

Full Length Research Paper

Major causes of organ condemnation and associated financial loss in cattle slaughtered at Hawassa Municipal Abattoir, Ethiopia

Shitaye Maseresha Berbersa¹, Tilaye Shibbiru Mengistu^{1*}, and Fanos Tadesse Woldemariam²

¹School of Veterinary Medicine, Wolaita Sodo University, Ethiopia.

²College of Veterinary Medicine and Agriculture, Addis Ababa University, Ethiopia.

Received 27 July, 2016; Accepted 15 September, 2016

Carcass and organ condemnations cause big economic losses in the cattle industry. A cross sectional study was conducted from October 2015 to May 2016 with the aim of identifying gross pathological changes that cause organ condemnation and to estimate the direct financial losses attributed to the condemned organs in cattle slaughtered at Hawassa municipal abattoir. Prior to slaughter, animals were subjected to routine ante-mortem examination. Post-mortem examination was used to identify the gross pathological changes. From the total of 384 slaughtered cattle examined postmortem, 171 (44.5%) liver, 137 (35.7%) lung, 36 (9.4%) spleen, 26 (6.8%) heart, 25 (6.5%) kidney and 9 (2.3%) tongue were totally condemned. Major causes of total condemnation of organs were fasciolosis, hydatidosis, pneumonia, emphysema, cirrhosis, calcification, nephritis, splenitis, edema, *Cysticercus bovis*, hemorrhage and abscess. There was statistically significant difference ($p < 0.05$) in condemnation of heart between animals with different body condition score. However, there was no statistically significant difference ($p > 0.05$) between animals' body condition score in condemnation of kidney, tongue, spleen, liver and lung. There was statistically significant difference ($p < 0.05$) between age in condemnation of lung and liver. The total financial loss calculated in this study, due to organ condemnation was 15,843.89 USD (342,228.00ETB) per annum. Therefore, the observation of such level of abnormalities and substantial financial loss with condemnation of affected organs warrants the veterinary institution of appropriate control measures.

Key words: Abattoir, cattle, financial loss, Hawassa, organ condemnation.

INTRODUCTION

Abattoirs played an important role in surveillance of various diseases of human and animals. Surveillance at the abattoir allows for all animals passing into human food chain to be examined for unusual signs, lesions or specific diseases (Alton et al., 2010). Monitoring and other conditions at slaughter has been recognized as one

way of assessing the disease status of herd; however, this source of information is not fully exploited worldwide (Mellau et al., 2010), especially in ascertaining the extent to which human is exposed to certain zoonotic diseases in addition to estimating the financial implications of organ condemnations (Jobre et al., 1996; Chhabra and

*Corresponding author. E-mail: tilayeshiberu@gmail.com.

Singla 2009).

Meat inspection is conducted in the abattoir for the purpose of screening animal products with abnormal pathological lesions that are unattractive and unsafe for human consumption. Meat inspection assists in detecting certain diseases of livestock and prevents the distribution of infected meat that could give rise to disease in animal and human being and to ensure competitiveness of products in the local market (Hinton and Green, 1993). Abattoir data can be a source of valuable information on the incidence and epidemiology of animal diseases. This can help to know to what extent the public is exposed to certain zoonotic diseases and estimate the financial losses incurred through condemnation of affected organs (Raji et al., 2010; Cadmus and Adesokan, 2009; Singla and Juyal, 2014).

The main causes of organ condemnation during post mortem inspection are diseases originated by parasites, bacteria and viruses. Flukes in liver and hydatid cyst in lung, liver and kidney are mainly involved (Mezegebu, 2003; Teka, 1997; Sirak, 1991). Parasites in the tropics are responsible for far greater loss to meat industry than any other diseases (Jobre et al., 1996). Similarly, like many other tropical countries in Africa, it is well known that parasitic diseases are the major factors responsible for low productivity in livestock in Ethiopia (Jobre et al., 1996; Abebe, 1995).

In Ethiopia, many studies have been undertaken to identify the major disease conditions encountered during antemortem and postmortem inspection and to determine the economic importance of organ and carcass condemnation (Jatenie et al., 2014). For instance, Fasciolosis, hydatid cyst, *C. bovis*, pneumonia, emphysema, hydronephrosis, cirrhosis, hepatitis, calcification and abscess were the major causes of organs condemnation in cattle slaughter at Adigrat municipal abattoir (Alembrihan and Haylegebriel, 2013). At Gonder ELFORA abattoir, the financial loss due to edible organ and carcass condemnation was estimated to be 1,268,579 USD (21,565,849 ETB) per annum. Fasciolosis and hydatidosis were the major causes for condemnation that lead to huge economic losses (Genet et al., 2012).

A report from Jimma showed that an average amount of 10,156.71 USD (172,664.09 ETB) was lost annually due to organ condemnation of cattle at the abattoir. Liver condemnation takes the higher proportion of all the losses accounting for 92.7% of all the losses at Jimma Municipal abattoir (Amene et al., 2012). Similar economic loss analysis by Fasil (2009) showed annual economic loss of 8826.41 USD (150,048.98 ETB) at Gondar Municipal abattoir. Another report in cattle slaughtered at Mekelle municipal abattoir revealed an estimated annual economic loss of 13110.86 USD (222,884.58 ETB) (Amene et al., 2012). Hence, it would be essential to have comprehensive information on occurrence of various diseases/causes and their economic loss to

establish appropriate strategy for prevention and controls. Causes of organ condemnation were not extensively studied in Hawassa Municipal Abattoir. Therefore, the objectives of the present study were: to identify the major causes of organ condemnation and to calculate the direct financial loss attributed to the condemned organs in cattle slaughtered at Hawassa Municipal Abattoir.

MATERIALS AND METHODS

Study area

The present study was conducted from October 2015 to May 2016 with the aims to identify major causes of organ condemnation and to calculate the direct financial loss due to condemnation in cattle slaughtered at Hawassa municipal abattoir. Hawassa city is located between 4° 27' and 8° 30'N latitude and 34° 25' and 39° 1' E longitude which is 275 km from south of Addis Ababa. The agro-ecology of the area is "wainadega" (semi-arid) having an altitude ranging from 1650 to 1700 m above sea level (masl). The average minimum and maximum temperature is 20.1 and 34°C, respectively (CSA, 2003).

Study population

The study animals were cattle slaughtered at Hawassa municipal abattoir for local consumption. These cattle were brought to the abattoir from different districts near Hawassa. These animals were kept under extensive production system in which the cattle were allowed to graze freely. The breeds of cattle were local and cross.

Sample size and sampling method

Sample size for the present study was determined by using the formula described by Thrusfield (2007). Since there was no previous data on the prevalence of organ condemnation in the study area, 50% prevalence was taken for sample size determination with 5% precision.

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

Where: N = required sample size, P_{exp} = expected prevalence, d = desired absolute precision.

Accordingly, the sample size was determined to be 384 heads of cattle. Systematic random sampling was used.

Study design

Cross-sectional study was carried out to estimate the cause of organ condemnation and to calculate the direct financial loss due to condemnation in cattle slaughtered at Hawassa municipal abattoir.

Study methodology

Ante mortem Inspection

Randomly selected animals were subjected to routine ante mortem inspection during which various risk factors such as body condition,

breed and age of animals were scored. The body condition score of animals was classified according to Nicholson and Butter (1986). Accordingly, animals were grouped into poor, medium and good body conditioned. Estimation of age was carried out by examination of teeth eruption and categorized into adult and old.

Post mortem inspection

The post mortem inspection was conducted based on the guidelines set on manual on meat inspection for developing countries (FAO, 1994). Accordingly, the liver, lung, heart, spleen, kidney and tongue were examined through visualization, palpation and systematic incision for any pathological lesion(s).

Assessment of direct financial loss

The total financial loss due to organ condemnation was computed based on the condemnation rate of each type of examined organs, average number of animals slaughtered in the abattoir per year from retrospective data of the abattoir, and condemnation rate of each organ. Average local market price of each organ was collected by questionnaire from the butcheries in Hawassa town, Ethiopia. The data obtained from Hawassa municipal abattoir indicated that the average annual slaughter rate of cattle at the abattoir was 19,000 heads of cattle/year. Consequently, the total direct financial loss was calculated by the following formula set by Ogunrinade and Ogunrinade (1980):

$$EL = \text{ésrk} \times \text{Coy} \times \text{Roz}$$

Where EL is estimated annual economic loss due to organ condemnation from domestic market; srk is annual cattle slaughter rate of the abattoir; Coy is average cost of each liver/lung/heart/kidney/tongue/spleen; Roz is condemnation rates of liver/lung/heart/kidney/tongue.

Data management and analysis

Collected data were recorded on specially prepared forms and entered into excel spreadsheet (Microsoft® office excel 2013) and analyzed by statistical software, SPSS version 20. Descriptive statistics was used to determine the condemnation rate of each organ, defined as proportion of organ condemned to the total number of that particular organ examined. Chi-square test was done to study association between the causes of condemnation and risk factors (breed, body condition score and age). The significance level was set at 0.05.

RESULTS

Out of 384 slaughtered cattle, 171 (44.5%) liver, 137 (35.7%) lung, 36 (9.4%) spleen, 26 (6.8%) heart, 25 (6.5%) kidney and 9 (2.3%) tongue were condemned due to gross abnormalities (Table 1) and found to be unfit for domestic markets and human consumption. The common macroscopic lesions encountered on liver were 21.1% Fasciolosis, 9.4% hydatidosis, 7.3% cirrhosis, 3.9% calcification, 1.5% abscess and 1.3% local necrosis. Lung was rejected due to pneumonia, hydatidosis, emphysema, abscess and hepatization with the rate of 10.2, 12.8, 10.2, 1.5 and 1.0%, respectively. Splenitis and splenomegaly were responsible for condemnation of 6.5

and 2.9% spleens, respectively. In the case of kidneys, 4.2, 1.5 and 0.8% were condemned due to nephritis, hemorrhage and infarction, respectively. Edema, pericarditis and hemorrhage caused the condemnation of heart at the rate of 2.9, 2.9 and 1.0%, respectively. 1.0 and 1.3% of the tongue examined were condemned due to *C. bovis* and abscess, respectively. Condemnation rate due to hydatidosis was higher in lung (12.8%) than liver (9.4%) (Table 1).

Rejection rate of all examined organs were higher in local than cross breed cattle. Liver was rejected at the rate of 39.8 (153/384) and 4.7% (18/384) in local and cross breed cattle, respectively. About 31.8 (122/384) and 3.9% (15/384) of lungs were condemned in local and cross breed cattle, respectively. The rejection rate of spleen, heart, kidney and tongue in local breed cattle were found to be 9.1 (35/384), 6.3 (24/384), 6.0 (23/384) and 1.8% (7/384), respectively. In cross breed cattle, the rejection rate of these organs was found to be 0.3 (1/384), 0.5 (2/384), 0.5 (2/384) and 0.5% (2/384), respectively. There was no statistically significant difference in rejection rate of organs between breed of animals ($p > 0.05$).

The rate of liver condemnation was higher in animals with medium body condition, 23.2% (89/384) followed by good, 14.3% (55/384) and poor body condition, 7.0% (27/384). Similarly, the rate of lung condemnation was higher in animals with medium body condition of 19.0% (73/384) followed by good, 12.8% (49/384) and poor body condition, 3.9% (15/384). The rejection rate of spleen, heart, tongue and kidney were higher in medium conditioned animals than good, and poor conditioned animals (Table 2). Except for heart ($X^2=7.318$; $df=1$; $p=0.007$), there was no statistically significant difference in rejection rate of organs among animals with different body condition score ($p > 0.05$).

The rejection rate of liver, lung spleen, heart, kidney and tongue were found to be higher in old than adult animals. In old animals, 31.2% (120/384) liver, 24.7% (95/384) lung, 5.2% (20/384) spleen, 5.5% (21/384) heart, 3.4% (13/384) kidney and 1.5% (6/384) tongue were condemned. In adult animals, the condemnation rate of 13.3 (51/384), 11.0 (42/384), 4.2 (16/384), 1.3 (5/384), 3.1 (12/384) and 0.8% (3/384) were recorded for liver, lung, spleen, heart, kidney and tongue, respectively. The rejection rate of liver and lung were significantly higher in old animals than in adult (liver $X^2=4.256$, $df=1$, $p=0.039$; Lung $X^2=6.899$, $df=1$, $p=0.009$).

The annual direct financial loss due to organ condemnation in cattle slaughtered at Hawassa municipal abattoir was estimated to be 15,843.89 USD (342,228.00ETB) (Table 3).

DISCUSSION

This study revealed that fasciolosis was the leading disease for condemnation of liver (21.1%). This finding is

Table 1. Causes and rate of organ condemnation in cattle slaughtered at Hawassa municipal abattoir during 2015/16.

Organ condemned	Causes of condemnation	Number (%*) condemned	Condemnation rate (%)
Liver	Calcification	15(8.8)	3.9
	Fasciolosis	81(47.4)	21.1
	Hydatidosis	36(21.0)	9.4
	Local necrosis	5(2.9)	1.3
	Abscess	6(3.5)	1.5
	Cirrhosis	28(16.4)	7.3
	Total	171(100.0)	44.5
Lung	Pneumonia	39(28.5)	10.2
	Hydatidosis	49(35.7)	12.8
	Emphysema	39(28.5)	10.2
	Abscess	6(4.4)	1.5
	Hepaticization	4(2.9)	1.0
	Total	137(100.0)	35.7
Spleen	Splenitis	25(69.4)	6.5
	Splenomegaly	11(30.6)	2.9
	Total	36(100.0)	9.4
Heart	Edema	11(42.3)	2.9
	Pericarditis	11(42.3)	2.9
	Petechial hemorrhage	4(15.4)	1.0
	Total	26(100.0)	6.8
Kidney	Nephritis	16(64.0)	4.2
	Hemorrhage	6(24.0)	1.5
	Infarction	3(12.0)	0.8
	Total	25(100.0)	6.5
Tongue	<i>C.bovis</i>	4(44.4)	1.0
	Abscess	5(56.6)	1.3
	Total	9(100.0)	2.3

*Percent per condemned organ.

comparable to that of Yifat et al. (2011) and Mungube et al. (2006) who reported the prevalence of 26% from Gonder and Kenya, respectively. Tadele and Worku (2007) from Jimma reported higher prevalence of 46.58%. In contrast, Alembrhan and Haylegebriel (2013) and Adigrat and Nebyou et al. (2014) from East Wollega found lower prevalence of 9.2 and 7.4%, respectively.

In this study, hydatidosis was the second leading pathological lesion responsible for the condemnation of lung and liver with the prevalence of 49 (12.8%) and 36 (9.4%), respectively. This finding was comparable with Nebyou et al. (2014) who reported prevalence of 26.55%. However, it was higher than the reports of Berihu and Toffik (2015) from Bako with the prevalence of 11.8%.

This result was lower than that of previous studies conducted by Asmerom and Berihun (2014) and Kebede et al. (2009) who reported the prevalence of 32 and 46.5%, from Shire and Debre zeyit, respectively.

In the present study, condemnation of spleen resulted to considerable economical loss caused by pathological conditions like splenitis (69.4%) and splenomegaly (30.6%). The current findings are in agreement with the studies reported by Fufa and Debele (2013) from Wolaita Sodo with the condemnation rate of 53%.

The main gross pathological changes that cause heart rejection in this study were edema, pericarditis and petechial hemorrhage which agree with the study done by Yifat et al. (2011) who reported that hydatidosis and

Table 2. Distribution of causes of condemnation among risk factors (breed, age and body condition) in cattle slaughtered at Hawassa municipal abattoir during 2015/16.

Organ condemned	Causes of condemnation	Risk factors						
		Breed		Age		Body condition		
		Local	Cross	Adult	Old	Poor	Medium	Good
Liver	Calcification	13(3.4%)	2(0.5%)	5(1.3%)	10(2.6%)	2(0.5%)	8(2.1%)	5(1.3%)
	Fasciolosis	74(19.3%)	7(1.8%)	26(6.8%)	55(14.3%)	11(2.9%)	47(12.2%)	23(6.0%)
	Hydatidosis	32(8.3%)	4(1.0%)	7(1.8%)	29(7.6%)	7(1.8%)	16(4.2%)	13(3.4%)
	Local necrosis	4(1.0%)	1(0.3%)	2(0.5%)	3(0.8%)	0(0.0%)	5(1.3%)	0(0.0%)
	Abscess	5(1.3%)	1(0.3%)	2(0.5%)	4(1.0%)	3(0.8%)	0(0.0%)	3(0.8%)
	Cirrhosis	25(6.5%)	3(0.8%)	9(2.3%)	19(4.9%)	4(1.0%)	13(3.4%)	11(2.9%)
	Total	153(39.8%)	18(4.7%)	51(13.3%)	120(31.2%)	27(7.0%)	89(23.2%)	55(14.3%)
Lung	Pneumonia	30(7.8%)	9(2.3%)	7(1.8%)	32(8.3%)	5(1.3%)	23(6.0%)	11(2.9%)
	Hydatidosis	44(11.5%)	5(1.3%)	13(3.4%)	36(9.4%)	7(1.8%)	23(6.0%)	19(4.9%)
	Emphysema	38(9.9%)	1(0.3%)	15(3.9%)	24(6.2%)	3(0.8%)	21(5.5%)	15(3.9%)
	Abscess	6(1.6%)	0(0.0%)	3(0.8%)	3(0.8%)	0(0.0%)	2(0.5%)	4(1.0%)
	Hepatization	4(1.0%)	0(0.0%)	4(1.0%)	0(0.0%)	0(0.0%)	4(1.0%)	0(0.0%)
	Total	122(31.8%)	15(3.9%)	42(11.0%)	95(24.7%)	15(3.9%)	73(19.0%)	49(12.8%)
Spleen	Splenitis	25(6.5%)	0(0.0%)	10(2.6%)	15(3.9%)	3(0.8%)	16(4.2%)	6(1.6%)
	Splenomegaly	10(2.6%)	1(0.3%)	6(1.6%)	5(1.3%)	1(0.3%)	7(1.8%)	3(0.8%)
	Total	35(9.1%)	1(0.3%)	16(4.2%)	20(5.2%)	4(1.0%)	23(6.0%)	9(2.3%)
Heart	Edema	9(2.3%)	2(0.5%)	3(0.8%)	8(2.1%)	5(1.3%)	6(1.6%)	0(0.0%)
	Pericarditis	11(2.9%)	0(0.0%)	0(0.0%)	11(2.9%)	3(0.8%)	4(1.0%)	4(1.0%)
	Hemorrhage	4(1.0%)	0(0.0)	2(0.5%)	2(0.5%)	0(0.0%)	1(0.3%)	3(0.8%)
	Total	24(6.3%)	2(0.5%)	5(1.3%)	21(5.5%)	8(2.1%)	11(2.9%)	7(1.8%)
Kidney	Nephritis	14(3.6%)	2(0.5%)	7(1.8%)	9(2.3%)	1(0.3%)	10(2.6%)	5(1.3%)
	Hemorrhage	6(1.6%)	0(0.0)	2(0.5%)	4(1.0%)	2(0.5%)	4(1.0%)	0(0.0%)
	Infarction	3(0.8%)	0(0.0)	3(0.8%)	0(0.0%)	1(0.3%)	0(0.0%)	2(0.5%)
	Total	23(6.0%)	2(0.5%)	12(3.1%)	13(3.4%)	4(1.0%)	14(3.6%)	7(1.8%)
Tongue	<i>C.bovis</i>	3(0.8%)	1(0.3%)	2(0.5%)	2(0.5%)	1(0.3%)	3(0.8%)	0(0.0%)
	Abscess	4(1.0%)	1(0.3%)	1(0.3%)	4(1.0%)	0(0.0%)	5(1.3%)	0(0.0%)
	Total	7(1.8%)	2(0.5%)	3(0.8%)	6(1.5%)	1(0.3%)	8(2.0%)	0(0.0%)

pericarditis were the main causes of heart condemnation. However, Alembrhan and Haylegebriel (2013) reported that Hydatidiosis and *C. bovis* were the main causes of heart rejection.

Nephritis, hemorrhage and infraction were the major causes of kidney rejection in this study. The results of this finding were in agreement with the study done by Yesihak et al. (2015). However, Jatenie et al. (2014) reported that *C. bovis* and hydatidosis were the main cause of kidney rejection. The main cause of tongue condemnation was *C. bovis* and abscess which is in agreement with other study reported by Lati et al. (2015) from Wollega. Organ condemnation rates did not show statistically significant difference ($P > 0.05$) in breed and

there was no statically significant difference ($p > 0.05$) between BCS and condemnation of liver, kidney, tongue, spleen and lung but it was statically significant for heart ($p < 0.05$). Condemnation rate of lung and liver showed statistically significant difference between age groups of animals ($p < 0.05$) but not for spleen, heart and tongue in the age groups of animals. Variation in the proportion of organs condemned due to gross pathological changes may be due to differences in agro-ecological condition of the animal environment that could be favorable to the causative agent, livestock management system and improper disposal of condemned organs. The total financial loss calculated in this study due to organ condemnation was 15,843.89 USD (342,228.00ETB) per

Table 3. Annual financial loss due to condemnation of organ (average annual slaughtered animal n=19,000).

Condemned organs	Rejection rate (%)	Av.unit price(ETB)*	Annual loss (ETB)*
Liver	44.5	30	253,650.00
Lung	35.7	6	40,698.00
Heart	6.8	15	19,380.00
Kidney	6.5	7	8,645.00
Tongue	2.3	25	10,925.00
Spleen	9.4	5	8,930.00
Total annual loss			342,228.00

During the study period 1USD=21.60ETB.

year which have extreme difference with the report done by Nebyou et al. (2014) from Nekemte, Ethiopia with loss of 5,435.97 USD (106,536.9 ETB) per year. The difference in the financial loss estimated in various abattoirs may be due to the variation in the prevalence of disease, mean annual number of cattle slaughtered in different abattoir which was higher in Hawassa municipal abattoir, and also, the variation in the retail market price of the organ.

CONCLUSION AND RECOMMENDATIONS

Organ condemnations cause big economic losses in the cattle industry. In this study, the rates of condemnation of organs were higher in liver followed by lung, spleen, heart, kidney and tongue. Major causes of total condemnation of organs were fasciolosis, hydatidosis, pneumonia, emphysema, cirrhosis, calcification, nephritis, splenitis, edema, *C. bovis*, hemorrhage and abscess. The total financial loss calculated in this study, due to organ condemnation was 15,843.89 USD (342,228.00ETB) per annum. Thus, proper meat inspections are essential to remove gross abnormalities from meat and its products in order to prevent the distribution of contaminated meat to the public.

Based on the findings of this study, the following recommendations were forwarded:

1. Promoting construction of abattoir with their appropriate disposal pits and immediate and proper disposal of condemned organ should be made.
2. Meat inspectors and abattoir workers should be well trained on handling condemned carcasses and organs.
3. Public awareness should be given to avoid eating of raw meat/organs hence for effective disease control.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

- Abebe G (1995). Current status of veterinary education and health research in Ethiopia in Veterinary Medicine impact on health and nutrition in Africa. Proceeding of an international conference, Addis Ababa. pp. 133-138.
- Alembrhan A, Haylegebriel T (2013). Major causes of organ condemnation and economic loss in cattle slaughtered at Adigrat municipal abattoir, northern Ethiopia. *Vet. World.* 6:734-738.
- Alton GD, Lpeah D, Bateman KJ, McNab WB, Berk O (2010). Factors associated with whole condemnation rates in provincially inspected abattoir in Ontario: Implication for food animal syndromic surveillance. *BMC Vet. Res.* pp. 6:42.
- Amene F, Eskindir L, Dawit T (2012). Cause Rate and Economic Implication of Organ Condemnation of Cattle Slaughtered at Jimma Municipal Abattoir, Southwestern Ethiopia. *Glob. Vet.* 9:396-400.
- Berihu H, Toffik K (2015). Study on Prevalence Economic Significance of Bovine Hydatidosis in Bako Muncpal Abattoir, West Shoa zone, Oromiya Regional State, Ethiopia. *Glob. J. Anim. Sci. Res.* 3:109-118.
- Cadmus SIB, Adesokan HK (2009). Causes and implications of bovine organs/offal condemnations in some abattoirs in Western Nigeria. *Trop. Anim. Health Prod.* 4:1455-1463.
- Central Statistical Authority (CSA) (2003). Livestock population of Ethiopia. Central Statistical Authority.
- Chhabra MB, Singla LD (2009). Food-borne parasitic zoonoses in India: Review of recent reports of human infections. *J. Vet. Parasitol.* 23(2):103-110.
- Fasil B (2009). Major causes of organ condemnation in cattle slaughtered at Gondar ELFORA abattoir. Faculty of Veterinary Medicine, Jimma University, Jimma, Ethiopia, DVM Thesis.
- Fufa A, Debele H (2013). Major Causes of Organ Condemnation for Cattle and its Financial Impact at Wolaita Soddo Municipality Abattoir, Southern Ethiopia. *Glob. Vet.* 11:730-734.
- Food and Agriculture Organization(FAO)(1994). Manual of meat inspection for developing countries.
- Genet M, Tadesse G, Basaznew B, Mersha C. (2012). Pathological Conditions Causing Organ and Carcass Condemnation and Their Financial Losses in Cattle Slaughtered in Gondar, Northwest Ethiopia. *Afr. J. Basic Appl. Sci.* 4:200-208.
- Hinton M, Green L (1993). Meat inspection which goes though university of Bristol, Langford, UK. *Vet. J.* 152:91-92.
- Jatenie J, Mahendra P, Rahman T (2014). Investigation into major causes of organs condemnation in bovine slaughtered at Adama municipal abattoir and their economic importance. *Haryana. Vet.* 53:139-143.
- Jobre Y, Lobago F, Tiruneh R, Abebe G, Dorchie PH (1996). Hydatidosis in three selected regions of Ethiopia: An assessment trial on the prevalence, economic and public health importance. *Rev. de med. Vet.* 147:797-804.
- Kebede N, Mitiku A, Tilahun G (2009). Hydatidosis of slaughtered animals in BahirDar abattoir, northwestern Ethiopia. *Trop. Anim. Health Prod.* 41:43-50.

- Lati E, Biresaw S, Berhanu S, Eyob H (2015). Causes of organ condemnation, its public health and financial significance in Nekemte municipal abattoir, Wollega, Western Ethiopia. *J. Vet. Med. Anim. Health*. 7:205-214.
- Mellau LSB, Longa HE, Karimuribu ED (2010). A Slaughter house survey of liver lesion in slaughter cattle, sheep and goats at Arusha. *Tanzan. Vet. J.* 3:179-188.
- Mezegebu Y (2003). Major cause of organ condemnation in ruminants slaughtered at Gonder Abattoir, North Western Ethiopia. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre-Zeit, Ethiopia.
- Mungube EO, Bauni SM, Tenhagen BA, Wamae LW, Nginyi JM and Mugambi JM (2006). The prevalence and economic significance of *Fasciola gigantica* and *Stilesia hepatica* in slaughtered animals in the semiarid coastal Kenya. *Trop. Anim. Health Prod.* 38:475-483.
- Nebyou M, Debela A, Solomon K, Tesema T, Fanta D, Alemayehu R (2014). Major Causes of Organs and Carcass Condemnation in Cattle Slaughtered at Nekemte Municipality Abattoir, East Wollega, Ethiop. *Glob. Veter.* 13:278-284
- Nicholson MJ, Butter MH (1986). A guideline to condition scoring of Zebu cattle. International Livestock Center for Africa, Addis Ababa, Ethiopia.
- Ogunrinade A, Ogunrinade BI (1980). Economic importance of bovine fasciolosis in Nigeria. *Trop. Anim. Health Prod.* 12:155-160.
- Raji MA, Salami SO, Ameh JA (2010). Pathological condition and lesions observed in slaughtered cattle at Zaria abattoir. *J. Clin. Pathol. Forensic Med.* 1:9-12.
- Singla LD, Juyal PD (2014). Sarcocystosis. In: *Zoonosis: Parasitic and Mycotic Diseases*, Garg SR (Ed), Daya Publishing House, New Delhi, pp 235-250.
- Sirak A (1991). Cause of organ condemnation in Bahir-Dar abattoir. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre-Zeit, Ethiopia.
- Tadele T, Worku T (2007). The Prevalence and Economic Significance of Bovine Fasciolosis at Jimma, Abattoir, Ethiopia. *Int. J. Vet. Med.* pp. 3:15.
- Teka G (1997). Meat hygiene in: Food hygiene principles and methods of food born disease control with special reference to Ethiopia. pp. 99-113.
- Thrusfield M (2007). *Veterinary Epidemiology*. (3rd edition.). Blackwell Science.
- Yesihak Y, Mummed E, Webb C (2015). Causes of Beef Carcass and Organ Condemnations in Ethiopia. *J. Anim. Vet. Adv.* 10:147-160.
- Yifat D, Gedefaw D, Desie S (2011). Major Causes of Organ Condemnation and Financial Significance of Cattle Slaughtered at Gondar ELFORA Abattoir, Northern Ethiopia. *Glob. Vet.* 7:487-490.