (n=215)	Adult (n=215)	Total (n=430)	
Hepatitis	38 (17.7)	44 (20.5)	82 (19.1)	15 (7.0)	18 (8.4)	33 (7.7)	115 (13.4)
Abscess	2 (0.9)	5 (2.3)	7 (1.6)	2 (0.9)	1 (0.5)	3 (0.7)	10 (1.2)
Adhesion	3 (1.4)	4 (1.9)	7 (1.6)	1 (0.5)	6 (2.8)	7 (1.6)	14 (1.6)
Hydatid cyst	5 (2.3)	4 (1.9)	9 (2.1)	2 (0.9)	3 (1.4)	5 (1.2)	14 (1.6)
St. hepatica	18 (8.4)	35 (16.3)	53 (12.3)	41 (19.1)	48 (22.3)	89 (20.7)	142 (16.5)
C. tenuicollis	11 (5.1)	13 (6.0)	24 (5.6)	16 (7.4)	11 (5.1)	27 (6.3)	51 (5.9)
Calcification	11 (5.1)	16 (7.4)	27 (6.3)	9 (4.2)	17 (7.9)	26 (6.0)	53 (6.3)
Fasciolosis	6 (2.8)	8 (3.7)	14 (3.3)	2 (0.9)	4 (1.9)	6 (1.4)	20 (2.3)
Total Shoats	94 (43.7)	129 (60.0)	223 (51.9)	88 (40.9)	108 (50.2)	196 (45.6)	419 (48.7)

Species:  $X^2=37.796$ ,  $p=0.000$  Age:  $X^2=62.005$ ,  $p=0.000$

Pneumonia (59.7%) followed by emphysema (18.9%) were the major causes of the total lungs rejection. There was no statistically significant difference ( $p>0.05$ ) between sheep and goats and age groups of both species (**Table 4**).

**Table 4.** Causes of lung condemnation.

Abnormalities	Animal species and Age groups, n (%) of cause of condemnation						
	Sheep			Goats			Total
	(n=430)			(n= 430)			
Lesions	Young	Adult	Total	Young	Adult	Total	Shoats
	(n=215)	(n=215)	(n=430)	(n=215)	(n=215)	(n=430)	(n=860)
Pneumonia	49 (22.8)	44 (20.5)	93 (21.6)	44 (20.5)	53 (24.7)	97 (22.6)	190 (22.1)
Emphysema	13 (6.0)	18 (8.4)	31 (7.2)	10 (4.7)	19 (8.8)	29 (6.7)	60 (7.0)
Hydatid cyst	1 (0.5)	4 (1.9)	5 (1.2)	2 (0.9)	4 (1.9)	6 (1.4)	11 (1.3)
Calcification	8 (3.7)	5 (2.3)	13 (3.0)	6 (2.8)	10 (4.7)	16 (3.7)	29 (3.4)
C. tenuicolis	7 (3.3)	5 (2.3)	12 (2.8)	7 (3.3)	9 (4.2)	16 (3.7)	28 (3.3)
Total Shoats	78 (36.3)	76 (35.3)	154 (35.8)	69 (32.1)	95 (44.2)	164 (38.1)	318 (37.0)

Species:  $X^2=1.308$ ,  $p=0.934$  Age:  $X^2=13.126$ ,  $p=0.593$

Out of 50 total hearts condemned due to gross abnormalities, pericarditis contributes 52% (26/50). There was no significant difference ( $p>0.05$ ) between the age groups and between the two species (**Table 5**).

**Table 5.** Cause of heart condemnation.

Abnormalities	Animal species and Age groups, n (%) of cause of condemnation						
	Sheep			Goats			Total
	(n=430)			(n= 430)			
Lesions	Young	Adult	Total	Young	Adult	Total	Shoats
	(n=215)	(215)	(n=430)	(n=215)	(n=215)	(n=430)	(n=860)
Nephritis	9 (4.2)	11 (5.1)	20 (4.7)	8 (3.7)	5 (2.3)	13 (3.0)	33 (3.8)
Calcification	4 (1.9)	6 (2.8)	10 (2.3)	5 (2.3)	4 (1.9)	9 (2.1)	19 (2.2)
Abscess	3 (1.4)	1 (0.5)	4 (0.9)	3 (1.4)	4 (1.9)	7 (1.6)	11 (1.3)
Nephrosis	9 (4.2)	10 (4.7)	19 (4.4)	7 (3.3)	5 (2.3)	12 (2.8)	31 (3.6)
Total Shoats	25 (5.8)	28 (13.0)	53 (12.3)	23 (10.7)	18 (8.4)	41 (9.5)	94 (10.9)

Species:  $X^2=1.783$ ,  $p=0.776$  Age:  $X^2=14.567$ ,  $p=0.226$

Renal problems were observed in 94 of the total kidneys examined. Nephritis contributes 35.1% (33/94). There was no statistically significant difference ( $p>0.05$ ) between age groups as well as among species (**Table 6**).

**Table 6.** Causes of kidney condemnation.

Abnormalities	Animal species and Age groups, n (%) of cause of condemnation						
	Sheep			Goats			Total
	(n=430)			(n= 430)			
Lesions	Young	Adult	Total	Young	Adult	Total	Shoats
	(n=215)	(215)	(n=430)	(n=215)	(n=215)	(n=430)	(n=860)
Nephritis	9 (4.2)	11 (5.1)	20 (4.7)	8 (3.7)	5 (2.3)	13 (3.0)	33 (3.8)
Calcification	4 (1.9)	6 (2.8)	10 (2.3)	5 (2.3)	4 (1.9)	9 (2.1)	19 (2.2)
Abscess	3 (1.4)	1 (0.5)	4 (0.9)	3 (1.4)	4 (1.9)	7 (1.6)	11 (1.3)
Nephrosis	9 (4.2)	10 (4.7)	19 (4.4)	7 (3.3)	5 (2.3)	12 (2.8)	31 (3.6)
Total Shoats	25 (5.8)	28 (13.0)	53 (12.3)	23 (10.7)	18 (8.4)	41 (9.5)	94 (10.9)

Species:  $X^2=4.124$ ,  $p=0.7189$  Age:  $X^2=6.759$ ,  $p=0.873$

The major pathological lesions that caused carcass to be rejected from international market was bruising with the amount of 39.6% (21/53), followed by abscess and adhesion 20.7% each (11/53) among the rejected organs. There was no statistically difference ( $p>0.05$ ) between age groups as well as between the two species (**Table 7**).

**Table 7.** Causes of carcass condemnation.

Abnormalities	Animal species and Age groups, n (%) of cause of condemnation						
	Sheep			Goats			Total
	(n=430)			(n=430)			
Lesions	Young	Adult	Total	Young	Adult	Total	Shoats
	(n=215)	(n=215)	(n=430)	(n=215)	(n=215)	(n=430)	(n=860)
Bruising	1 (0.5)	7 (3.3)	8 (1.9)	8 (3.7)	5 (2.3)	13 (3.0)	21 (2.4)
Jaundice	3 (1.4)	3 (1.4)	6 (1.4)	1 (0.5)	3 (1.4)	4 (0.9)	10 (1.2)
Abscess	4 (1.9)	2 (0.9)	6 (1.4)	3 (1.4)	2 (0.9)	5 (1.2)	11 (1.3)

Adhesion	3 (1.4)	2 (0.9)	5 (1.2)	0 (0)	6 (2.8)	6 (1.4)	11 (1.3)
Total Shoats	11 (5.1)	14 (6.5)	25 (5.8)	12 (5.6)	16 (7.4)	28 (6.5)	53 (6.2)

### Assessment of Direct Economic Loss

Using all necessary information in the formula set by Ogunrinade and Ogunrinade <sup>[31]</sup> the annual direct economic loss from international and domestic markets of organs and carcass at ELFORA export abattoir was estimated to be 16,007,448.2 ETB (827,686.05 USD) (1 USD=19.34 ETB) (Table 8).

**Table 8.** Findings of the study used in the direct economic analysis.

Organs/Carcass	Species of animaland		Average annual		Average price of	
	rejection rates		slaughter	rates	Organs/Carcass	
	Sheep (%)	Goats (%)	Sheep (n)	Goats (n)	on market	
Liver	51.86%	45.58%			3.45	USD/Kg
Lung	35.81%	38.14%			3.25	ETB/Kg
Heart	5.81%	5.81%	50,000	250,000	3.75	ETB /Kg
Kidney	12.32%	9.53%			3.45	USD/Kg
carcass	5.80%	6.51%			3.45	USD/Kg

## DISCUSSION

Meat inspection is commonly perceived as the sanitary control of slaughter animals and meat. The aim of meat inspection is to provide safe and wholesome meat for human consumption. The responsibility for achieving this objective lies primarily with the relevant public health authorities who are represented by veterinarians and meat inspectors at the abattoir stage. Meat inspection and meat hygiene shall make sure that meat and meat products are safe and wholesome for human consumption. The classical antemortem and postmortem procedures were designed to detect disease in an animal before slaughter and the lesions produced by the disease after slaughter respectively <sup>[32]</sup>.

The present study revealed that parasites and poor management practices are the major causes of organs and carcass condemnation. Parasitic causes like *Stelesia hepatica*, *Cysticercus tenuicollis*, fasciolosis and hydatidosis were found to be the major parasitic conditions responsible for organ condemnation. The major management practices that rendered organs and carcasses unfit for human consumption were bruising of the carcass mainly brought about by mishandling of animals during transportation to the slaughter houses and mechanical damage to organs due to faulty evisceration. In addition, the higher rate of occurrence of pneumonic and emphysematous lungs and poor meat quality are related to mishandling. In the present study, hydatid cysts were more frequently observed in the livers than lungs of small ruminants. The most common site for hydatid cyst was the liver followed by the lungs in the Middle East <sup>[15,33]</sup>. The presence of small ruminant hydatidosis at slaughter houses has been documented in Ethiopia <sup>[34]</sup>. Bekele et al. reported a prevalence rate of 16.4% in sheep which is higher than the finding in this study (1.6% in liver and 1.2% in lung). Similarly Jobre et al. <sup>[12]</sup> reported prevalence rates of 11% and 6% from South Omo and Jibat <sup>[22]</sup> reported prevalence rates of (4.3%) in sheep and goats in Bishoftu.

The low occurrence in this study is explained by the fact that increased international market demand and population growth has resulted in shortage of animal supply, hence, many younger animals are slaughtered now than the previous years. Hydatidosis is maintained as a major zoonotic disease in the country because small ruminants are mainly slaughtered at the backyard for home consumption without any veterinary inspection, the absence of rigorous and enforced meat inspection legislation and the long standing habit of feeding offal to dogs. The presence of large number of stray dogs exacerbates the problem. Animals transported on foot suffer from transportation stress and lack of feed and water. Those which were transported on open trucks are overcrowded. Furthermore, animals are suffocated at the lairages <sup>[35]</sup> and there was short resting time before slaughter for the animals to recover from physical stresses. These conditions were causes of pneumonia and emphysema as observed at a higher magnitude in this study. This indicates also violation of animal welfare stretching from farm to slaughter. Pneumonia was the major cause of lung condemnation both in sheep and goats. Pneumonia might be also a result of endemic diseases of sheep and goats such as pasteurellosis, which is triggered by stress and contagious caprine pleura pneumonia. Losses from liver condemnation are generally associated with infections of public health importance and for aesthetic reasons <sup>[36]</sup>.

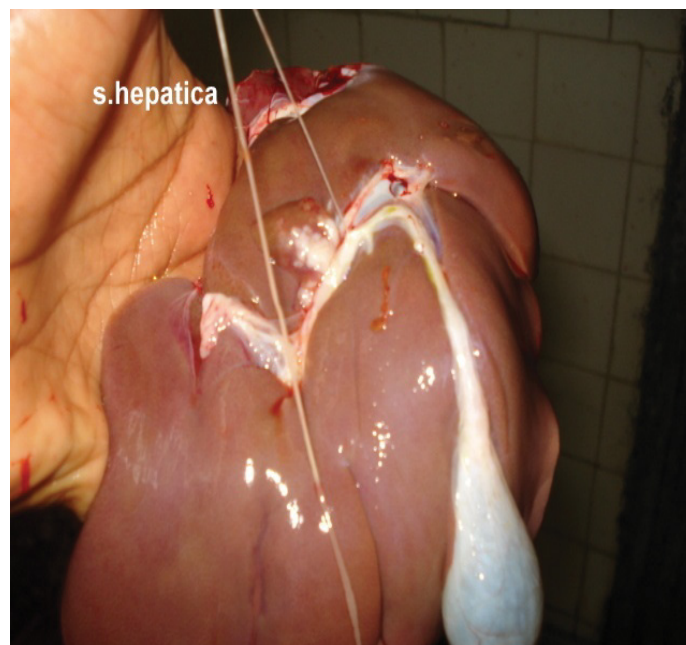
Almost half of livers were condemned due to parasites. The rate of livers condemned in this study (48.7%) was relatively higher than a report in Kenya where 5.2% was recorded <sup>[37]</sup>. Higher rate of liver condemnation was reported by Ezana <sup>[23]</sup> 76.8%, but relatively lower rate of liver condemnation was reported by Jibat <sup>[22]</sup> 43.8% in the same area in Ethiopia. The slightly higher rate of fasciolosis observed in sheep than in goats could be due to their feeding behavior in which sheep are usually grazers and goats tend to be more of browsers making them less exposed to the parasite. About 32.9% of the kidneys were condemned due to mechanical damage that was caused by faulty practices during evisceration. Higher frequencies of mechanical damages were observed in young sheep than adults which might be related to the difficulty associated with the removal of liver from the former.

Bruising (39.6%) caused almost half of all carcasses condemned. Bruising occurs due to beating of animals during transportation and the use of rough vehicles. Apart from affecting carcass value, bruising has also animal welfare implications

as excessive use of sticks while driving to the abattoir, mishandling of animals during loading and unloading, improper transport vehicle and at slaughter could be responsible causes [38]. Bruising could also result in the slaughter houses when animals struggle during slaughter [39] as stunning of small ruminants was not practiced at HELMEX abattoir in particular and in other abattoirs in general in Ethiopia. It has been suggested that bruising during transportation is the major source of economic loss in Africa and Asia [35]. During red meat production, major contamination occurs in the abattoir during skinning and evisceration, that some contamination could occur during transport, lairage and deboning and that the most effective control point is in the chiller. Therefore, it is absolutely essential for meat inspectors to ensure that skinning and evisceration are done properly [32].

Hepatitis, *Stilesia hepatica*, pneumonia, pericarditis, nephritis, and bruising, were important causes for the condemnation of edible organs like liver, lung, heart, kidney and carcasses in this study. Similarly, the same causes were found at Gondar [22,24,40] at HELMEX abattoir. Though *Cysticercus tenuicollis* and *Stilesia hepatica* do not have public health importance, they are considered as important cause of economic loss in the meat industry since viscera harbouring them are rejected for aesthetic reasons. The threat these parasites pose to small ruminants meat industry in Ethiopia is evident due to the present situation of improper disposal of offal at abattoirs and backyard slaughter. The presence of freely roaming stray dogs on grazing land together with livestock and the deep rooted habit of feeding dogs with offal, including sheep and goats heads, are important risk factors. This may lead to the perpetuation of the life cycle between intermediate hosts (ruminants) and the final hosts (dogs) for *Cysticercus tenuicollis* and hydatidosis.

The economic loss in the abattoir was relatively high because of its export standard. However, this study analyzed those losses only through condemnation of edible organs and carcass from international market. A total loss of 827,686.05 USD or 16,007448.2 ETB was incurred in the abattoir which is lower than the report of Sisay [24] and higher than Ezana [23] total annual financial loss due to organs and carcass condemnation of 548,128,894.10 ETB and 1,418,253.5 ETB respectively on study conducted at HELMEX abattoir. However, rejected carcass unfit for international market but fit for domestic market including approved lung and heart were sold with salvage value (heart and lung) in Bishoftu town in a very low price. The above figure / amount of loss did not include the loss from poor flaying techniques that downgrades the quality and quantity of skins which is also the main source of foreign currency of the country (**Figure 1**). Liver condemnation accounts highest part of the losses (48.7%) of the total direct losses whereas lung, heart, kidney and carcass takes 37.0%, 5.8%, 10.9% and 6.3% respectively. The indirect losses from body weight gain, mortality at the farms, public health implications were not included in the analysis in this study. Thus, the total economic loss attributable to diseases of small ruminants and, hence, abattoir wastage could be much higher. The economic analysis of livestock diseases in Ethiopia is scarce and inadequate because of lack of information on the prevalence and partly by the complexity of the analysis. Negategize et al. [41] have reported a financial loss associated with liver condemnation due to *Ovine fasciolosis* alone in the central highlands of Ethiopia amounting to be 2.3 million ETB (460,000 USD). Similarly [12,42] have estimated a total annual loss of 1.3 million Ethiopian Birr (260,000 USD) resulting from offal condemnation and carcass weight loss.



**Figure 1.** Major post mortem findings recorded in ELFORA abattoir, Bishoftu.

## CONCLUSION AND RECOMMENDATIONS

Disease and poor management practice were the major concern to the livestock industry as it causes extensive financial waste as a result of direct and indirect economic losses. According to the result of the study hepatitis, *Stilesia hepatica*, pneumonia,

pericarditis, nephritis and bruising were the major causes for respective organs and carcass of shoats to be rendered from international and domestic market. There was statistically significance difference ( $p < 0.05$ ) among causes of liver condemnation between young and adult as well as between sheep and goats. Annually the abattoir losses about 16,007,448.2 ETB (827,686.05 USD) per annum. Monitoring disease conditions and management practices of animals that have public health hazard, aesthetic value and consequently of economic significance was fundamental. Since most of the observed conditions were causes of organs and carcass condemnation, it had great financial losses. So as to reduce these losses, the following recommendations are worth mentioning:

- Education of farmers, urban dwellers, abattoir workers, butchers and dog owners on proper disposal of offal.
- Immediate, safe and controlled elimination of all condemned abattoir materials and contaminated offals.
- Back yard slaughter of small ruminants should strictly be controlled by the government.
- Regular deworming of dogs and elimination of stray dogs should be practiced and training of worker's procedures and cares during flaying and evisceration should be done.
- Standard regulations and functional meat inspection policies should be formulated for organs and carcass approval/ rejection for abattoirs in order that a positive relation with importing countries and profitable and sustainable international meat trade relationships to continue.
- Different workshops should be prepared to enhance the awareness of the animal attendants, farmers, customers, abattoir workers and butchers pertaining the public health significance of the diseases and proper disposal of condemned offals and carcasses.

Further studies should be carried out in small ruminants that are going to be slaughtered in different abattoirs of the country and introduce preventive measures to reduce unnecessary financial losses encountered in the industry.

## **REFERENCES**

1. Delgado C, et al. Livestock to 2020: The next food revolution. Food, Agriculture and the Environment. Discussion 1999. Paper. 28. IFPRI/FAO.
2. Delgado C. Rising demand for meat and milk in developing countries. implications for grass lands based livestock production. Grassland: a global resource. 2005; pp: 540-563.
3. Funk C, et al. A climate trend analysis of Ethiopia. Climate change adaptation series. U.S. Geological Survey. Famine Early Warning Systems Network-Informing (FEWSNET). 2012; Fact sheet 3053. p: 6.
4. CSA (Central Statistical Authority). Housing and Population Census of Ethiopia: Results for Oromia Region, Addis Ababa, Ethiopia. 2011;1:22.
5. Devendra C and Meclorey G. Goat and sheep production in the tropics. Singapore, Longmont. 1990; pp: 1-5.
6. Gatenby RM. Sheep: The tropical agriculturalist. London and Basingstoke, Macmillan education Ltd., ACCT. 1991; pp: 6-10.
7. CSA (Central Statistical Authority). Agricultural sample survey 2010-2011. Report on livestock and livestock characteristics. Statistical Bulletin No, 2011;2:505.
8. Fletcher I and Zelalem A. Small ruminant productivity in central Ethiopia mixed farming system, Institute of agricultural research. Proceeding of the 4th national livestock improvement conference. Addis Ababa, Ethiopia;1991.
9. Teferi M. An epidemiological study on ovine pasteuriosis in Arsi, South East Ethiopia. Bishoftu: Faculty of Veterinary Medicine, Addis Ababa University, DVM Thesis. 2000.
10. Jacob L. Seminar for Animal Health Officials. Ministry of Agriculture and Settlement, Animals and Fisheries Authority, Addis Ababa, Ethiopia;1979.
11. Abebe G. Current status of veterinary education and health research in Ethiopia. In: Veterinary medicine impact on human health and nutrition in Africa Proceeding of an international conference ILRI, Addis Ababa. 1995; pp: 133-138.
12. Jobre Y, et al. Hydatidosis in three selected regions in Ethiopia: An assessment trial on its prevalence, economic and public health importance. Rev Med Vet 1996;11:797-804.
13. Gracey JF. Meat Hygiene. 8th edn. Baillere Tindall, London;1986.
14. Teka G. Meat hygiene. In: food hygiene principles and methods of food borne diseases control with special reference to Ethiopia. 1997; pp: 99-113.
15. Vanlongtestijin JG. Integrated quality meat safety: A new Approach. Meat foc Int 1993;2:23-128.
16. Abo-Shehada MN. Some observations on hydatidosis in Jordan. J Helminthol 1993;6677:248-252.



17. Nfi AN and Alonge DO. An economic survey of abattoir data in Fako division of south West province, Cameron. *Bull Anim Hlth Prod Afr* 1987;35:239-242.
18. Sirak A. Causes of organ condemnation in Bahir Dar abattoir. Proceeding of the 4th South West province, Cameroon. *Bull Anim Hlth Prod Afr* 1991;35:239-242.
19. Libby JA. *Meat Hygiene*. 4th edn. Lea and Febiger, Philadelphia. 1975; pp: 40-160.
20. Jembere S. A survey of causes of organs/carcass condemnation in slaughtered cattle at Nazareth abattoir. Bishoftu: Faculty of Veterinary Medicine, Addis Ababa University, DVM Thesis; 2002.
21. Yimam M. Major causes of organ condemnation in ruminants slaughtered at Gondar abattoir, North West Ethiopia. Bishoftu, Faculty of Veterinary Medicine, Addis Ababa University, DVM Thesis;2003.
22. Aseffa M. Parasitic causes of carcass/organ condemnation at Asella municipality Abattoir. Bishoftu: Faculty of veterinary Medicine, Addis Ababa University, DVM;2005.
23. Jibat T. Causes of organ and carcass condemnation in small ruminant slaughtered at HELIMEX abattoir. Bishoftu: Faculty of Veterinary Medicine, Addis Ababa University, DVM Thesis;2008.
24. Ezana G. Major diseases of export oriented livestock in Export abattoirs in and around Ada'a liben wereda, Bishoftu. Faculty of Veterinary Medicine, Haramaya University, DVM Thesis, Haramaya, Ethiopia; 2008.
25. Sisay D. Study on the major health problems that causes carcass and organs condemnation at Hashim's export abattoir, Bishoftu. Faculty of Veterinary Medicine, Jimma University, DVM Thesis, Jimma, Ethiopia, 2011.
26. NMSA National Meteorology Service Agency. Addis Ababa, Ethiopia, 2003.
27. NMSA National Meteorology Service Agency. Addis Ababa, Ethiopia, 2011.
28. Steele M. *Goats: The tropical Agriculturist*. Macmillan Education Ltd, ACCT. London. 1996; pp: 79-83.
29. Thrusfield M. *Veterinary epidemiology*. 2nd edn. Blackwell Science Ltd, UK, 2005; pp: 182-198.
30. Cannon M and Roe RT. *Livestock disease survey. Afield Manual for Veterinarians*. Australian Government published services, Canberra, Australia. 1982;17:54-90.
31. FAO. *Meat inspection manual for developing countries*, Rome, Italy. 1994.
32. Ogunrinade A and Ogunrinade B. Economic importance of bovine fasciolosis in Nigeria. *Trop Anim Hlth Prod* 1980;12:155-160.
33. Herenda D, et al. FAO: *Animal Production and Health. Manual on Meat Inspection for Developing Countries*, Food and Agriculture Organization of the United Nations, Rome, Italy. 2000.
34. Kamhawi S. Prevalence of hydatid cysts in livestock from the five regions in Jordan. *Ann Trop Med Hyg* 1995;8899:621-629.
35. Yitbarek D, et al. Prevalence of hydatidosis of Sheep Slaughtered at Abergelle Export Abattoir, Mekelle, Northern Ethiopia. *Glo Vet* 2012;9:490-496.
36. Mitchell JR and Slough CA. *Guide to meat inspection in the tropics*. Common wealth Bureau of Animal Health, UK. 1980.
37. Nurit M, et al. Major Cause of Liver Condemnation and Associated Financial Loss at Kombolcha ELFORA Abattoir, South Wollo, Ethiopia. *Europ J Appl Sci* 2012;4:140-145.
38. Mungube EO, et al. The prevalence and economic significance of *Fasciola gigantica* and *Stilesia hepatica* in slaughtered animals in the semi-arid coastal Kenya. *Trop Anim Hlth Prod*. 2006;3388:475-483.
39. Edward DS, et al. Meat Inspection and overview of present practice and future trend. *The Vet J* 1997;154:135-147.
40. Gracey JF, et al. *Meat Hygiene*. 10th edn, Bailliere Tindall, London. 1999; pp: 223-260.
41. Zeleke A and Tesema T. Historical milestones of Bishoftu Agricultural Research Center (DZARC) in half a century (1995-2005) bulletin of golden jubilee. 2005; p: 5.
42. Negategize K, et al. Financial losses caused by ovine fasciolosis in Ethiopian highlands. *Trop Anim Healt Prod* 1993;23:155-167.