

A Retrospective Study on the Causes of Carcass and Organ Condemnation and Financial Loss in Debrezeit Helmex Abattoir

Jalel Negero^{1*} and Geremew Ferede²

¹College of Agriculture and Veterinary Medicine, School of Veterinary Medicine, Jimma University, Jimma, Ethiopia

²Faculty of Veterinary Medicine, University of Gondar, Jimma, Ethiopia

Abstract

Objectives: To assess the major causes of organ and carcass condemnation of sheep and goats slaughtered at Hashim Nurs' Ethiopian Livestock and Meat Export (HELMEX) abattoir and to estimate the magnitude of direct financial loss attributed to the condemned organs and carcasses.

Methods: A retrospective data of four year period from October 2005 to October 2008 was analyzed to identify the causes of organs and carcass condemnation in slaughtered sheep and goats at HELMEX abattoir of Debre Zeit. The international and domestic average price during the four year period was used to calculate the financial losses.

Results: A total of 1,883,652 small ruminants (1,36,484 sheep and 1, 747, 168 goats) were slaughtered in the four year period and 313,331 (16.63%) livers, 215,185 (11.42%) lung, 104,368 (5.54%) heart, 133,295 (6.02%) kidney, 107,748 (5.72%) brain and 27,153 (1.44%) carcasses were condemned due to gross abnormalities. The present survey revealed that hepatitis (33.27%) in the liver, pneumonia (48.19%) in the lung, pericarditis (92.37%) in the heart, nephritis (65.13%) in the kidney, *Coenurus cerebralis* (70.14%) in the brain and bruising (21.71%) in the carcass were found to be the major condition responsible for the respective organs and carcasses condemnation. Annual financial losses from domestic and international market of carcass at HELMEX abattoir in a period of 4-years was 174 million of USD/1,476 millions of ETB.

Conclusion: The result of present work suggest that immediate control and prevention of the prevailing conditions which helps the country to compete in the current attractive market there by increase the foreign exchange earnings.

Keywords: Economic losses; Export abattoir; Goats; Organs; Carcass; Condemnation; Sheep

Introduction

Small ruminants are the vital source of milk, meat, fibers and pelts in almost all the countries of the world and they also serve as means of risk alleviation during crop failures, property security, monetary saving and investment in addition to many other socio economic and cultural functions [1]. In Ethiopia, there are about 23.62 and 23.33 million sheep and goats respectively [2]. However, their contribution to the country's socio-economic sphere is considered below its potential, when compared with their size and diversity due to some infectious and non-infectious diseases, poor nutrition, poor husbandry and poor infrastructure [3]. These above mentioned and other factors like mortality; inferior weight gain and condemnation of edible organs at slaughter [4] are responsible for significant economic losses occurred each year in the different abattoirs of Ethiopia.

In Ethiopia, various studies have been conducted through abattoir survey to determine the prevalence and economic importance of organs and carcass condemned in cattle [5,6]. For example, data reported from Hashim Nurs' Ethiopian Livestock and Meat Export (HELMEX) abattoir showed that, out of 2688 sheep and goats examined, 2898 organs (lung, heart, liver and kidney) were condemned [7]. However, still the sufficient information is not available with regards to cause of organ and carcass condemnation in small ruminants. Therefore, the objectives of this study were to assess the significant causes of organ and carcass condemnation of sheep and goats slaughtered at HELMEX abattoir and to estimate magnitude of direct financial loss attributed to the condemned organs and carcasses.

Materials and Methods

Study area

The study was conducted at HELMEX abattoir, Bishoftu, from October 2009 to March 2010. The abattoir is a privately owned export abattoir exporting beef, mutton, lamb, goat meat and edible organ like liver, kidneys and brain of sheep and goats to Middle East countries. The abattoir is found in Debre Zeit town, which is located at 9°N and 40°E with an altitude of 1880 m a.s.l in central highlands of Ethiopia at 47 km South East of Addis Ababa capital city. It has annual rainfall of 1151.6 mm of which 84% fall down during the long rainy season that extends from June to September and the remaining during the short rainy season that extends from March to May. The mean annual minimum and maximum temperature are 8.5°C and 30.7°C respectively [8].

Study design and sample populations

The retrospective type of study design for the period of 2005 to 2008 was carried out at HELMEX abattoir using abattoir record book. In this record book, small ruminants originated from the low land areas of Afar, Somali, Southern Nations Nationalities and Peoples Regional

*Corresponding author: Jalel Negero, College of Agriculture and Veterinary Medicine, School of Veterinary Medicine, Jimma University, Jimma, Ethiopia, Tel: 020-25869599; E-mail: negerojalel@gmail.com

Received July 14, 2017; Accepted August 28, 2017; Published August 29, 2017

Citation: Negero J, Ferede G (2017) A Retrospective Study on the Causes of Carcass and Organ Condemnation and Financial Loss in Debrezeit Helmex Abattoir. J Vet Sci Technol 8: 466. doi: 10.4172/2157-7579.1000466

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States (SNNPRS) and Oromia region of the country were the sources of the sampling population.

Sample size calculation and data collection methods

The sample size was determined based on the purposive sampling of retrospective record. Data on the sex, number of condemned organs, causes of condemnation and price of organs and carcass in the international and domestic market was collected from abattoir record book. Comparison was made between the two species (sheep and goats) on major causes of condemnation.

Data management and statistical analysis

Data generated from retrospective documented data of meat inspection were recorded in the Microsoft excel 2000 program and descriptive statistics like percentage was used to determine the level of organs and carcass condemnation rates which was defined as proportion of condemned organ and carcass to the total number of organs and carcass and species of animals were evaluated by person's chi-square (χ^2) and difference were regarded statistically significant if P-value ≤ 0.05 using STATA.

Assessment of direct financial loss

To assess the economic losses, only the direct financial losses due to rejection of organs and carcasses from international market were considered. To calculate financial loss the formula given below were used by considering the average market price of each organ and carcass from interviews made with personnel of the abattoir and marketing department. Then the information obtained through interviews was subjected to mathematical computation by modifying the formulation or ogurinate and ogurinate [9] for liver rejection according to the following formula.

$$EL = \sum sr_x \cdot Coy \cdot Roz$$

Where, EL: estimated annual economic loss due to organ/carcass condemnation from international/domestic market.

Srx: annual sheep/goats slaughter rates of the abattoir.

Coy: average cost of each sheep/goats liver/lung/kidney/heart/brain/carcass.

Roz: condemnation rates of sheep/goats liver/lung/heart/kidney/brain/carcass.

To calculate economic loss by using the above formula the following data was considered: The annual slaughter rates of the abattoir, the average retail market price of an organ in Debre Zeit town and the rejection rate of specific organs. The price of domestic and international market was mentioned as shown in the Table 1.

Results

Abattoir surveys

A total of 1,883,652 small ruminants (sheep 136,484 and goats 1,747,168) slaughtered in the four year period and 313,331 (16.63%) livers, 215,185 (11.42%) lung, 104,368 (5.54%) heart, 133,295 (6.02%) kidney, 107,748 (5.72%) brain and 27,153 (1.44%) carcass were condemned due to gross abnormalities as unfit for domestic and international markets (Figures 1 and 2). In both sheep and goats, liver (16.63%) and lung (11.42%) were found to be the most frequently condemned organs. However, the frequency of condemnation was higher in sheep compared to goats and the difference was statistically

significant ($p < 0.05$). Similarly, statistically significant difference was observed in the condemnation rates of kidney, heart, brain and carcass between the two species ($P < 0.05$).

Chi square (χ^2) values were calculated to test if significant difference occurs between sheep and goats in condemnation rate of liver, lung, kidney, heart, brain and carcass. The values that are observed were 168865.78, 1119596.44, 172533.44, 39934.57, 202402.88 and 9952.56 and all are greater than the tabulated value (3.841) and a statistically significant difference exists between rejected organs and carcasses of both species of animals.

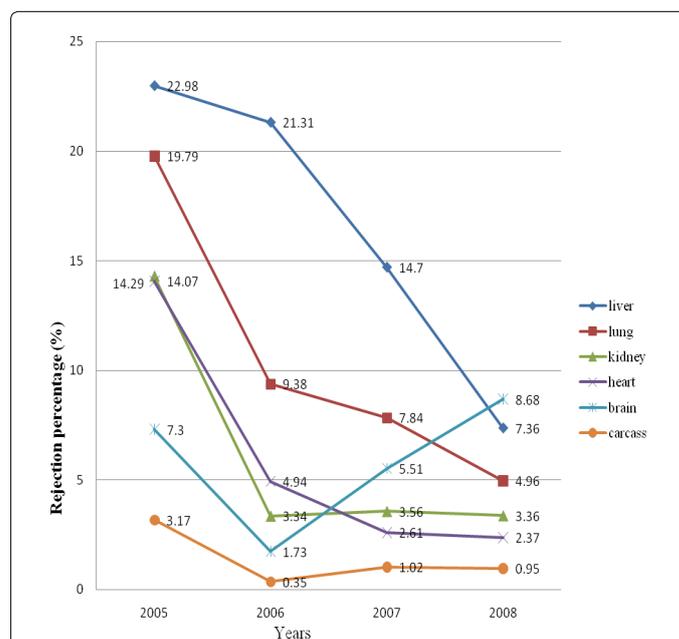


Figure 1: Trend of organ and carcass condemnation from 2005 to 2008 at HELMEX abattoir in goats.

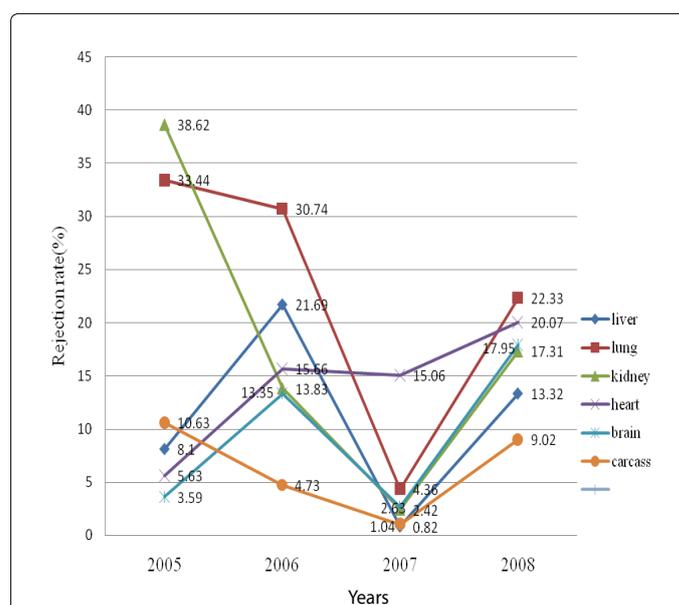


Figure 2: Trend of organ and carcass condemnation from 2005 to 2008 at HELMEX abattoir in sheep.

Types of organs	Unit price of organ (in ETB/USD)	
	Caprine	Ovine
Liver	0.40 (2.75 USD/kg)	0.40 (2.75 USD/kg)
Lung*	0.25	0.25
Kidney	0.20 (2.75 USD/kg)	0.20 (2.75 USD/kg)
Heart*	0.20	0.20
Brain	0.75 (2.75 USD/kg)	0.75 (2.75 USD/kg)
Carcass	3.00 (2.75 USD/kg)	3.00 (2.75 USD/kg)

*Organs not exported; Source: HELMEX Abattoir records (2005-2008)

Table 1: The price of edible organs/carcass in local and international market in HELMEX abattoir.

Major cause	Number and percentage of rejection liver							
	Caprine				Ovine			
	2005	2006	2007	2008	2005	2006	2007	2008
Calcification	3285(14.83)	12897(7.95)	4868(15.4)	4975(15.04)	2178(11.54)	2454(15.37)	3124(7.53)	1849(22.79)
Hepatitis	6841(30.89)	58411(35.99)	30028(46.42)	9532(28.82)	6841(36.24)	3795(23.76)	6727(15.49)	116(1.43)
<i>St. hepatica</i>	2014(9.09)	47311(29.15)	14709(22.74)	4661(14.09)	3762(19.93)	2195(13.74)	18427(44.40)	1263(15.57)
<i>C. tenuicollis</i>	5768(26.05)	16755(10.32)	7029(10.87)	4730(14.30)	733(3.88)	2870(17.97)	3425(8.25)	1048(12.92)
Fasciolosis	993(4.48)	1887(1.16)	1877(2.90)	5622(17.00)	3312(17.55)	1544(9.67)	3808(9.18)	509(6.27)
Abscessation	421(1.90)	5313(3.27)	2132(3.30)	612(1.85)	2889(1.58)	288(1.80)	2683(6.46)	340(4.19)
Cirrhosis	457(2.06)	6510(4.01)	2140(3.31)	982(2.97)	398(2.11)	296(1.85)	1378(3.32)	345(4.25)
<i>C. ovis</i>	89(0.40)	298(0.18)	103(0.16)	209(0.63)	125(0.66)	85(0.53)	128(0.31)	98(0.21)
Hydatid cyst	493(2.23)	8401(5.18)	964(1.49)	400(1.21)	298(1.58)	248(1.555)	1234(2.97)	350(4.31)
Other*	1785(8.06)	4533(2.7)	828(1.28)	1349(4.08)	942(4.99)	2195(13.74)	868(2.09)	2195(27.06)

*Numbers in bracket indicate percentages; *Include jaundice and tubercle lesion

Table 2: Causes of liver condemnation at HELMEX abattoir during 2005-2008.

Liver condemnation

The liver condemnation rates due to various causes (Table 2) in sheep and goats in the respective organs were average percentage of 16.58%+6.16 SD and 10.98%+8.79 SD respectively. The principal causes of liver condemnation were hepatitis in caprine and *Stilesia hepatica* in ovine species accounting averagely 35.53%+6.80 SD and 23.41%+12.33 SD respectively in the period of four year. Parasites diseases responsible for the condemnation of liver in both species were *Fasciola* species, *Stilesia hepatica*, *Cysticercus tenuicollis* and Hydatid cysts. There was significant statistical difference ($P<0.05$) observed in rejection of liver between two species.

Lung condemnation

In a period of four year average percentage of 10.49%+6.46 SD and 22.72%+13.12 SD lung in both species of caprine and ovine, respectively was rejected (Table 3). Both in sheep and goats the major cause of lung condemnation during four year period was pneumonia comprising average percentage of 48.13%+9.21 SD and 44.03%+12.68 SD respectively. Other causes include lung worm, tubercle lesion and Hydatid cyst which contributed to lung condemnation. There was statistical significant difference ($P<0.05$) in rejection of lung between two species.

Kidney condemnation

In a period of four year average percentage of 6.14%+4.71 SD and 18.05%+15.12 SD kidney was rejected in caprine and ovine, respectively. Nephritis was found to be the major cause of kidney condemnation in both species during four year period (Table 4) which comprising average percentage 60.43%+16.88 SD and 76.16%+3.34 SD in sheep and goats respectively. There was statistically significant difference ($P<0.05$) in rejection of kidney in both species.

Heart condemnation

Pericarditis was the major pathological lesions encountered and the major cause of heart condemnation in both species of animals and it accounts average percentage of 60.86%+15.31 SD and 76.16%+14.10 SD and played the major role in condemnation of heart (Table 5). In a period of four year average percentage of 5.99%+5.50 SD and 14.10%+6.08 SD heart in both species of caprine and ovine, respectively was rejected. There was statistically significant difference ($P<0.05$) in rejection of heart between two species.

Causes of brain condemnation

In a period of four year average percentage of 5.81%+3.01 SD and 9.38%+6.49 SD brain in both species of caprine and ovine, respectively was rejected. *Coenurus cerebralis* was found to be the sole cause of brain rejection that accounted 67.02%+4.88 SD and 74.39+1.40 S. Relatively statically significant difference was observed in rejection of brain between goats and sheep (Table 6).

Carcass condemnation

In a period of four year average percentage 1.34%+1.07 SD and 6.36%+4.33 SD Carcasses in both species of caprine and ovine, respectively was rejected. The major pathological conditions that caused carcass to be rejected from international market were emaciation with the amount of average percentage 39.99%+24.05 SD and 59.25%+8.81 SD, followed by bruising 31.16%+14.29 SD and 13.07%+55.73 SD among the rejected carcass in both caprine and ovine species respectively. There was significant statistical difference observed in rejection of carcass between the species (Table 7).

Assessment of direct financial loss

The Annual direct financial losses of the HELMEX abattoir was approximately 174 million of USD/1,476 millions of ETB due to

Slaughtered animal species								
Major cause	Caprine				Ovine			
	2005	2006	2007	2008	2005	2006	2007	2008
Pneumonia	8426(44.18)	41286(17.77)	12055(34.93)	1240(55.65)	2846(36.55)	9867(43.80)	6932(31.31)	9877(64.64)
P. emphysema	6156(32.28)	2830(3.96)	1437(21.55)	6592(29.57)	1194(15.34)	4607(20.36)	4291(19.38)	2158(14.12)
Hydatid cyst	617(3.24)	9760(13.66)	4970(14.40)	329(1.48)	558(7.17)	1760(7.78)	3145(14.20)	992(6.49)
Calcification	350(1.84)	11354(15.89)	3980(11.53)	329(1.79)	2178(27.97)	3639(16.08)	2740(12.37)	935(6.12)
Abscessaiton	282(1.48)	3560(4.98)	3124(9.05)	450(2.02)	204(2.62)	562(2.48)	3087(13.94)	359(2.35)
Other	3241(16.99)	2678(3.75)	2943(8.53)	2119(9.50)	806(10.35)	2198(9.71)	1948(8.80)	959(6.28)

Table 3: Causes of lung condemnation at HELMEX abattoir during 2005-2008.

Slaughtered animal species in year								
Major cause	Caprine				Ovine			
	2005	2006	2007	2008	2005	2006	2007	2008
Nephritis	10348(75.15)	12559(49.31)	6678(42.69)	11249(76.69)	6853(76.20)	7612(74.77)	8980(72.93)	9563(79.69)
Nephrosis	2155(15.65)	5642(22.15)	4236(27.08)	910(6.03)	292(3.25)	1046(10.28)	1280(10.40)	496(2.13)
Abscessation	248(1.80)	1643(6.45)	391(2.50)	698(4.63)	256(2.85)	561(5.51)	657(5.34)	386(3.32)
Calcification	342(2.48)	3984(15.64)	3879(24.80)	1254(8.31)	998(11.10)	398(3.91)	412(3.35)	685(7.81)
Other	676(4.91)	1642(6.45)	459(2.93)	974(6.46)	594(6.61)	563(5.53)	984(7.99)	738(7.06)

Table 4: Causes of kidney condemnation at HELMEX abattoir during 2005-2008.

Slaughtered animal species in year								
Major cause	Caprine				Ovine			
	2005	2006	2007	2008	2005	2006	2007	2008
Pericarditis	9734(71.78)	15689(41.72)	6345(55.36)	7949(74.58)	6549(50.31)	8769(76.07)	5398(76.07)	9349(79.69)
<i>C. ovis</i>	250(1.84)	928(2.47)	150(1.31)	298(2.80)	186(1.43)	229(1.99)	442(4.76)	250(2.13)
Abscessation	1682(12.40)	9876(26.26)	1689(14.74)	420(3.94)	425(3.26)	989(8.58)	958(10.32)	389(3.32)
Calcification	1062(7.83)	8925(23.73)	2399(20.93)	1219(11.44)	2948(22.65)	999(8.67)	1235(13.31)	916(7.81)
Other	833(6.14)	2189(5.82)	879(7.67)	772(7.24)	2910(22.35)	542(4.70)	1249(13.46)	828(7.06)

Table 5: Causes of heart condemnation at HELMEX abattoir during 2005-2008.

Slaughtered animal species in year								
Major cause	Caprine				Ovine			
	2005	2006	2007	2008	2005	2006	2007	2008
<i>C. cerebralis</i>	4649(61.21)	9639(73.14)	15689(64.69)	9944(68.38)	6342(76.09)	7355(74.82)	9773(73.86)	8938(72.79)
Other	2683(34.99)	3543(26.88)	8562(35.31)	4598(31.62)	1993(23.91)	2475(25.18)	3495(26.14)	3342(27.21)

Table 6: Causes of brain condemnation at HELMEX abattoir during 2005-2008.

condemnation of organs and carcasses from domestic and international market.

Discussion

Abattoirs provides information on the epidemiology of disease on livestock to know what extent the public is exposed to certain zoonotic diseases and estimate the financial losses incurred through condemnation of affected organs and carcasses [10]. In the current study, off the organs and carcass condemned both in sheep and goats, liver (16.63%) and lung (11.42%) constitute the major portions. This result is in agreement with reports of Cadmus and Adesokan [11] who recorded that lungs (45.7%) and the liver (32.9%) were the most affected organs. In contrast, the proportions of liver condemned in the current study were relatively higher than a report in Debre Zeit HELEMEX where 3.6% was recorded [7]. However, it was found to be much lower than the report of Yimam, [12] and Byazem, [13] who reports 40.6% and 53.3% from Gondar and Eastern Gojjam respectively. Low prevalence of the liver condemned encountered in the present study might be associated with the origin of slaughtered small ruminants in which all were brought from the low land areas of the country where there is no conducive ecological factors for the survival of snails intermediate host and the trematodes (*Fasciola* species) in the environment [14].

Even though liver was found to be the most frequently condemned organ (16.63%) followed by lung (11.42%), there was significant statistical difference between the rejection rates of liver between two species, in which the higher proportion of liver condemnation due to fasciolosis was observed in sheep, compared to goats. This observed difference could be partly associated with the feeding behavior where sheep are usually grazers and goats tend to be more of browsers making them less exposure to the parasites [7]. Present survey revealed that in addition to poor management practices, parasitic diseases like *Fasciola* species, *Stilesia hepatica*, *Cysticercus tenuicollis* and hydatid cysts were identified as the major causes of edible organs and carcass condemnation in both sheep and goats. In harmony with this, earlier studies from different areas of Ethiopia indicated that annual bases of higher economic loss was condemnation of edible organs and carcass due to parasitic disease [5,6,15,16].

Current retrospective study revealed that 48.19% of lungs were condemned from the total lungs inspected during 4 year study period from being used as pet food due to various reasons like pneumonia, emphysema, hydatid cysts, calcification and abscesses. Similarly, Getachew, [17] reported that pneumonia is a principal cause of lung condemnation in central Ethiopia and accounts 42.1%. Occurrence of pneumonia on current study populations might be due to,

Major cause	Slaughtered animal species in year							
	Caprine				Ovine			
	2005	2006	2007	2008	2005	2006	2007	2008
Bruising	1138(37.21)	599(22.57)	819(18.18)	2340(54.69)	534(21.58)	394(11.32)	498(9.69)	598(9.69)
Emaciation	1070(34.99)	1633(61.53)	2491(55.28)	349(8.16)	1250(50.51)	2489(71.50)	3740(57.49)	3549(57.49)
John disease	291(9.52)	52(1.96)	110(2.44)	159(3.72)	214(8.65)	32(0.92)	128(4.86)	300(4.86)
Tuberculosis	49(1.60)	86(3.24)	112(2.49)	89(2.08)	103(4.16)	142(4.08)	214(5.54)	342(5.54)
Other	510(16.68)	254(9.57)	974(21.62)	1342(31.36)	374(15.11)	424(12.18)	697(22.42)	1384(22.42)

Table 7: Causes of carcass condemnation at HELMEX abattoir during 2005-2008.

transportation stress and lack of feed and water route. Pneumonia might be also as a result of endemic diseases of sheep and goats such as pasteurellosis, which is triggered by stress, contagious caprine pleuro pneumonia [18].

The main cause of brain rejection was found to be *Coenurus cerebralis* and the highest prevalence occurred in sheep which might be associated with the grazing behaviour between two species of study animals. In line with this result, previous reports by Achenefti et al. [19] and Abdella, [15] recorded the same result from ELEFORA, Hashim and Luna export and Debre Birhan abattoir respectively. Bruising was observed as major causes of carcass condemnation and it accounts 21.71%. Similarly, Mitchell and Slough, [20] states that bruising is the major source of economic losses in Africa and Asia. A loss due to bruising is more apparent in partial and total condemnation of affected carcass [21], even though, abattoir does not export partially approved organ and carcass. Apart from affecting carcass value, bruising has also animal welfare effect due to undue use of sticks while driving to the abattoir [22]. Moreover, infectious and non-infectious diseases like pericarditis and nephritis were found to be the important causes for the condemnation of edible organs like heart, kidney Likewise, the same causes were reported from Gondar [6] and goats slaughtered at Nigeria [23].

Losses from liver condemnation were assumed to occur since hepatic pathology is associated to infection that might have public health importance [10,24] and aesthetic value. Annually losses of the HELMEX abattoir approximately 174 million of USD /1,476 millions of ETB due to condemnation of organs and carcasses from domestic and international market in a period of 4-years. This figure was found to be greater than other studies undertaken in other Ethiopia municipal abattoirs by Seid, [25] and Shiferaw, [26] who reports the annual financial losses 57,939.84 and 130,718.49 of ETB respectively. This might be due HELMEX abattoir export standard compared to other abattoirs of the country. In conclusion, the present result revealed that parasitic diseases and other pathological conditions, mechanical damage during evisceration and bruising were found to be the major causes of organ and carcass condemnations. Currently estimated financial losses due to organ and carcass condemnation at HELMEX abattoir were also found to be high. At the end, 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.

Acknowledgments

Authors would like to thanks all staff members of HELMEX exporter abattoir, University of Gondar Faculty of Veterinary Medicine and Addis Ababa University College of Veterinary Medicine and Agriculture for their kind cooperation during the study period.

Conflict of Interest

Authors have no conflict of interest.

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