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## FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

# The study of major parasitic causes of organ condemnation and financial losses in cattle slaughtered at Hawassa Municipal Abattoir, Ethiopia

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**Abstract:** The prevalence of major parasitic infections is responsible for the condemnation of major organs during meat inspection, this leads to the associated economic losses. This study was conducted from November 2010 to April 2011 on cattle slaughtered at Hawassa Municipal Abattoir. Liver, lung, heart and kidneys were the organs examined for the parasites and find that *Fasciola* spp.'s (37.19%), hydatid cyst (73.65%) and *Cysticercus bovis* (5.91%) were the main factors for condemnation of those inspected organs. Out of 406 cattle examined postmortem, 313 (77.09%) animals had at least one organ condemned due to the presence of helminth parasites. Among those 228 (56.16%), 234 (57.63%), 42 (10.34%) and 30 (7.39%) animals' liver, lung, heart and kidney were rejected respectively. Helminth parasites presence were compared among the different body conditions of animals and a statistically significant difference ( $p < 0.05$ ) was observed between presence of *Fasciola* and various body condition scores. *Fasciola* spp.'s were commonly found in animals with poor body condition (78.95%) as compared to medium (35.16%) and good (35.12%) body condition animals. In contrast, the presence of hydatid cyst and *C. bovis* were found to be insignificantly associated with the body condition score of the animal ( $p > 0.05$ ). The financial loss between 2010 and 2011 due to the condemnation of these organs was calculated to be 651,342.5 Eth birr (£20,592.03 GBP) per annum. Therefore, creation of awareness on animal attendants and/or cattle owners and abattoir workers about the effect of parasites and safe disposal of condemned organs must be made.

### ABOUT THE AUTHORS

Dr Bedaso's graduated from Addis Ababa University since July, 2010 and Dr Dinsefa Jemal graduated from Haramaya University since June, 2011. Their research interests are focused on the animal diseases and public health. The research article is the study of Major Parasitic Causes of Organ Condemnation and Financial Losses in Cattle Slaughtered at Hawassa Municipal Abattoir, Ethiopia. We interested to conduct this research because of public health and economic impact of the parasitic diseases cause on human health and country economy.

### PUBLIC INTEREST STATEMENT

The prevalence of major parasitic infections is responsible for the condemnation of major organs during meat inspection for the public health and this leads to the associated economic losses. Helminth parasites encountered during postmortem inspection that were responsible for marketable organ condemnation were hydatid cyst, *Fasciola* spp.'s and *Cysticercus bovis*. The financial loss due condemnation of these organs were calculated to be 651,342.5 Eth birr per annum according to this study. Therefore, creation of awareness on animal attendants and/or cattle owners and abattoir workers about the effect of parasites and safe disposal of condemned organs must be made.

**Subjects: Bioscience; Environment & Agriculture; Food Science & Technology**

**Keywords: abattoir; cattle; condemnation; organs**

### 1. Introduction

Ethiopia has the larger livestock population in Africa, estimated at 49 million head of cattle 47 millions of small ruminant, 2.7 million head of donkeys and about 76,000 of camel and 42 million chickens (Central Statistical Agency, 2009). Even though, the livestock subsector contributes much to the national economy, its development is hampered by different constraints. These include rampant animal diseases, poor nutrition, poor husbandry, infrastructure and shortage of trained man power and lack of government policies (PACE-Ethiopia, 2003).

In Ethiopia livestock contributes about 30.35% of agricultural gross domestic product and more than 85% of farm cash income. They provide high quality food from consumption of fibrous and unusable resource. They serve as source of cash income and means of savings, import export commodity and provide raw materials for industries like leather industry. In Africa in general and in Ethiopia in particular, the level of ruminant livestock production doesn't commensurate with its size (Berhanu, 2006).

In Ethiopia, increasing human population, coupled with expanding urbanization and higher average income is putting increasing pressure on the meat supply to meet this demand, millions of food animals are slaughter every year throughout the country primary for domestic consumption (FAO, 2009). One of the losses from endemic disease is express in terms of organ condemnations. The most commonly affected organs are liver and lung mainly due fasciolosis and hydatidosis (Teka, 1997).

An abattoir as a building for butchering can be a source of valuable information of the incidence of animal disease and condition. Some of which may be zoonotic. It is food factory whose primary animals to produce health, wholesome and clean products which are safe for human consumption. In adequate care of those food animals reduce their productivities and expose them to different forms of disease agent which may became hazardous to man and his environment (Cadmus & Adesokan, 2009). Abattoir also provides information on the bases of the epidemiology of disease on the livestock, to know to what extent the public is exposed to certain zoonotic disease and estimate the financial losses incurred through condemnation of affected organs and carcass (Nif & Alonge, 1987; Vanlongtestijin, 1993). Each year a significant financial losses result from weight loss, condemnation of edible organs and carcass at slaughter and this production loss in livestock industry is estimated at more than 900 million USD annually (Abebe, 1995; Jobre, Lobago, Tirunesh, Abebe, & Dorchies, 1996). It is necessary to be aware of the extent to which the public is exposed to certain zoonotic diseases detected in the abattoir and estimate the financial losses through condemnation of affected organs and carcass (Nif & Alonge, 1987).

Meat is an important source of protein and valuable commodity in resource poor communities. In many developing countries lack of appropriate slaughtering facilities and unsatisfactory slaughtering techniques are causing unnecessary losses of meat as well as invaluable by product from animal carcass. Slaughtering place is frequently contaminated and may not be protected against dogs, rodents and insects. In many developing countries regulations concerning meat inspection and/or control are inadequate or nonexistent allowing consumer to be exposed to pathogens including zoonotic parasite (Alemu & Merkel, 2008).

As meat is the main source of protein for man it should be clean and free from diseases of particular importance to the public such as tuberculosis (TB), hydatidosis, cysticercosis and fasciolosis (Sirak, 1991). The main cause of organ condemnation during post mortem inspection are disease originated by parasite, bacteria and virus; of these diseases liver fluke in the liver and hydatid cyst in the liver, lung and kidney are mainly involved (Teka, 1997).

Parasites in the tropics are responsible for greater losses to the meat industry than any other disease (Jobre et al., 1996). Similarly like many other tropical countries of Africa, it is well known that parasitic diseases are among the major factors responsible for the low productivity of livestock in Ethiopia (Abebe, 1995). These infestations not only cause clinical disease and mortality but also cause economic losses through production losses and condemnation of whole carcass and organs at slaughter. The latter have a huge effect in countries like Ethiopia as export beginner and its effect were seen significant in different abattoirs (Jibat, Ejeta, Asefaw, & Nusie, 2006).

Fasciolosis: *Fasciola*/liver fluke is a parasite which affects liver of mammals especially ruminants (cattle, sheep and goats) occasionally human being as an accidental host for both species, *Fasciola hepatica* and *Fasciola gigantica* (Gracey, Collins, & Holey, 1999). It is classified as acute (2–6 weeks), subacute (6–10 weeks) and chronic (4–5 months) fasciolosis based on the duration it takes to cause its pathology (Urquhart, Armoure, Duncan, Dunn, & Jennings, 1996). In line with this the affected organ have different findings like in the acute hepatic fasciolosis which is characterized by a badly damaged, swollen liver; in which the capsule may shows many small perforations and sub scapular hemorrhages, the parenchyma shows tracts of damage tissues and is much more friable than normal. On the other hand, the chronic hepatic fasciolosis characterized by the presence of a large, leaf-shape flukes in grossly enlarged and thickened bile ducts, particularly in the ventral lobe of the liver. Thus, the bile ducts may protrude above the surface of the liver; they may be seen due to the blockage of ducts with flukes and desquamated epithelial cells. The disease causes very high mortalities, especially in small ruminants and calves (Radostitis, Gay, Hinchclity, & Constable, 2007). Parasites cause a major economic loss in ruminants. These losses are associated with total condemnation of infected liver or partial condemnation through trimming of affected part of the liver, which reduce the volume of liver sold (Hansen & Perry, 1994).

Metacestodes: the presence of larvae of certain tape worms in the tissue of humans or animals results in a disease known as cysticercoids (beef/pork measles, bladder worm disease). Its effect on host depends largely on the organs involved and the degree of parasitism. In some sites, such as peritoneum and sub cutis, the cysticerci are tolerated with little reaction, but those species that invade and displace tissue in the critical organs (liver, heart and brain) may produce grave signs and death (Hayumga, Sumner, & Rhoads, 1991). In general metacestode of cattle include *Cysticercus tenuicollis* (*Taenia hydatigena*), *Cysticercus bovis* (*Taenia saginata*) and *Coenurus cerebralis* (*Taenia multiceps*) causes parasitic cyst in the carcass and offals (Urquhart et al., 1996).

Echinococcosis: Echinococcosis/hydatidosis is a zoonotic parasitic disease caused by the dog tape worm of *Echinococcus* and its larval stage, the hydatid cyst. This cestode parasite is readily recognizable in the lungs and liver of an effected animal is very much linked with geographical location. This parasite is found worldwide and causes series public health problems in certain parts of the world (Schantic, 1990). Larval echinococcosis is a disease of mammals due to the development of cysts in certain organs or visceral (Urquhart et al., 1996). The parasite in liver and lung may degenerated to form cheesy mass encapsulated in multilocular may resemble TB, but the laminated cuticular member is still present even after the cyst has degenerated and can be readily picked up with a pair of forceps (Gracey, 1986).

Echinococcosis is the cause high economic loss to the animal industry (Fesseha, 1998). Hydatidosis as the major causes of organ condemnation result in a huge economic loss in Ethiopia (Eshetu & Bogale, 1982). As infected viscera, usually both liver and lungs are lost with this parasite because this organ is unsuitable for human consumption and such meat thus is thrown away (Fesseha, 1998). Principally, condemnation is due to aesthetical value. Its presence is an indicator of the presence of zoonotic parasite in the dog population (Edwards, Johnston, & Mead, 1997). Additionally, one of the great cares to be taken is during surgical removal, because spillage of the cyst fluid in to the peritoneum contaminates the other organs (Daniel, 1995). *C. bovis* is the larval stage of *T. saginata* which occur in cattle. The cyst are essential parasites of intramuscular connective tissue and are found in heart mainly under epicardium beneath the pleura covering of diaphragmatic and in the

skeletal muscle including tongue, masseter muscle. After 8 weeks the cyst begins to degenerate, sometimes forming greenish blood stained purulent material which eventually calcifies. The parasite may be detected in routine inspection of heart, diaphragm by incisions in to the external and internal jaw muscles (Gracey, 1986). The larval tape worm (metacestode) having fluid filled cyst at atypical site in the body acts as space occupying lesions and causes a condemnation at meat inspection (Radostitis et al., 2007).

Nevertheless, proper evaluation of the economic losses due to major causes of organs condemnation in different species of animal in the country is of great relevance where economic realities often determine the type and scope of control measures to be established.

The main objectives of these studies were therefore:

- To identify the measure parasitic causes of organ condemnation at Hawassa Municipal Abattoir.
- To determine the direct economic losses of organ condemned.

## 2. Materials and methods

### 2.1. Study area

The study was conducted from November 2010 to April 2011 in Hawassa town Northern Nation Nationalities and People region Municipal Abattoir. Hawassa is the capital city of Sidama zone and the region. It is located on the shore one of the rift valley lakes and found at 275 km south of Addis Ababa. The total population of Hawassa is estimated to be 150,000, dwelling over an area of 50 km<sup>2</sup>. The annual rain fall and temperature range of the town is 800–1,000 ml and 20.1–25°C respectively. The total livestock population of Sidama zone including Hawassa is estimated to constitute 1,721,341 cattle, 228,941 goat, 457,465 sheep, 57,643 horses, 54,066 donkeys, 725,540 poultry and 44,492 beehives. Live stock production occupies an enormous share in farm economy of the area. They are kept for milk production where as equines are used for pulling carts, carrying people and goods in the town nearby villages adding to income generation employment opportunity in the town. Considerable number of small ruminant is also kept in Hawassa as income generation for poor residents. As elsewhere in rural Ethiopia the economic live of the people in the surrounding of Hawassa is mostly dependent on mixed farming in the 93% of the population is engaged in agriculture (SZARDB, 2008).

### 2.2. Study animals

The study was conducted on 406 cattle slaughtered at Hawassa Abattoir. The majority of cattle destined for slaughter were local breed (zebu), male, adult with different body condition and brought from Hawassa and towns found around (near to) Hawassa like Wolayita, Arsinagele, Tula, Shashemene, Bishan guracha. Also there were cattle that are brought from distance areas like Harar.

### 2.3. Study design

A cross-sectional type of study design was used for determining the major parasitic causes of organ condemnation via thorough inspection of organs at the time slaughter.

### 2.4. Sample size determination

The required sample size of the study animals was determined using the formula simple random sampling given in Thrushfield (2005).

$$n = \frac{1.96^2(P_{exp}(1 - P_{exp}))}{d^2}$$

where  $n$  is the required sample size,  $P_{exp}$  is the expected prevalence and  $d$  is the desired absolute precision.

A 50% expected prevalence with 95% confidence interval and 5% desired absolute precision was used to determine the sample size required for the study. Hence, substituting these values the required sample size was determined to be 384 cattle. But to increase the precision of our estimates, the total numbers of animals included in the present study were 406. The sample units were selected using simple random sampling method from those animals brought for slaughter on the scheduled day of examination.

## 2.5. Study methodology

### 2.5.1. Abattoir survey

During antemortem examination, each study animal was given an identification number and then their origin, breed, sex, age and body condition scores were recorded. The body condition score is determined in accordance with Nicholson and Butterworth (1986) and then classified in to three groups as lean/poor (score 1, 2 and 3), medium (score 4, 5, and 6) and fat/good (score 7, 8 and 9). Therefore, each recorded animal was inspected at postmortem paying attention to organs where the parasites localize (liver, lung, kidney and heart). To determine the presence of helminth parasites major organs inspection was conducted using visualization, palpation and incision. Any abnormalities encountered were judged according to FAO (1994), guidelines on meat inspection for developing countries and then the result recorded.

### 2.5.2. Financial assessment

All organs affected by parasites were totally condemned. Total direct economic loss due to parasitosis at Hawassa Municipal Abattoir was estimated by using the formula indicated below (Orgunriade & Orgunriade, 1980).

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

where EL is the annual economic loss estimated due to organ condemnation from local markets,  $\sum sr_x$  is the annual cattle slaughter rate of the abattoir, Coy is the average cost of each bovine liver/lung/kidney/heart and Roz is the rejection rate (condemnation) rates of bovine liver/lung/kidney/heart.

## 2.6. Data management and analysis

Data generated were recorded using the format prepared for this purpose and stored in Microsoft excel 2007 program. Analysis was done using STATA (version 11) statistical package (Stata Crop, 2009). Descriptive statistics was used to determine the proportion of animals whose major visceral organs were condemned, proportion of organs rejected and proportion of infection of helminthes. The former was calculated by dividing the number of animals whose organs were condemned due to helminth infection by total number of animals examined then multiplied by 100. The proportion of organ condemnation due to helminth infection was obtained by dividing the total number of organs condemned divided by total of number of organs examined and then divided by 100. The association between body condition score and type of helminth infection was assessed by Pearson chi-square ( $\chi^2$ ) and difference was regarded statistically significant *p*-value is found to be less than 0.05 at 95% confidence level.

## 3. Results

### 3.1. Proportion of organs condemned and helminthes disease distribution

Among 406 cattle that were slaughtered and thoroughly examined using the standard postmortem procedure, at least single organ was condemned from 313 (77.09%) animals due to severe helminth infection of major viscera. Of which, 228 (56.16%), 234 (57.63%), 42 (10.34%) and 30 (7.39%) animals had their livers, lungs, hearts and kidneys rejected respectively (Table 1).

**Table 1. Proportion of organ condemned due to helminthosis at Hawassa Abattoir**

Organ	Number of animals		Percent
	Inspected postmortem	Organ condemned	
Liver	406	228	56.16
Lung	406	234	57.63
Heart	406	42	10.34
Kidneys	406	30	7.39

From a total of 2030 organs examined 534 (26.3%) were rejected as a result of parasitic infection. Among each 406 organs examined, 234 (57.63%) lungs were found harbouring hydatid cysts, 228 (56.16%) livers were infested with hydatid cysts and *Fasciola* spp. and 42 (10.34%) hearts showed *C. bovis* infestation. In addition, from 812 kidneys examined, hydatid cyst was recovered from 30 (3.70%) kidneys (Tables 2 and 3).

Hydatid cyst was encountered in 359 organs, of which the highest rate was recorded in lungs (65.18%) and the least infection rate was obtained in heart (5.01%) (Table 4).

Hydatid cyst dispersed in 299 organs, of which the highest dispersion rate was recorded in lung only (60.87%) and the least dispersion rate was obtained in heart (1.67%) (Table 5).

Organ condemnation due to parasitosis was compared among various body conditions of animals and 15 (78.95%), 77 (35.16%) and 59 (35.12%) were recorded for poor, medium and good body condition score of cattle respectively. Significant difference ( $p < 0.05$ ) of the prevalence of fasciolosis was observed.

However, in case of hydatid cyst and *C. bovis* were insignificantly different  $p$  (0.231), and  $p$  (0.162) respectively.

### 3.2. Direct financial loss assessment

The annual economic loss was estimated from the summation of totally rejected organs (liver, lung, heart, and kidney) of cattle slaughtered at Hawassa Municipal Abattoir. The annual rate of organs condemnation was assessed considering the overall rejection rate of each organ, the total annual slaughtered animals and retailed market price of cattle was estimated from the retrospective abattoir record of the last two years. While the retailed market price, was determined from the interview made with the butcheries in Hawassa town. Information obtained was then subjected to mathematical computation using the formula set by Orgunriade and Orgunriade (1980) and it was found to be about 651,342.5, Eth birr (Table 5).

**Table 2. The proportion of organs rejected due to helminth infestation at Hawassa Abattoir**

Organ	Number of organ		Percent
	Inspected postmortem	Condemned	
Liver	406	228	56.16
Lung	406	234	57.63
Heart	406	42	10.34
Kidneys	812	30	3.7
Total	2,030	534	26.3

**Table 3. Organ condemnation due to helminths**

Helminths	Organ condemned							
	Liver		Lung		Heart		Kidney	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Hydatid cyst	77	18.96	234	57.63	18	4.43	30	3.7
<i>Fasciola</i> spp.	130	32.02	-	-	-	-	-	-
<i>Fasciola</i> spp. and hydatid cyst	21	5.2	-	-	-	-	-	-
<i>Cysticercus bovis</i>	-	-	-	-	24	5.91	-	-
Total	228	56.16	234	57.63	42	10.34	30	3.7

**Table 4. Site of hydatid cyst infected**

Organ	Number infected	Percentage
Lung	234	65.18
Liver	77	21.45
Heart	18	5.01
Kidneys	30	8.34
Total	359	100

#### 4. Discussion

Meat inspection is conducted in the abattoir for the purpose of screening and removing animal products with abnormal pathological lesions unsafe for human consumption and having poor aesthetic value. An important function of meat inspection is to assist in monitoring diseases in the national herd and flock by providing feedback information to veterinary services to control or eradicate diseases and to produce wholesome products and to protect the public from zoonotic hazards (Gracey et al., 1999).

In the present study 2030 organs obtained from 406 animals out of these 228 livers, 234 lung, 42 hearts and 30 kidneys were rejected from the total local market. The rejected organs which were found unfit for human consumption and as pet animal food were incinerated in the abattoir to break the life cycle of the disease transmission.

From the total cattle slaughtered parasites like fasciolosis, hydatidosis, and fasciolosis plus hydatidosis were found to be the major causes that rendered liver rejection from the domestic market. Losses from liver condemnation were assumed to occur since hepatic pathology is associated to infections that might have public health importance (Budke, Deplazes, & Torgerson, 2006; Radostitis, Blood, Gay, & Hinchclity, 2000) and aesthetic value. The highest number of liver was condemned due to *Fasciola* (32.02%) causing considerable direct economic loss in this study area. These results agree with the finding of Andualem (2007), Shegaw (2008), and Teka (1997) who stated that liver flukes in the liver and hydatid cyst in the lung among the main causes of organ rejection during post mortem.

The current study revealed that the prevalence rate of fasciolosis which was recorded to be 37.19% and there was a significant difference between fasciolosis and body conditions of slaughtered animal ( $p < 0.05$ ) and also this study shows that a lower prevalence fasciolosis were observed when compared with following study like, Berhanu (2006), Fistum (2009), Gemechu (2008) and Shegaw (2008) reported a rejection rate of 54.8, 43.7, 53.9, 50, liver due to fasciolosis at Dire Dawa,

**Table 5. Distribution of hydatid cyst on the basis of organ**

Location of cyst	Number infected	Percentage
Lung only	182	60.87
Liver only	45	15.05
Kidney only	11	3.68
Heart only	5	1.67
Lung and liver	27	9.03
Lung and kidney	15	5.02
Lung and heart	7	2.34
Liver and heart	2	0.67
Lung, heart and kidney	2	0.67
Liver and kidney	1	0.33
Liver, lung and heart	1	0.33
Liver, lung and kidney	1	0.33
Total	299	100

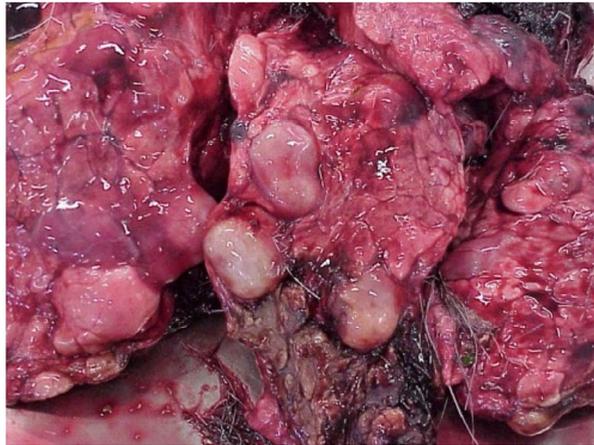
Gonder, Haramaya and Addis Ababa abattoirs respectively. The relative low prevalence of bovine fasciolosis observed in this study as compared to the findings other studies may be attributed to the agro ecological condition unsuitable for the development of snail intermediate host prevailing in the areas from which the slaughtered animals were brought. In Ethiopia bovine fasciolosis exist almost in all regions (Bahiru & Ephraim, 1979).

Hydatidosis is zoonotic disease that occurs worldwide and causes considerable economic losses and public health problem in many countries (Budke et al., 2006). It also the main disease in ruminant and man in Ethiopia affecting primary the lung and liver (Fisseha & Yilma, 1983; Teka, 1997). From the total animal examined 234 (57.6) lungs were condemned due to hydatidosis. This study shows that the prevalence rate of hydatidosis in which was recorded to be 73.65% which is higher compared with previous report made at the same study area with a prevalence 25.2% (Andualem, 2007), 64.56% (Fistum, 2009), 24.3% (Shegaw, 2008). Even a lower prevalence of bovine hydatidosis (4.8%) and 5.6% were reported in Kenya (Cerlinat, 1983) and in Libya (Mohammed, 1985) respectively (Figures 1 and 2).

**Figure 1. Liver cirrhosis by fasciolosis.**



**Figure 2. Lung infected by hydatid cyst.**



Factors governing prevalence of hydatidosis in a given locality may be associated with prevailing specific social, cultural environmental and epidemiological situation (Macpherson, 1985). In agreement with present study many research reported that liver and lung were the most commonly affected organs by hydatid cyst (Jobre et al., 1996; Urquhart, Armoure, Duncan, Dunn, & Jennings, 1997) particularly the lungs in the organ most affected by hydatidosis because at old age the liver capillaries are dilated and most cyst pass directly to the lung, secondly the cyst passes to the lung via the thoracic duct without involving the liver (Gracey, 1986).

The rejection rate of kidney and heart was not as significance as those of liver and lung and such unlike to produce the pronounced economic effect associated with the first two. During the study period bovine kidney were rejected due to hydatidosis, where as bovine heart were rejected mainly due to *C. bovis*, hydatidosis. However, *C. bovis* accounts for the most causes for the heart to be condemned, with comprised about (5.91%) of all rejected heart (Table 3).

The economic losses from rejected organs were suppressing the relative income of the butcher men in the town; however this study analyzed those losses through condemnation of organs due to helminthosis from domestic market. A total loss of 651,342.5 Eth birr in cattle was incurred in the abattoir only due to condemnation of edible organs. The above figure/amount of loss did not include the loss from poor flaying techniques that downgrades the quality of hide and other condemnation that leads to the rejection of edible organ. This study suggested that parasites particularly, fasciolosis and hydatidosis were the major causes economic loss through condemnation of affected organs. Annual losses in animal productivity due to fasciolosis were conservatively estimated to approximately 3.2 billion per annum (Spithil, Smoker, & Copeman, 1999). The result of this study clearly demonstrate the need to develop effective control measures on the prevention and control of cattle parasite so as to decrease the direct economic losses that can occur in the livestock production system of the country (Tables 6 and 7).

## **5. Conclusion and recommendations**

Disease is the major concern to the livestock industry as it causes extensive financial waste as the result of direct and indirect economic losses. According to the result of this study parasitic disease like fasciolosis, hydatidosis and *C. bovis* were the major causes for the respective organs condemnation at the abattoir, which may also reflect the same scenario in other slaughter houses in Ethiopia. Hence, this study may be valuable for the country by providing data in monitoring disease conditions and management practices of animals that have public health hazard and aesthetic value.

**Table 6. Association between fasciolosis and the body condition score of animals**

Body condition	Total	Positive	Percent	$\chi^2$ -value	df	p-value
Poor	19	15	78.95	14.8774	2	0.001*
Medium	219	77	35.16			
Good	168	59	35.12			

\*Significant.

**Table 7. Estimated over all financial loss due to organs condemned**

Examined organs	Rejection rate of organs (%)	Annual slaughter rate of cattle in the abattoir	Average market price of an organ at Hawassa town (Eth birr)	Total
Liver	56.16	18,250	50	512,460
Lung	57.63		10	105,174.75
Heart	1,034		15	28,305.75
Kidney	3.7		8	5,402
Total				651,342.5

Based on this concluding remark the following recommendations are forwarded:

- Standard regulations and functional meat inspection procedure should be properly conducted in the abattoir to provide safe and wholesome meat to the consumer.
- Condemned organs should be incinerated in a place of giving to the hyenas in order to break the live cycle of the diseases transmission.
- Enhance awareness of animal attendants, customers and abattoir workers about the public health significance of the continuous life cycle of the involved parasites.
- All condemned organs should be safely disposed, stray dogs and cats must be prohibited from abattoirs and their numbers should be systematically reduced.
- Detailed epidemiological study should be carried out for those important helminthes identified in the study.

**List of abbreviations**

- CSA Central Statistically Agency  
 EthB Ethiopia Birr  
 FAO Food Agricultural Organization  
 ILRAD International Laboratory for Research on Animal Diseases  
 km<sup>2</sup> square kilometer  
 mm millimeter  
 °C degree centigrade  
 SZARDB Sidama Zone Agricultural Development Bureau  
 TB tuberculosis  
 USD United State Dollar  
 $\chi^2$  chi-square

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#### Competing Interests

The authors declare no competing interest.

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