ISSN: 2831-3887

Research Article

Journal of Veterinary Health Science

Occurrence of Gross Lesions and Cysts on the Lungs of Cattle Slaughtered At the Asella Municipal Abattoir, Ethiopia

Kassahun Berhanu[1], Daniel shiferaw[2], Dinka Ayana[3]

[1]*Jigjiga University, College of Veterinary Medicine, Department of Parasitology and Pathology, P.O. Box 1020, Jigjiga, Ethiopia*

[2]*Haramaya University, College of Veterinary Medicine, P.O. Box 138, Dire Dawa, Ethiopia*

[3]*Addis Ababa University, College of Veterinary Medicine and Agriculture, Department of Pathology and Parasitology, P.O. Box 34, Bishoftu, Ethiopia*

***Corresponding author:**
Kassahun Berhanu, Jigjiga University, College of Veterinary Medicine, Department of Parasitology and Pathology, P.O. Box 1020, Jigjiga, Ethiopia

Submitted:01 Sep 2022; **Accepted:** 08 Sep 2022; **Published:** 29 Oct 2022

Citation: *Berhanu K*, Shiferaw D, Ayana D. (2022). Occurrence of Gross Lesions and Cysts on the Lungs of Cattle Slaughtered At the Asella Municipal Abattoir, Ethiopia. J Vet Heal Sci, 3 (4), 324-330.*

Abstract

A total of 384 randomly selected cattle were examined for the presence of gross lesions and cysts, according to standard inspection procedures for developing countries. Out of the total 384 male cattle presented for slaughter, 303 (79.3%) of the lungs of cattle had different gross lesions and cysts. Hydatid cyst (40.9%), emphysema (15.4%), congestion (12.2%) and calcification were the major gross lesions and cysts found in the lungs. Cattle with an older age (OR = 1.74; 95% CI = 1.10–2.78; p = 0.018) and a poor body condition score (OR = 6.10; 95% CI = 2.29–16.59; p = 0.001) were more likely to have hydatidosis and calcified cysts than cattle with a younger age and a good body condition score. Furthermore, emphysema and congestion were more common in crossbred cattle (OR = 2.57; 95%CI = 1.19–5.28; p = 0.012) and younger cattle (OR = 2.87; 95%CI = 1.40–5.83; p = 0.004), respectively. The hydatid cyst was the most common cyst and the cause of lung condemnation in the Asella municipal abattoir. Therefore, better meat inspection procedures, proper lung disposal systems, and preventing the entrance of stray dogs to the abattoir would reduce the prevalence and transmission of diseases to humans.

Key words: Cattle, Cysts, Gross lesion, Lung

Introduction

Data from abattoirs can provide important information for animal disease surveillance purposes as well as for detecting emerging diseases [1]. In addition, the gross pathological examination of carcasses and organs in abattoirs has an important role in providing information on the epidemiology of livestock diseases and giving an indication of the extent of public exposure to certain zoonotic diseases. Humans might exposed to different zoonotic diseases such as tuberculosis, hydatidosis, and toxoplasmosis through the consumption of infected animal products [2].

As meat is the main source of protein for human beings, it should be clean and free from diseases of public health importance. At abattoirs, meat and organs are condemned in order to break the cycle of some important public health diseases like hydatidosis that are not directly passed from man to meat [3]. For these reasons, during the meat inspection processes, an ante-mortem and post-mortem examination were conducted to reach a decision about abnormalities and leave only the meat that was fit for human consumption [4]. Even though some parasitic and bacterial infections are without clinical manifestation on animals, different gross lesions were detected on systemic organs (liver, lung, and heart) during post-mortem examination at the slaughtering house.

Because of their anatomical and histological characteristics, the lungs are one of the most vulnerable organs to physical, chemical, and biological injuries. During a post-mortem investigation, infections caused by parasites, bacteria, and viruses are the leading causes of lung condemnation. The main parasitic disease causing lung condemnation during post mortem inspection is hydatid cyst, which is the disease, caused by the metcestode stage of Echinococcus granuloses. The lungs were found to be the common lo-

cation for hydatid cysts in cattle [5]. Pulmonary emphysema is an excessive abnormal accumulation of air in the lungs related to some disease conditions and caused during destruction of connective tissue of the lung, including the supporting and elastic tissue of the pulmonary parenchyma [6]. Failure of alveoli to inflate or compression causes collapsing of alveoli, which exposes the lung to atelectasis [7].

Infectious agents' combinations with predisposing factors cause pulmonary diseases, which have public health and economic importance. During ante mortem examination, most animals harboring disease conditions have been passed for slaughtering due to the absence of clinical manifestation [8, 9]. But the lung is the major organ used for meat inspection during post mortem examination. Suggest that closely examining the gross lesions in the lung could give us important information to identify specific lesions that might have both public health and economic importance. Even though there have been several studies on major causes of organ condemnation in Ethiopia, closer examination of lung lesions and their prevalence has not been adequately addressed throughout the current study area. Therefore, the objective of this study was to identify and examine the gross lesions and cysts on the lungs of cattle slaughtered at the Asella municipal abattoir [10, 11].

Materials and Methods

Study Area

The study was conducted in Asella town municipality abattoir, about 175 km southeast of Addis Ababa, in the Arsi zone of Oromia regional state, which is located at 6°59 to 8° 49 N altitude and 38° 41 to 40° 44 E longitude. The area has a bimodally distributed mean annual rainfall of 1200mm, with low and high temperatures of 5 and 28 degrees Celsius, respectively. Topographically highland region at an elevation of around 2500 m, the long rainy season lasts from June to September, and the short rainy season lasts from January to April [12].

Study Animals

The study animals were all male cattle brought for slaughtering to the Asella municipal abattoirs from Asella and the surrounding area, including Kersa, Iteya, Huruta, Shirka, and Diksis. Both local and crossbred cattle, different age groups and body conditions of cattle were included in the investigation of lung lesions and cysts by post mortem examination.

Study Design and Sampling Procedures

A cross-sectional study was conducted from November 2020 to April 2021 to identify the gross lesions and cysts that occurred on the lungs of cattle and estimate the economic loss due to lung condemnation. During sample collection, information regarding age, sex, origin, and body condition of the animals was recorded. Three visits were made randomly per week out of five slaughtering days in a week.

Sample Size Determinations

An estimated prevalence of 50% was used while calculating the sample size. Using Thrust Field's (2005) formula, the appropriate sample size for the study was determined with a 95 percent confidence interval and a 5 percent absolute precision. Therefore, 384 cattle were required for the study.

Data Collection Methodology

Ante Mortem Examinations

Each sampled animal underwent ante-mortem examinations before entering the lairage, during their entry, and afterward in large groups. At rest and when moving, the animals' both sides were examined for cleanliness, disease signs, and normal animal behavior. The animals' breed, age, and body condition scores were also recorded. The ages of the animals were estimated through examination of the tooth eruptions as described by the De Lahunta and Habei approach (1986). Accordingly, three age groups were conveniently considered; less than or equal to 3 years as young, adult (4-6 years) and old (> 7 years) age categories.

According to Nicholson and Butterworth (1986), the body condition scores were divided into three categories: poor, medium, and good. The exterior qualities that clearly distinguish local from European types were used to classify the breed types (local breed and crossbreed). Local breed cattle have long legs, a sloping rump, and a hump, whereas Holstein Friesian cross breeds have large bodies, a black-and-white color, and no hump (therefore, they are frequently referred to as black-and-white breeds) [13]. Finally, prior to slaughter, information regarding live animals gathered through ante mortem examination was recorded, and the respected enumeration marks (mostly numbers) were put on the gluteal surface using ink, and the marks were transferred to all visceral organs during evisceration.

Post Mortem Examination

Lungs were systematically inspected for the presence of any cysts and gross lesion lesions by utilizing the routine meat inspection procedures recommended by [14]. The primary examination involved visual inspection, palpation, and systematic incision of the lung to detect deep-seated lesions and abnormalities. Guidelines on meat inspection for developing countries differentiated the gross pathological lesions encountered in the lungs of cattle [15].

During postmortem examination of a slaughtered cattle lung, one or multiple hydatid cysts grossly presented as enlargements with fluctuating fluid, which contained fluid or semi-solid material with an inner germinal layer from daughter cysts, with developed scolices, were appreciated. On gross examination, the emphysematous lung was identified as pale, enlarged, greyish-yellow, pearl-like, shiny, and puffy in appearance. This crepitant feeling was appreciated on observation and palpation of the lung. Depositions of calcium salts in the semi-solid materials that provided a gritty sound upon incision with a knife, and white and grey cysts with irregularly rounded and frequently honeycombed cysts were observed and

identified as calcified cysts.

Data Management and Analysis

Data from ante-mortem and post-mortem examinations were entered into the Microsoft Excel 2013 spreadsheet program. R software (version 4.2.0) was used to analyze the data. The association of individual predictors or factors for the occurrence of lung lesions was tested by simple logistic regression followed by multiple logistic regression to identify potential risk factors. If the P-value was less than 0.05 at a 95% confidence level, the association between factors and the occurrence of lung lesions was considered to exist.

Result

Prevalence of Parasitic Cysts and Gross Lesions of Lungs

According to the guidelines of postmortem meat inspection for developing countries, a total of 384 slaughtered male cattle lungs were examined for the occurrence of any cysts and gross abnormalities using visual examination, palpation, and systematic incision. Out of the entire postmortem examined lung samples, 301 (78.3%) were infested by different parasitic cysts and gross lesions. Accordingly, the major cysts and gross lesions found on the lungs during post mortem examination were hydatid cysts (40.8%), emphysema (15.1%), congestion (12.2%), and calcified cysts (10.15%).

The occurrence of gross lesions and cysts encountered during the study varies among different factors like age, body condition, and breed of the animals. Hydatid cysts and calcified cysts were more common in older cattle and cattle with poor body condition (Table 1). On the other hand, emphysema and congestion occurred more frequently in young and cross cattle, respectively (Table 2).

Risk Factors for the Occurrence of Cysts and Gross Lesions of the Lung

In simple regression analyses, only the age of cattle shows a significant association with the occurrence of hydatid cysts (Table 1). Older cattle are more likely (OR = 1.71) to be affected by hydatid cysts than adult animals. However, young animals are less likely (OR = 0.31) to be affected by hydatid cysts than adult animals. Breed and body condition are not significantly associated with the occurrence of a hydatid cyst. In addition, in poor cattle, the occurrence of calcified cysts was six times higher than in cattle having good body conditions.

Table 1: Simple logistic regression analysis of host risk factors with the occurrence of hydatid and calcified cysts

Cysts	Variables	Category	Animals Examined	Number of positive (%)	Odd ratio	95% CI	p-Value
Hydatid cyst	Age	Young	63	11 (17.5)	0.31	0.14 – 0.60	0.001
		Old	112	61(54.5)	1.71	1.07 – 2.76	0.027
		Adult	209	85 (40.7)	Ref		
	Body condition	Medium	232	91 (39.2)	0.87	0.55 – 1.39	0.566
		Poor	31	9(29)	0.47	0.19 – 1.11	0.094
		Good	121	57 (47.1)	Ref		
	Breed	Local	342	141 (41.2)			
		Cross	42	16 (38.1)	0.88	0.44 – 1.74	0.725
	Total observation		384	157 (40.8)			
Calcified cysts	Age	Young	63	7 (11.1)	1.28	0.47 – 3.18	0.614
		Old	112	12(10.7)	1.10	0.49 – 2.42	0.811
		Adult	209	20 (9.6)	Ref		
	Body condition	Medium	232	18 (7.8)	0.92	0.41 – 2.16	0.840
		Poor	31	11(35.5)	6.09	2.28 – 16.60	0.001
		Good	121	10(8.3)	Ref		
	Breed	Local	342	35(10.2)			
		Cross	42	4(9.5)	0.98	0.27 – 2.78	0.967
	Total observations		384	39(10.15)			

The occurrence of emphysematous lungs was associated with the breed of animals (Table 2). Crossbred animals were more likely (OR = 2.50) to be affected by emphysema when compared with local animals brought for slaughtering. Other factors (age and body condition) are not significantly associated with emphysema in simple logistic regression. Furthermore, the occurrence of congestion in the lungs of cattle slaughtered at an abattoir was significantly affected by the age of the animals, in which young animals were three times more affected than adult animals. In addition, older animals were less likely (OR = 0.3) to be affected by calcification than adult animals.

Table 2: Simple Logistic Regression Analysis of Host Risk Factors with Occurrence of Emphysema and Congestion

Lung lesion	Variables	Category	Animals Examined	Number of positive (%)	Odd ratio	95% CI	p-Value
Emphysema	Age	Young	63	7(11.1)	0.66	0.26 – 1.53	0.365
		Old	112	16(15.3)	0.97	0.49 – 1.87	0.933
		Adult	209	35 (16.7)	Ref		
	Body condition	Medium	232	39 (16.8)	1.23	0.67 – 2.34	0.513
		Poor	31	1 (3.2)	0.20	0.01 – 1.03	0.123
		Good	121	18 (14.9)	Ref		
	Breed	Local	342	46 (13.5)			
		Cross	42	12 (28.6)	2.50	1.13 – 5.28	0.018
	Total		384	58(15.1)			
Congestion	Age	Young	63	17 (27.0)	3.0	1.44 – 6.11	0.003
		Old	112	4(3.6)	0.3	0.08 – 0.75	0.022
		Adult	209	26 (12.4)	Ref		
	Body condition	Medium	232	29 (12.5)	0.75	0.37 – 1.55	0.429
		Poor	31	3(9.7)	0.65	0.14 – 2.28	0.538
		Good	121	15(12.4)	Ref		
	Breed	Local	342	(11.1)			
		Cross	42	9 (21.4)	2.15	0.88 – 4.91	0.077
	Total observation		384	47(12.23)			

The number of cysts and gross lung lesions encountered during the study varies among different factors (Table 3). The multiple logistic analysis of the final model showed that there was a significant association between the occurrence of hydatid cyst and congestion with the age of cattle presented to the abattoir during the study period. Additionally, the occurrence of emphysema and calcification was significantly associated with the breed and body condition of cattle, respectively.

Table 3: Final Model of Multiple Logistic Regression Analysis of Potential Risk Factors for the Occurrence of Cysts and Gross Lung Lesions

Parasite cysts/Lung lesion	Variables	Category	OR	95%CI	P-value
Hydatid cyst	Age	Young	0.31	0.15 – 0.61	0.001
		Old	1.74	1.10 – 2.78	0.018
		Adult	Ref		
Emphysema	Breed	Cross	2.57	1.19 – 5.28	0.012
		Local	Ref		
Congestion	Age	Young	2.87	1.40 – 5.83	0.004
		Old	0.29	0.08 – 0.78	0.026
		Adult	Ref		

Calcified cysts	Body condition	Medium	0.93	0.42 – 2.17	0.867
		Poor	6.10	2.29 – 16.59	0.001
		Good	Ref		

Discussion

The overall prevalence of cysts and gross lung lesions in the present study was 78.3%, which was lower than that who reported 91.7% from Jimma municipal abattoir. However, this finding was higher than that of with a finding of 42.7% and 22.8% from Kombolcha and Northwestern Ethiopia, respectively [16-18].

The most common parasitic cyst investigated in current studies was the hydatid cyst (40.8%). The finding was lower than that of who reported 58.1% and 55.5% of hydatidosis from Gondar and Bangladesh, respectively. Variation in the prevalence of hydatid cyst might be due to the geographical location and epidemiological factors that affect the rate of transmission of Echinococcosis granulose. Furthermore, some diseases are endemic to specific agro-ecologies where the causative agent or its intermediate host may find favorable conditions. On the other hand, the prevalence of hydatid cyst is higher than that of with a report of 5.0% and 5.1% from Northwestern Ethiopia and Adigrat, respectively. The cultural habit of home slaughtering, the abundance of stray dogs, the habit of feeding raw offal and lungs to the pets, improper disposal of organs from abattoirs, and the attitude of people to pet animals might have promoted the prevalence of hydatid cysts in the current study [19-24].

The final model of multiple logistic regression shows that the occurrence of hydatid cyst has a significant association ($p \leq 0.05$) with the age of cattle, and older cattle (OR = 1.74) are more likely to be affected. The longer duration of time for the chance of exposure to a greater number of infective stages and reduction of developing immunity, contributes to the older animals' having a higher prevalence of hydatid cysts than younger and adult animals (Z. The lungs are more severely affected by Echinococcus granulosus due to the larger capillaries that help the migrating hexacanth embryo (Echinococcus oncosphere) as it takes the portal vein route and primarily passes through the hepatic and pulmonary faltering systems sequentially before reaching any other peripheral organ [25].

The overall prevalence of emphysema in this study was 15.1%, which is higher than the findings of with reports of 6.77% and 10.5% from Jimma and Gondar, respectively. However, the finding in the current study was lower than that of the reports by, with a prevalence of 36.3% from Tigray municipal abattoir. Cattle are susceptible to interstitial emphysema because of their well-developed interlobular septa and lack of collateral ventilation. Obstruction of airflow and extensive gasping respiration during the slaughter process may also have a high contribution to the occurrence of pulmonary emphysema in cattle. Emphysema may also be impacted by the stress factors that animals are exposed to, such as overcrowding in lairage and tiredness from lengthy treks in search of grass and water during the dry season. In addition, improper stunning and delayed slaughtering after stunning may also have a role in the occurrence of lung emphysema [26-30].

Pulmonary congestion was the third prevalent gross pathological lesion (12.2%) and the result was much lower than, which reports 49.7% from Jimma municipal abattoirs. but higher than the prevalence of pulmonary congestion reported by from Bangladesh, North Western Ethiopia, and Algeria, which were 1.02%, 2.5%, and 5.33%, respectively. Pulmonary congestion has been significantly associated with the age of cattle. About age, more congestion occurred among young cattle (OR = 2.87) than adult cattle. More strangling of young cattle during slaughtering and improper stunning and bleeding during the slaughtering system might have played a role in the high occurrence of pulmonary congestion at young ages [31-34].

On the other hand, the prevalence of calcification in this study was 10.15%, which is in line with who reported 10.2%. In contrast, the finding was greater than, who reported 5.32% from Wolaita Sodo municipal abattoir. The occurrence of calcification was significantly associated with the body condition of cattle in which the lesion was more likely to occur in cattle having poor body condition. The association has not been clear, but cattle with poor body condition are prone to different infections, which might be localized in the lungs and cause calcified cysts.

Conclusion

The current study identified major parasitic cysts and gross lesions in slaughtered cattle in the study area. The common parasitic cysts and gross lesions examined during the post mortem examination were hydatid cysts, calcified cysts, emphysema, and congestion. The presence of zoonotic diseases (hydatidosis) in the area necessitates special attention to prevent infection transmission to humans through regular monitoring at slaughterhouses and intermediate hosts. Meat inspection is crucial for the monitoring of animal diseases with substantial economic importance and for obtaining important epidemiological disease information from abattoirs, which can be used to combat controllable and notifiable diseases as well as zoonotic diseases of public health significance such as hydatidosis. Therefore, proper disposal of condemned lungs, preventing the entrance of dogs and cats to abattoirs, and community awareness of zoonotic diseases are important to prevent the transmission of zoonotic infections.

Data availability

The raw data used to support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Acknowledgement

We would like to Thanks College of veterinary medicine, Haramaya University for their support and meat inspectors in Asella municipal abattoir for their excellent technical assistance during our abattoir work.

References

1. Dupuy, C., Morignat, E., Maugey, X., Vinard, J. L., Hendrikx, P., Ducrot, C., & Gay, E. (2013). Defining syndromes using cattle meat inspection data for syndromic surveillance purposes: a statistical approach with the 2005–2010 data from ten French slaughterhouses. BMC Veterinary Research, 9(1), 1-17.
2. Raji, M. A., Salami, S. O., & Ameh, J. A. (2010). Pathological conditions and lesions observed in slaughtered cattle in Zaria abattoir. Journal of Clinical Pathology and Forensic Medicine, 1(2), 9-12.
3. Arbabi, M. O. H. S. E. N., & Houshyar, H. (2006). Survey of echinococcosis and hydatidosis in Kashan region, central Iran.
4. Phiri, A. M. (2006). Common conditions leading to cattle carcass and offal condemnations at 3 abattoirs in the Western Province of Zambia and their zoonotic implications to consumers. Journal of the South African Veterinary Association, 77(1), 28-32.
5. Cadmus, S. I. B., & Adesokan, H. K. (2009). Causes and implications of bovine organs/offal condemnations in some abattoirs in Western Nigeria. Tropical Animal Health and Production, 41(7), 1455-1463.
6. Belkhiri, M., Tlidjane, M., Benhathat, Y., & Meziane, T. (2009). Histopathological study and pulmonary classification of bovine lesions. African Journal of Agricultural Research, 4(7), 584-591.
7. Blowey, R., Boyd, H., & Eddy, R. G. (1992). Bovine medicine: diseases and husbandry of cattle. Blackwell.
8. Rahman, A. K. M. A., Nooruddinm, M., Begum, N., Rahman, M. S., & Lee, J. H. (2003). Epidemiological study of pulmonary lesions and diseases in slaughter cattle. Korean Journal of Veterinary Service, 26(1), 81-88.
9. Jaja, I. F., Mushonga, B., Green, E., & Muchenje, V. (2016). Prevalence of lung lesions in slaughtered cattle in the Eastern Cape Province, South Africa. Journal of the South African Veterinary Association, 87(1), 1-9.
10. APEDO (2007). Socio-economic information of Arsi Zone. AsellaArsi, Ethiopia. pp: 1-105.
11. FAO. (2012). Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No. 11. Rome.
12. FAO. (2007). Manual on meat inspection for developing Countries. Animal Health and Production Papers, Food and Agriculture Organization of the United Nations. Mekelle, Ethiopia. pp. 27-31.
13. FAO. (1994). Manual of Meat Inspection for Developing Countries. Animal and Health Production Papers Food and Agriculture Organization of the United Nations Rome. Italy. 5-9.
14. Tsegaye, S., Tessema, D., & Asebe, G. (2016). Gross Pulmonary Lesions of Bovine Lung Slaughtered at Jimma Municipality Abattoir, Ethiopia. J Veterinar Sci Technol, 7(356), 2.
15. Desalegn, Z and Dagninet, M. (2016). Gross Pathological Study on Pulmonary Lesions of Cattle Slaughtered in Kombolcha Elfora Abbattoir. Southern Ethiopia. Researcher, 8(10): 23-31.
16. Teshale, B., Mebrahtu, G., & Abebe, T. (2017). Identification of pulmonary lesions in slaughtered cattle and associated risk factors, North West Ethiopia. African Journal of Agricultural Research, 12(17), 1447-1450.
17. Islam, M. S., Das, S., Islam, M. A., Talukdar, M. M. I., Hashem, M. A., Chowdhury, S., & Asuduzzaman, M. (2015). Pathological affections of lungs in slaughtered cattle and buffaloes at Chittagong Metropolitan Area, Bangladesh. Advances in Animal and Veterinary Sciences, 3(1), 27-33.
18. Amuamuta, A., Akalu, B., & Chanie, M. (2012). Major causes of lung and liver condemnation and financial impact in cattle slaughter at Bahir Dar Municpial Abattior. Afr. J. Basic Appl. Sci, 4, 165-171.
19. Zeryehun, T., & Alemu, B. (2017). Major gross lesions of lung in cattle slaughtered at hawassa municipal abattoir, Southern Ethiopia. Journal of veterinary medicine, 2017.
20. Amene, F., Eskindir, L., & Dawit, T. (2012). The cause, rate and economic implication of organ condemnation of cattle slaughtered at Jimma municipal abattoir, southwestern Ethiopia. Global Veterinaria, 9(4), 396-400.
21. Mesele, G., Guadu, T., Bogale, B., & Chanie, M. (2012). Pathological conditions causing organ and carcass condemnation and their financial losses in cattle slaughtered in Gondar, Northwest Ethiopia. African Journal of Basic & Applied Sciences, 4(6), 200-208.
22. Mellau, L. S. B., Nonga, H. E., & Karimuribo, E. D. (2010). A slaughterhouse survey of lung lesions in slaughtered stocks at Arusha, Tanzania. Preventive Veterinary Medicine, 97(2), 77-82.
23. Kebede, N., Gebre-Egziabher, Z., Tilahun, G., & Wossene, A. (2011). Prevalence and Financial Effects of Hydatidosis in Cattle Slaughtered in Birre-Sheleko and Dangila Abattoirs, Northwestern Ethiopia. Zoonoses and Public Health, 58(1), 41-46.
24. Benhathat, Y., & Aggad, H. (2017). Occurrence and severity of major gross pulmonary lesions in cattle slaughtered at Tiaret (Western Algeria). J. Appl. Environ. Biol. Sci, 7(10), 48-53.
25. Abebe, A., Beyene, D., & Kumsa, B. (2014). Cystic echinococcosis in cattle slaughtered at Gondar Elfora export Abattoir, northwest Ethiopia. Journal of Parasitic Diseases, 38(4), 404-409.

26. Amuamuta, A., Akalu, B., & Chanie, M. (2012). Major causes of lung and liver condemnation and financial impact in cattle slaughter at Bahir Dar Municpial Abattior. Afr. J. Basic Appl. Sci, 4, 165-171.
27. Alembrhan, A., & Haylegebriel, T. (2013). Major causes of organ condemnation and economic loss in cattle slaughtered at Adigrat municipal abattoir, northern Ethiopia. Veterinary World, 6(10), 734-738.
28. Lahunta, A. D., & Habel, R. E. (1986). Applied veterinary anatomy. WB Saunders.
29. Abunna, F., & Hordofa, D. (2013). Major causes of organ condemnation for cattle and its financial impact at Wolaita Soddo municipality abattoir, southern Ethiopia. Global Veterinaria, 11(6), 730-734.
30. Gebrehiwot, T., Berihu, K., Birhanu, H., & Verma, P. C. (2015). Study on gross pulmonary lesions in lungs of slaughtered animals and their economic importance in Tigray, Ethiopia. Momona Ethiopian Journal of Science, 7(1), 46-54.
31. Gracey, J.F., Collins, D.S and Huey, R.J. (1999). Variation in personal and environmental hygiene and Meat Hygiene, 3 editions. W.B. Saunders Company control measures and eradication programs. Bovine Ltd. pp: 669-678.
32. Nicholson, M. J., & Butterworth, M. H. (1986). A guide to condition scoring of zebu cattle. ILRI (aka ILCA and ILRAD).
33. Ogunrinde, A and Ogunarinde, B.I. (1980). Economic importance of fasciolosis in Nigeria. Tropical animal Health and Production. 12: 155-160.
34. Thrusfeild M. (2005). Veterinary Epidemiology. 2nd Edn. Blackwell Science Ltd., Oxford. 182-198