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Gross Pathological Abnormalities and Related Economic Loss in Slaughtered Cattle at Dire Dawa Municipal Abattoir, Eastern Ethiopia

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Abstract: In Ethiopia, the meat production is not satisfactory due to the condemnation of organs at abattoirs that leads to the associated economic losses. A cross-sectional study was conducted from November 2017 to April 2018 with the attempt to determine the gross pathological abnormalities that cause organ and carcass condemnation, associated risk factors and financial loss in Dire Dawa Municipal abattoir. Out of the total 700 cattle slaughtered, 292 (41.7%) of them had various types of abnormalities such as emaciation 84 (28.8%), branding 50 (17.2%), tick infestation 40 (13.7%), lacrimation 30 (10.3%), lameness 16 (5.5%), Local swelling (5.13%), depression 14 (4.79%), Nasal discharge 12 (4.1%), Salivation 10 (3.4%), blindness 10 (3.4%), Diarrhea 8 (2.7%) and Itching 3 (1.02%) at anti mortem inspection. The postmortem examination revealed that 140 (59.32%) liver, 68 (28.811%) lungs, 19 (8.05%) hearts, 4 (1.7%) spleen, 2 (0.85%) kidneys, 2 (0.85%) GIT and 1 (0.42%) carcass were totally condemned due to gross pathological abnormalities. Hydatidosis and fasciolasis were the commonest causes for the organ condemnation with the frequency of 42.37% and 17.4% respectively. However, TB was the only pathological condition which causes total condemnation of the carcass (0.42%).The rate of organ condemnation was higher on cattle having poor body condition (39.3%) than fat (37.5%) and the adults (53.6%) than youngs (23.21) and old cattle (23.21). So the relationship of body condition and age in respect with the infected organs had a significant difference (P<0.05). Due to considered pathological conditions and health problems in the area, the significant annual economic losses estimated were 217, 700, 000 Eth birr. In Conclusion, the results identified various gross pathological abnormalities that cause organ condemnation and the related economic importance in the area. Therefore, it is necessary to create awareness for the concerning bodies about routine follow-up of animal health, good handling of animals during transportation, the public health significance of diseases of animal origin and the related losses.

Key words: Financial Losses · Organ Condemnations · Pathological Abnormalities · Risk Factors

INTRODUCTION

In Ethiopia, livestock is source of food (milk, meat and eggs), draught power, fertilizer and fuel, cash income and wealth accumulation (living bank) at producers' household levels. At the national level, livestock is the source of industrial raw materials (milk, meat, hides and skins) and high value protein to urban consumers [1]. Ethiopia has large livestock population in Africa with an estimate of 49 million heads of cattle, 23, 619, 720 sheep and 23, 325, 113 of goats [2]. However, their constraints that hindered the potential of livestock production include traditional management system, limited genetic potential, lack of appropriate disease control policy and veterinary Services. Due to these and related factors, every year significant economic losses result from condemnation of edible organs and carcass are estimated from different parts of the country. In spite of large livestock population, the productivity remains marginal due mainly to malnutrition, prevalent diseases and management problems. The rate of food production is much degraded than the rate of growth of human population. Therefore, the country is unable to assure adequate food for the people [3, 4].

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Meat is one of the main components of human diet in Ethiopia. Available beef should therefore, be clean and free from diseases of the public health importance and it should be economically produced. Information that is available from municipal abattoirs in the country reveals that there are several causes of organ condemnation. Parasitic diseases are considered as a major health problems and cause a significant economic loss in countries where livestock production is an important segment of the agricultural practice. The production loss to the meat industry due to organ condemnation is not despicable [5-7].

The purpose of meat inspection is to protect public health and to provide risk free products to the society. Also, it provides information that can be utilized for animal disease control. Abattoir data is an excellent option for detecting disease of both economic and public health importance. Especially in ascertaining the extent to which human is exposed to certain zoonotic diseases, in addition to estimating the financial implication of carcass condemnation [6, 8, 9].

Monitoring and other conditions at slaughter house have been recognized as one way of assessing the disease status of cattle and abattoirs play an important role in screening animal products with various abnormalities and disease that not fit for human consumption [10]. Major parasitic diseases such as fasciolasis, hydatid cyst, *Cysticercus boves* and other causes like Abscessation and cirrhosis cause a significant economic loss by lowering the productivity of cattle and condemnation of edible organs [11, 12].

Several studies have been conducted through abattoir survey to determine a prevalence and economic loss resulting from organ condemnation in many abattoirs of Ethiopia [13]. However, most of the studies were focusing only on specific diseases such as fasciolasis, hydatidosis and cysticercosis. Furthermore, economic loss due to various diseases causes was estimated in some abattoirs of the country [14]. Hence, it would be essential to have information on occurrence of gross pathological abnormalities and associated economic loss due to organ and carcass condemnation at Dire Dawa municipal abattoir. Therefore, the main objectives of the study were to identify gross pathological abnormalities and related risk factors that cause organ condemnation in cattle slaughtered at Dire Dawa municipal abattoir and to estimate the direct economic loss due to organ condemnation at the study area.

MATERIALS AND METHODS

Study Area: The study was conducted at Dire Dawa Municipal abattoir from November 2017 to April 2018 which is located in the eastern part of the country bordered by the state of Somali region and state of Oromia region. It is found at the distance of 515 km from Addis Ababa, lies between 1000 to 2000 meters above sea level in between 09°28 to 09°49'N latitude and 41°38' to 42°19'E. The Dire dawa city administration has an area of 146, 802 hectares. The city has bimodal rainfall pattern with the rainfall in July and August. The mean annual rainfall in the study area varies from 700 mm in the lowland Northern part to 900 mm in the Southern mountain ranges. The rainy season lasts from July to September. The mean annual temperature varies from 20°C to 30°C in *kola* and 14°C to 20°C in *weina-daga*. The temperature during the hottest month of the year ranges from 28.1°C in December and January to 34.6°C in May [15].

Study Animals: All male cattle brought to Dire Dawa municipal abattoir from districts of Dire Dawa zone at the study period were examined by ante mortem and postmortem inspection procedures to identify gross pathological abnormalities, related risk factors and to estimate associated economic loss.

Study Design: A cross sectional study was conducted from November 2017 to April 2018 to determine the gross pathological cause of organ condemnation and to estimate the direct economic loss due to organ condemnation in cattle slaughtered at Dire Dawa municipal abattoir. A total of 700 cattle were examined by ante mortem and postmortem examinations using standard examination procedure. During ante mortem examination, each study animals were identified based on the enumerate marks on their body marked before slaughter and their general behavior, signs of disease, cleanliness and any types of abnormalities observed were recorded. Postmortem examination was conducted through visualization, inspection, palpation and systematic incision of carcass and each visceral organs particularly, liver, lung, heart and kidney for the presence of cysts, fasciolasis, various adult parasites and other abnormalities. Data regarding price of organs and meat were collected using a checklist from butchers at retails and from abattoir personnel.

Sample Size Determination: The sample size was determined as description of Thrusfield (2007) [16] with 50% expected prevalence, 95% confidence interval and 5% desired absolute precision as shown below.

$$N = \frac{1.96^2 P_{exp}(1 - P_{exp})}{d^2} = \frac{1.96^{2*}0.5(1-0.5)}{0.05^2} = 384$$

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. However, 700 head of cattle were included in this study with the intension of maximizing its accuracy and precisions.

Assessment of Direct Financial Losses: To calculate financial losses, annual slaughter capacity of the abattoir was an important data. Annual slaughter rate of the abattoir varies depending on the market demand of the customers and religion concerned season. The financial losses were computed mathematically by the formula of Ogunrinade and Ogunrinade [17] for organs and carcass rejection as follows;

$$EL = \Sigma Sr*Coy*Roz$$

where,

- EL = Estimated annual financial loss due to condemnation of edible organs and carcass
- Sr = Annual slaughter rate of the abattoir
- Coy = Average Cost of each edible organs and carcass
- Roz = Condemnation rates of each edible organs and carcass

Data Analysis: The data which collected from the study area was recorded in the format developed for these purpose and later on it was coded and accordingly entered into Microsoft Excel spread sheet version 2007 and was analyzed by using STATA version 11.0 computer software to observe association and effects of different explanatory variables.

RESULTS

A total of 700 head of cattle were thoroughly inspected during ant-mortem inspection and subjected to post mortem examination up on the abattoir visit. Out of the total (700) cattle slaughtered at Dire Dawa Municipal abattoir 292 (41.7%) of them were monitored by various types of abnormalities at the ante mortem inspection such as lacrimation 30 (10.27%), blindness 10 (3.4%), branding 50 (17.12%), emaciation 84 (28.76%), itching 3 (1.02%), lameness 16 (5.48%), diarrhea 8 (2.73), nasal discharge 12 (4.1%), tick infestation 40 (13.7%), salivation 10 (3.42%), depression 14 (4.79%) and local swelling 15 (5.13%) as shown on the table (Table 1). These cattle were conditionally passed for slaughter.

Organs affected with several lesions were recognized and rejected up on post mortem inspection. The proportion of each organ condemned were 140 liver, 68 lung, 19 heart, 4 spleen, 2 kidney, 2 GIT and 1 carcass with the percentage of 59.32%, 28.811%, 8.05%, 1.7%, 0.85%, 0.85% and 0.42% respectively (Table 2). Fasciolasis and Hydatidosis were the commonest reason for their condemnation. The liver was the most commonly condemned organ due to infection of Fasciola species 41 (29.3%), Hydatid cyst 39 (27.9%), calcification 29 (20.7%), cirrhosis 9 (6.4%), *C. boves* 4 (2.9%) and other causes 18 (12.9%) compared to other rejected organs. Out of the total examined Lung, the leading cause of its rejection was Hydatid cyst with the outstanding rate of 41 (60.29%) followed by hemorrhage 12 (17.65%), pneumonia 10 (14.71%), TB 1 (1.47%), *C. boves* 1 (1.47%) and abscess 1 (4.4%). The Hydatid cyst was also the pathological lesion responsible for condemnation of heart and spleen with a rate of 84.2%, 100% respectively (Table 3).

Numerous pathological conditions were observed as the causes of condemned organs in the current study. Out of 236 organs condemned, the most frequent causative pathological abnormalities were hydatid cyst that affected 42.37% of the organs, followed by fasciolasis which occurred in a rate of 17.4% and calcification which occurred in 12.3% of the organs (Table 4).

As the current study reveals, one of major risk factors associated with the occurrence of different disease was body condition of slaughtered cattle. It was observed that the animals with poor body condition score had higher percentage (39.3 %%) of pathological lessions followed by a good body condition score (37.5%) and medium body condition score (23.2%).The occurrence of the disease with association to origin of slaughtered cattle in present study was lowest in W/dega (6.7%), moderate in dega (41.4%) and the higher in kola (51.7%). As the study shows, age related pathological conditions was higher in adult (53.6%) than old and young that each occurred in equal rate (23.21%) with statistically significant association (p = 0.02) (Table 5).

Table 1: Abnormal conditions encountered during ante mortem inspection

Abnormalities	No of affected animals	Percentage (%)
lacrimation	30	10.3
Blindness	10	3.4
Branding	50	17.12
Emaciation	84	28.8
Itching	3	1.02
Lameness	16	5.5
Diarrhea	8	2.73
Nasal discharge	12	4.1
Tick infestation	40	13.7
Salivation	10	3.42
Depression	14	4.79
Local swelling	15	5.13
Total	292	100

Table 2: Proportion of organ condemned at Dire Dawa municipal abattoir

	Proportion of slaughtered cattle and condemned organs		
Organs	Postmortem inspected organ	Condemned organ (n= 236)	Percentage of rejection (%)
Lung	700	68	28.81
Liver	700	140	59.32
Heart	700	19	8.05
Spleen	700	4	1.7
Kidney	1400	2	0.85
GIT	700	2	0.85
Carcass	700	1	0.42

Table 3: Organ condemnations rate due to pathological conditions

	Organ condemned (n= 236)													
	Lung		Liver		Heart		Spleen		Kidney		GIT		Carcass	
Cause of condemnation	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Hydatid cyst	41	60.29	39	27.9	16	84.2	4	100	-	-	-	-	-	-
Abscess	3	4.4	-	-	3	15.8	-	-	2	100	2	100	-	-
C. boves	1	1.47	4	2.9	-	-	-	-	-	-	-	-	-	-
TB	1	1.47	-	-	-	-	-	-	-	-	-	-	1	100
Hemorrhage	12	17.65	-	-	-	-	-	-	-	-	-	-	-	-
Pneumonia	10	14.71	-	-	-	-	-	-	-	-	-	-	-	-
Cirrhosis	-	-	9	6.4	-	-	-	-	-	-	-	-	-	-
Calcification	-	-	29	20.7	-	-	-	-	-	-	-	-	-	-
Fasciolasis	-	-	41	29.3	-	-	-	-	-	-	-	-	-	-
Others	-	-	18	12.9	-	-	-	-	-	-	-	-	-	-
Total	68	100	140	100	19	100	4	100	2	100	2	100	1	100

Table 4: Frequency of pathological conditions on affected organs

Pathological conditions	No of affected organs	Percentage (%)
Hydatid cyst	100	42.37
Abscess	10	4.24
C. boves	5	2.11
TB	2	0.85
Hemorrhage	12	5.08
Pneumonia	10	4.24
Cirrhosis	9	3.81
Calcification	29	12.3
Fasciolasis	41	17.4
Others	18	7.6
Total	236	100

Table 5: Major risk factors associated with the occurrence of different pathological abnormalities

Risk factor		No examined	Positive	Chi squ	p-value
Body condition score	Good	415	21 (37.5%)	37.73	0.00
	Medium	201	13(23.2%)		
	Poor	84	22(39.3%)		
	Total	700	56 (100%)		
Origin	Kola	312	30 (51.7%)	4.27	0.118
	w/dega	78	4 (6.7%)		
	Dega	310	24 (41.4%)		
	Total	700	58 (100%)		
Age	Young	211	13 (23.21%)	7.79	0.02
	Adult	406	30 (53.6%)		
	Old	83	13 (23.21%)		
	Total	700	56(100%)		

Table 6: Number of organs condemned and economic loss analysis

Organ	Annual slaughter rate of abattoir	No. of affected organ	Average Cost of each organ and carcass (Et. birr)	Total Cost of each organ and carcass (Et. birr)
Liver		140 (59.32%)	110	91, 352, 800
			30	
Lung		68 (28.81%)		12, 100200
Heart	14000	19 (8.05%)	35	3, 944, 500
Spleen		4 (1.7)	15	357, 000
GIT		2 (.85)	300	
Kidney		2 (0.85)	45	535, 500
Carcass		1 (0.42)	18000	105, 840, 000
Total		236(100%)	18, 535	217, 700, 000

The organs unfit for human consumption were condemned totally during slaughter. Out of 700 head of slaughtered animals, 140 liver, 68 lung, 19 heart, 4 spleen, 2 GIT, 2 kidneys and 1 carcass were lost. Information collected from butchery shops on the mean current price of edible organs and carcass at Dire Dawa city for the total annual direct financial loss incurred due to rejection of edible organs and carcass was estimated to be total of 217, 700, 000 Ethiopian Birr/ year (Table 6).

DISCUSSION

In this study, both the ante mortem and post mortem examinations were carried out in the abattoir. Lameness and bruising were abnormalities encountered during the ante mortem inspection. One of the causes of lameness was trauma caused by inappropriate vehicles, loading and off-loading negligence during transportation to market places. Some vehicles were found with sharp materials that could hurt the animals and additionally there was carelessness during the loading and off-loading of the animals which could cause trauma. The respiratory signs such as presence of nasal discharge, coughing and sneezing were most probably related to stress due to lack of feed and water, immune suppression and overcrowding during transportation. Animals that showed signs of abnormality during ante mortem inspection were not immediately approved for slaughter, rather detained for further confirmatory diagnosis. However, in certain conditions when the cases were not serious, “conditional approval” of the animal was judged to pass for slaughter and special attention was given to such animals during post mortem inspection. The present study revealed that out of 700 cattle examined during ante mortem examination, 292 (41.7%) cattle had various types of abnormalities that were higher when compared to the report of Hussen *et al.* [18] that refers occurrence of varies types of abnormalities in 9 (2.34%) heads out of 384 cattle at Assela Municipal Abattoir Arsi, South Eastern Ethiopia. The difference was probably due to variation in agro-ecological conditions that may be favorable to the parasites and also cultural differences in livestock management practices such as animal identification or treatment.

Lung and Liver were the most condemned organs and hydatidosis had been contributed significant condemnation rates (60.29% and 27.9% respectively) of these organs. The current findings were relatively in agreement with previous report by Haimanot *et al.* [19] and Kassaye *et al.* [20] that shows the liver and lungs are the most common sites of hydatidosis infection in cattle. The reason as explained by Nigatu [21] was that the liver and lungs possess the first great capillaries sites encountered by the migrating echinococcosis oncosphere which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved. The current study showed that hydatid cyst, fasciolasis and calcification were the major causes of organs condemnation in cattle slaughtered at the study area with the rate of 42.37%, 17.4% and 12.3% respectively. These findings were similar with reports of Biresaw and Deneka [22] who reported fasciolasis and hydatid cyst occurrence with a rate of 40.60 and 31.46%, respectively from the same study area. The study revealed that the prevalence of fasciolasis on the liver of slaughtered cattle at Dire Dawa municipal abattoir was 29.3% which was nearly similar when compared with the prevalence reported by Yifat *et al.* [14], 26.9 % at Gonder Elfora abattoir but it was lower when compared to the finding of Getachew *et al*. [23] who reported prevalence of 39.7% and 41% in Wondo-genet and Kemissie areas respectively. The difference might be probably due to the ecological, climatic and animal husbandry practices difference between the different localities. The prevalence of liver calcification revealed was 20.7% and the rate was higher than the rejection rate of liver (i`e 0.8%) at Gonder Elfora Abattoir, Norther Ethiopia that reported by Yifat *et al*. [14], 0.33% at Adigrat municipal abattoir, northern Ethiopia by Alembrhan and Haylegebriel [24] and 7.7% at Assela Municipal Abattoir Arsi, South Eastern Ethiopia by Hussein *et al.* [18].

In present study, hydatid cysts were more frequently observed in the lung of slaughtered cattle at Dire Dawa municipal abattoir. The current finding (60.29%) were some how, greater than the finding reported from Hawassa municipal abattoir by Tesfaheywet and Biruk [12] who reported45.3% and were far greater than the finding of Alembrhan and Haylegebriel [24] who reported 3.62% at Adigrat municipal abattoir, northern Ethiopia. The lung was also condemned due to the occurrence of pneumonia (14.71%) that was much higher than the findings 0.9% from Hawassa abattoir by Tesfaheywet and Biruk [12] and 6% from Gondar abattoir by Yifat *et al*. [14].

Assessment of pathological conditions and infected organ with body condition scoring were made in cattle. Affected organs rate in a cattle with poor body condition scoring had higher number on average 39.3% while those of fat cattle had on average 37.5% and medium body condition score were 23.2% that disagree with 78.95% for poor, 35.16% for medium and 35.12% for good body conditions reported by Jemal and Kebede [25]. However, the current finding nearly agree with the report of Kassaye *et al*. [20] who reported 62% for medium body condition, 59.1% for poor and 53.5% for good body conditions. So the relationship of body condition in respect with the infected organs have a statistically significant difference ($p<0.05$) as shown on the Table 5 above. When considering age related to pathological conditions, the study revealed major occurrence rate of pathological conditions in adult (53.6%) than young (23.21%) and old animals (23.21%) that were not in agreement with the finding reported by Kassaye *et al*. [20] from Hawassa municipal abattoir who reported lower occurrence rate of pathological conditions in adult cattle. However, body condition of animals and age group in comparison with occurrence of different disease conditions was showed a statistically significant difference ($P< 0.05$) for the rate of organ condemnation. The finding agrees with Tesfaheywet and Biruk [12] Jemal and Kebede [25] and Asmare *et al*. [26] who reported the presence of a statistically significant difference in the rate of organ condemnation in different body condition of animals.

The economic losses from rejected organs were estimated to be 217, 700, 000 Eth birr per year which were greater than the annual loss of 651, 342.5 Eth. birr analyzed at Hawassa municipal abattoir as reported by Jemal and Kebede [25] and 109, 492, 727.5 Eth. birr per annum loss at the current study area as reported by Haymanot *et al*. [19]. The current study reported that pathological conditions particularly, fasciolasis and hydatidosis were the major causes of economic loss through condemnation of affected organs. At the study area, there should be effective control and preventive measures taken to minimize direct economic loss of the country from the sector.

CONCLUSIONS

Ante-mortem and post mortem inspections were conducted in the abattoir for the purpose of screening and rejecting animal products with pathological lesions which were unsafe for human consumption and having

poor aesthetic value. Out of the total 700 cattle slaughtered at Dire Dawa Municipal abattoir, 292 (41.7%) of them had various types of abnormalities which revealed during ante mortem and 236 (33.71%) organs were totally condemned due to different pathological conditions that unfit for human consumption including inedible organ. Hydatid cysts, fasciolasis and calcification were found to be major causes of organs condemnation. Different pathological conditions observed on the organ causes considerable economic loss in livestock due to condemnation of organs and associated live weight loss. Cultural differences in livestock management practices such as animal identification or treatment have risks to expose animal to various disease. Young animals slaughter for human consumption is better since they have less pathological conditions which have public health importance when compared with adult age as the finding indicates at the study. In light of the above Conclusions, creating Awareness for the animal attendants, farmers, customers, abattoir workers and butchers regarding routine follow-up of animal health, good handling of animals during transportation, the public health significance of diseases of animal origin and the related losses were recommended.

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Conflict of Interest: The Authors declare that there is no conflict of interest

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