Pathological Conditions Causing Organ and Carcass Condemnation and Their Financial Losses in Cattle Slaughtered in Gondar, Northwest Ethiopia

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Abstract: A cross sectional study was conducted from November 2011 to April 2012 to identify the major causes of organ and carcass condemnation and to estimate the direct financial losses attributed to the condemned organs and carcasses in cattle slaughtered at Gondar ELFORA abattoir, northwest Ethiopia. Out of the total 1550 randomly selected cattle subjected to antemortem and postmortem examination, 378 (24.4%) and 944 (60.9%) were found to have various types of abnormalities, respectively. From the total organs and carcasses examined, 532(34.23%) livers, 305(19.68%) lungs, 32(2.06%) hearts, 17(1.1%) kidneys, 16(1.03%) heads, 6(0.39%) tongues and 1(0.06%) carcass were totally condemned while 35 (3.22%)carcasses were partially condemned from gross abnormalities as unfit for human consumption. Emaciation (43.9%), nasal discharge (10.58%), branding (16.92%) and lameness (10.05%) were the dominant abnormalities observed during antemortem examination. Major pathological conditions that caused a total condemnation of organs were fasciolosis (48.5%), hydatidosis (17.29%), cirrhosis (15.41%), calcification (7.89%), abscess (6.2%), pneumonia (12.45%), emphysema (10.5%) pericarditis (78.1%), pylonephritis (29.41%), infarcts (23.53%), hydronephrosis (17.65%), cysticercosis (42.85.7%) and wooden tongue (14.3%). Organ and carcass condemnation rates did not show significant difference (P>0.05) among age groups. However, there was a statistical significant difference P<0.05 between body condition groups in organ and carcass condemnation rates. The financial loss due to edible organ and carcass condemnation was estimated to be 21,565,849 Ethiopian Birr (1,268,579 USD) per annum. The current study revealed that fasciolosis and hydatidosis were the major causes for condemnation that lead to huge economic losses. In conclusion, the observation of such a level of abnormalities and substantial financial loss with condemnation of affected organs warrants the institution of appropriate control measures.

Key words: Cattle · Financial Loss · Antemortem · Postmortem, ELFORA, Gondar, Ethiopia

INTRODUCTION

Abattoir data can be a source of valuable information on the incidence and epidemiology of animal diseases conditions, to know to what extent the public is exposed to certain zoonotic diseases and estimate the financial losses incurred through condemnation of affected organs and carcasses [1, 2]. Antemortem and post mortem examinations of animals slaughtered in abattoirs give a good opportunity to identify the most important diseases prevalent the animal's source region [3]. The importance of antemortem inspection in the abattoir has long been recognized in an attempt to avoid the introduction of clinically diseased animals in to the slaughter hall and should be done within 24 hours of slaughter and repeated if slaughter has been delayed over day and when there is the suspected case [4, 5].

Each year a significant economic loss results from mortality, poor weight gain, condemnation of edible organs and carcasses at slaughter. This production loss in the livestock industry is estimated at more than 900 million USD annually [4]. Apart from this economic loss diseases that occur in livestock have public health impact. This is one of the major impacts and has highly pronounced effect on the large scale abattoirs where there are large numbers of animal slaughtered and large number

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of worker present [6]. The final judgment as to be taken with an organ, carcass or part of a carcass is based on the total evidence produced by observation, palpation and incision of each organ and carcasses, any ante mortem signs and the result of any laboratory test [7]. The main purpose of post mortem examination is to detect and eliminate abnormalities, including contamination, thus ensuring that only meat fit for human consumption is passed for food [3, 8].

In Ethiopia many studies have been undertaken to identify the major disease condition encountered during antemortem and postmortem inspection and to determine the economic importance of organs and carcass condemnation. However, there was no information on the major causes of organs and carcass condemnation at Gondar ELFORA abattoir. Therefore, the objectives of this study were to identify the major causes of organs and carcass condemnation and estimate the direct financial loss attributed to the condemned organs and carcasses in cattle slaughtered at Gondar ELFORA abattoir, northwest Ethiopia.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2011 to April 2012 at Gondar ELFORA abattoir in Gondar town, northwest Ethiopia. It is located at latitude of 12.4 N and longitude of 27.25 E. It receives a mean annual rain fall of 1000 mm. The average maximum and minimum temperature of the area vary between 22°C-30.7°C and 12.3°C-17.1°C, respectively. The human population of the town is estimated at 214,000 (CSA, 2008). The livestock population in the area comprises of cattle (8,202), goat (22,590), sheep (2,695), horses (1,065) and donkey (9,001). The livestock production system in the area is predominantly extensive type [9].

Study Animals: The study included 1550 male indigenous cattle destined for slaughter at Gondar ELFORA abattoir from various herds in Gondar and neighboring local areas. Animals were of different age groups. Based on their dental eruption patterns, two conventional age groups were formed as young-adult (2 to 6 years) and adult (>6 years) [10].

Study Design and Sample Size Determination: A cross-sectional study design was used to determine the major abnormal conditions of organs and carcasses and to estimate the direct financial loss in cattle slaughtered at Gondar ELFORA abattoir. Each week, five days visit was

made for antemortem and postmortem examination of slaughtered animals. Simple random sampling technique was used to select study animals on each visit day.

Data Collection Procedures: A total of 1550 cattle were subjected to AMI in the abattoir during the study period. Complete antemortem inspection of the animals was carried out shortly prior to slaughter. During the antemortem inspection, the age, sex (all males) and body condition of each individual animal was recorded. Each animal was enumerated on its body surface before slaughter using ink. Inspection of the animals was made while at rest or in motion for any obvious sign of diseases and abnormalities and recorded according to the standard antemortem inspection procedures [3]. Following the judgments passed by FAO [11], animal fit for human consumption were allowed for slaughter.

Before conducting the postmortem examination, the identification markings done in the antemortem examination were transferred to all organs that are going to be examined by postmortem examination. Organs and carcasses were collected and examined thoroughly using visual inspection, palpation and systematic incision of each organ and carcass for the presence of abnormalities. Pathological lesions were differentiated and judged according to guidelines on meat inspection for developing countries [11].

Assessment of Direct Financial Loss: The annual loss from organ condemnation was assessed by considering the overall annually slaughtered animal in the abattoir and retail market price of each organ and carcass. Annual slaughtered rate was estimated from retrospective abattoir records of the last four years, while retail market price of organs was determined from the information collected from butcheries in Gondar town. The information obtained was subjected to mathematical computation using the formula set by Ogunrinade and Ogunrinade [12].

Data Analysis: All the data collected during the study period were stored in Microsoft excel spreadsheet for statistical analysis and analyzed using Statistical Package for Social Science soft ware version 17.0 to determine prevalence and analyze the associations with risk factors. The outcome variables were the cases of abnormalities detected during routine postmortem inspection. Degree of association between different risk factors and distribution of the abnormalities was determined using Chi square test (χ^2). A 95% confidence interval was used. $P < 0.05$ was considered as statistically significant in all cases.

RESULTS

Antemortem Inspection: Among the total 1550 cattle examined, 378 (24.4 %) of them had various types of abnormalities during antemortem inspection. Emaciation (43.9%), branding (16.92%) and nasal discharge (15.34%) were the major abnormalities observed (Table 1).

Postmortem Examination: All animals that had been examined by antemortem inspection were subjected to postmortem examination. From the total organs and carcasses examined, 532(34.23%) livers, 305(19.68%) lungs, 32(2.06%) hearts, 17(1.1%) kidneys, 16(1.03%) heads, 6(0.39%) tongues and 1(0.06%) carcass were totally condemned while 35 (3.22%)carcasses were partially condemned from gross abnormalities as unfit for human consumption. There was no statically significant difference ($\chi^2 = 2.555$; p-value=0.110) between the two age categories and frequencies of organs and or carcasses condemned based on overall abnormalities (Table 2).

Liver Condemnation: From the total 1550 examined cattle at slaughter, 532 (34.32%) livers were totally condemned as unfit for human consumption because of various abnormalities. Of these condemned livers, fasciolosis was responsible for 258 (48.5%) liver condemnation followed by hydatidosis 92 (17.92%) and cirrhosis 82(15.41%). Rejection rate due to calcification, abscess and hepatitis was 7.89, 6.2 and 4.7%, respectively. There were no statically significant difference ($\chi^2 = 2.281$; p-value 0.131) between the two age categories and frequencies of liver condemned (Table 3).

Lung Condemnation: The major gross pathological conditions observed in lung were hydatid cyst and pneumonia accounting for 68.2 and 12.45%, respectively from the total lungs rejected. The rejection due to other causes such as; abscess, pleurisy and emphysema was 19.34%. There was statistically significant difference between ($\chi^2 = 4.002$; p-value=0.045) between the two age categories and frequencies of lung condemnation (Table 4).

Heart Condemnation: The causes of heart condemnation were pericarditis, abscess and hydatidosis. Of these, pericarditis (78.1%) was the major pathological lesion encountered. Abscess and hydatidosis accounted for 12.5% (4/32) and 9.4% (3/32) heart condemnation respectively. There was statically significant difference ($\chi^2 = 4.002$; p-value=0.045) between the two age categories and frequencies of heart condemned (Table 5).

Kidney Condemnation: Pyonephritis and hydatidosis were found to be the major principal causes for kidney condemnation, accounting for 29.41% each. The rejection rate due to infarcts and hydronephritis were 23.53% (4/17) and 17.65 % (3/17), respectively in both young adult and adult cattle. There was statically significant difference ($\chi^2 = 6.346$; p-value = 0.012) between the two age categories and frequencies of kidney condemned (Table 6).

Carcass Condemnation: The only cause of whole carcass condemnation in the abattoir during the study period was generalized calcified *Cysticercus bovis*.

Table 1: Proportion of abnormal conditions encountered during antemortem inspection

Abnormal conditions	No of animal affected	Abnormality percentage
Branding	64	16.92
Blindness	12	3.17
Emaciation	166	43.90
Lameness	38	10.05
Localized swelling	18	4.80
Nasal discharge	58	15.34
Fracture	5	1.32
Rough hair coat	17	4.50
Total	378	100.00

Table 2: Percentage of organs and carcasses of cattle condemned based on age groups(November 2011-April 2012)

Age	No. of cattle slaughtered	No (%) of organ and carcass condemned						
		Liver	Lung	Kidney	Heart	Carcass	Tongue	Head
Young	219	85(5.48%)	54(3.49%)	6(0.39%)	3(0.19%)		1(0.06%)	6(0.39%)
Adult	1331	447(28.84%)	251(16.19%)	11(0.71%)	29(1.87%)	1(0.06%)	5(0.33%)	10(0.64%)
Total	1550	532(34.32%)	305(19.68%)	17(1.1%)	32(2.06%	1(0.06%	6(0.39%)	16(1.03%

$\chi^2 = 2.555$; p-value=0.110

Table 3: Proportion of causes of liver condemnations based on age categories(November 2011-April 2012)

Cause	No(%) of liver condemned		Total
	Young-adult	Adult	
Fasciolosis	41(48.23%)	217(48.54%)	258(48.5%)
Hydatid cyst	17(20%)	75(16.78%)	92(17.29%)
Cirrhosis	9(10.59%)	73(16.33%)	82(15.41%)
Hepatitis	4(4.7%)	21(4.7%)	25(4.7%)
Abscess	10(11.76%)	23(5.14%)	33(6.2%)
Calcification	4(4.7%)	38(8.5%)	42(7.89%)
Total	85(100%)	447(100%)	532(100%)

χ^2= 2.281; p-value 0.131

Table 4: Proportion of causes of lung condemnation based on age categories (November 2011-April 2012).

Disease condition	No(%) of lungs condemned		Total
	Young adult	Adult	
Hydatid cyst	32(59.3%)	176(70.11%)	208(68.2%)
Emphysema	9(16.7%)	23(9.16%)	32(10.5%)
Pneumonia	8(14.8%)	30(11.95%)	38(12.45%)
Pleurisy	1(1.8%)	12(4.8%)	13(4.26%)
Abscess	4(7.4%)	10(3.98%)	14(4.59%)
Total	54(100%)	251(100%)	305(100%)

χ^2=4.002; p-value = 0.045

Table 5: Proportion of cause of heart condemnation based on age categories

Cause	No(%) of heart condemned		Total
	Young adult	Adult	
Pericarditis	2(66.7%)	23(79.31%)	25(78.1%)
Abscess	1(33.3%)	3(10.345%)	4(12.5%)
Hydatid cyst	-	3(10.345%)	3(9.4%)
Total	3(100%)	29(100%)	32(100%)

χ^2 =4.002; p-value=0.045

Table 6: Proportion of cause of kidney condemnation based on age categories

Cause	No(%) of kidneys condemned		Total
	Young adult	Adult	
Hydronephritis	1(16.7%)	2(18.1%)	3(17.65%)
Pyonephritis	2(33.3%)	3(27.3%)	5(29.41%)
Infarcts	1(16.7%)	3(27.3%)	4(23.53%)
Hydatid cyst	2(33.3%)	3(27.3%)	5(29.41%)
Total	6(100%)	11(100%)	17(100%)

χ^2=6.346; P-value = 0.012

Table 7: Proportion of causes of carcass condemnation based on age categories

Cause	No(%) of carcasses condemned		Total
	Young-adult	Adult	
Cysticercus bovis	-	1(3.6%)	1(2.8%)
Bruise	4(50%)	27(96.4%)	31(86.1%)
Localized abscess	4(50%)	-	4(11.1%)
Total	8(100%)	28(100%)	36(100%)

χ^2= 0.227; p-value=0.599

Table 8: Proportion of causes of tongue condemnation based on age categories(November 2011-April 2012)

	No. (%) tongues condemned		
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Causes	Young-adult	Adult	Total
Cysticercus bovis	1(100%)	2(33.3%)	3(42.85%)
Wooden tongue	-	1(16.7%)	1(14.3%)
Abscess	-	3(50%)	3(42.85%)
Total	1(100%)	6(100%)	7(100%)

χ^2= 0.000; p-value= 0.990

Table 9: Organ and carcass condemnation based on body condition score (BCS)

| BCS | Slaughtered Cattle | No(%) of organ and carcass condemned | | | | | | | Total Condemned | % |
		Liver	Lung	Kidney	Heart	Carcass	Tongue	Head		
Good	930	144 (15.48%)	160 (17.2%)	10 (1.1%)	18 (1.9%)	23(2.47)	3(0.3%)	4(0.43%)	362	38.92
Medium	447	238(53.24%)	112(25%)	5(1.1%)	10(2.23%)	8 (1.79%)	2(0.4%)	6(1.34%)	381	85.2
Poor	173	150(86.7%)	36(20.8%)	2(1.3%)	4(2.3%)	5(2.9%)	1(0.56%)	6(3.47%)	204	117.92
Total	1550	532(34.32%)	308(19.9%)	17(1.1%)	32(2.1%)	36(2.32%)	6(0.39%)	16(1.03%)	947	61.1

χ^2 =304.466; p-value = 0.000

Table 10: Findings of the study used in the direct financial loss assessment

Type of organs	Rejection rate of organs and carcass (%)	Average annual slaughtered animals se (per-year)	Average price of organs/carcass at local market (ETB)	Annual loss estimation (ETB)
Liver	34.32	5127	60	10557518.14
Lung	19.68	5127	20	201798.72
Heart	2.06	5127	30	316848.60
Kidney	1.1	5127	30	169191.00
Head	1.03	5127	50	158424.30
Tongue	0.39	5127	30	59985.90
Carcass		5127	90birr/kg	8285893.55
Total Estimated Loss (ETB)		21,565,849.00		

From the total examined animals at slaughter, 1(0.06%) carcass was totally condemned while 4(11.1%) and 31(86.1%) carcasses affected with localized abscess and bruises were passed as fit for human consumption after trimming of the affected parts. There was no statically significant difference (χ^2= 0.227; p-value=0.599) between the two age categories and frequencies of carcass condemned (Table 7).

Tongue Condemnation: The causes of tongue condemnation were abscess, *Cysticercus bovis* and wooden tongue which accounted for 42.82, 42.85 and 14.3%, respectively. There was no statically significant difference (χ^2= 0.000; p-value= 0.990) between the two age categories and frequencies of tongue condemned (Table 8).

Head Condemnation: Abscess was found to be the only cause for the head condemnation which accounted for 1.03% from the total cattle inspected at slaughter during the study period. There was statically significant difference (χ^2 = 7.278; P- value = 0.007; p<0.05) between young-adult (37.5%) and adult (62.5%) in the frequency of head condemnation.

Organ and Carcass Condemnation Based on Body Condition: Based on body condition score, 117.92 % (204/173), 85.2% (381/447) and 38.92% (362/930) of organs and/or carcass were totally condemned from poor, medium and good body conditioned cattle, respectively. While 2.9 % (5/173), 1.79 % (8/447), 2.47 % (23/930) of carcasses were partially condemned from poor, medium and good body conditioned animals, respectively. There was a statistical significant difference between the different body condition scoring categories (χ^2 = 304.466; p-value= 0.000) (Table 9).

Assessment of Direct Financial Loss: The annual direct financial loss incurred due to organs and carcass condemnation at Gondar ELFORA abattoir was calculated based on the formula set by Ogunrinade and Ogunrinade [12].

$$EL = \Sigma srx \times Coy \times Roz$$

where:

EL = Annual loss from organ and carcass condemnation.

Σsrk = Mean annual cattle slaughtered Gondar ELFORA abattoir.

Coy = Average cost of each cattle liver/ lung/ heart/ kidney/ head /tongue and carcass

Roz = Condemnation rates of /liver/ lung/ heart/ kidney/head/ tongue and carcass

Therefore, the annual direct financial loss was estimated to be 21,565,849 ETB or 1268579 USD per year (Table 10).

DISCUSSION

The most commonly encountered abnormalities during antemortem inspection were emaciation branding, nasal discharge, lameness and localized swelling. Lameness and localized swelling might be due to trauma while being driven to market places and during transportation to the abattoir by inappropriate vehicles. Hence, in both cases the affected parts were trimmed off and the rest part of the carcasses was passed as fit for human consumption. The nasal discharge was most probably due to stress, immune suppression, overcrowding in the holding pens of the abattoir, during transportation and respiratory diseases.

Bruising was observed at a rate of 2.0 % from the total cattle examined at slaughter. Ezana, [4] reported that bruising of animals during transport is the major source of economic loss in Africa and Asia. Loss due to bruising is more apparent in partially and totally condemned carcasses [13]. Apart from affecting carcass value, bruising has also an implication for animal welfare as excessive use of sticks while driving animals to the abattoir is greatly responsible for this phenomenon [2, 14].

The present findings indicated that a high number of livers were condemned due to various abnormalities. Of these, fasciolosis and hydatidosis were found to be the major causes for liver rejection from local market. Losses from liver condemnation were assumed to occur since hepatic pathology is associated to infection that might have public health importance and aesthetic value [15, 16]. Previous studies have indicated a higher economic loss resulting from condemnation of edible organs and carcass due to parasitic causes [14, 17] in different abattoirs in the country.

In the current abattoir survey, 16.64% of the animals' liver abnormalities were found to be caused by fascioliasis. This finding is comparable with the value reported by Swai and Ulicky, [18] and Abunna *et al.* [19] with a prevalence of 14% and 14.04 % in Hai, Tanzania and Wolaita Sodo, Ethiopia, municipal abattoirs, respectively. However, this result was higher than the value reported by Okoli *et al.* [20] and Kithuka *et al.* [21] with a prevalence of 8 and 8.2 %, from Nigeria and Kenya, respectively. On the other hand, this result was lower than reports of Phiri [8], Tadelle and Worku, [22] and Berhe *et al.* [23] as 37%, 46 % and 46.2% from Kafue in Zambia, Mekelle and Jimma municipal abattoirs in Ethiopia, respectively. These differences can be attributed to the difference in agro-ecological condition and strategic control of internal parasites in the areas. Apart from its veterinary and economic importance throughout the world, fasciolosis has recently been shown to be a re-emerging and widespread zoonosis affecting a number of human populations [24, 25].

Hydatidosis was another leading disease which was recorded at the abattoir. It affected most of the visceral organs such as lungs, liver, heart and kidney. The overall prevalence of hydatidosis was 19.87% which occurred predominantly in the lungs (67.53%). This finding is higher than the report of Elmahdi *et al.* [26], (3%) and Kebede *et al.* [27] (15.2%) from Sudan and Wolaita Sodo abattoirs respectively, but. it is lower than that reported by Kebede *et al.* [28]; Getaw *et al.* [29]; Regassa *et al.* [30] and Borji, [31] with a prevalence of 46.8, 48.5, 52.7% and 82% from Debre-Markos,Adama, Hawassa and Greece respectively.

The present study indicated that 19.68% of lungs were condemned from the total lungs inspected from being used as pet food due to pneumonia, emphysema, hydatid cysts, pleurisy and abscess. From the total lung rejected, hydatid cyst accounts for 68.2% as a principal cause of lung condemnation.

Pneumonia is the second important disease for lung condemnation in this abattoir during the study period. The prevalence of pneumonia was 2.45%. This finding is lower than the rejection rate (4.8 and 8.8%) that was reported by Raji *et al.* [1] in cattle slaughtered at Zaria and it was higher than that reported (0.14%) in cattle slaughtered at Zango abattoir [32]. A number of factors may explain the high prevalence of pneumonic lungs, including stress factors such as exposure to dust from the environment or exhaustion during long treks of pastoral livestock in search of pasture and water and when animals are taken to livestock markets or abattoirs and parasitism [7, 15].

Cysticercosis was the leading cause of total carcass condemnations (0.06 %) during the study This was comparable with the value reported by Basem *et al.* [33], Rodriguez - Hidalgo [34] and Huggies [35] with a prevalence of 1.69, 0.32 and 0.23% from Egypt, Northern Ecuador and Swaziland abattoirs respectively. The lower prevalence of bovine cysticercosis in this study might be attributed to personal awareness and environmental hygiene through proper use latrine which may contribute less contamination of grazing land by human excreta containing *T. saginata* eggs that may lead subsequent reduction of chance of infecting the intermediate host, cattle. On the contrary the occurrence of cysticercosis in this study 8520/is lower than those reported by Abunna *et al*. [36]; Regassa *et al.* [37]; and Garedaghi *et al*. [38] with an infection rate of 26.3, 13.3 and 3 % from Hawassa, Wolaita and Meshkinshahr abattoirs in Ethiopia and Iran, respectively. These variations in the reported prevalence rates may be due to several factors such as variation in the habit of raw meat consumption, awareness of patients about the clinical pictures of the disease, variation in personal and environmental hygiene and control measures and eradication programs. Bovine cysticercosis has impacts on cattle industry and poses a serious health risks to the beef consumers. Therefore, to reduce the transmission of taeniasis/cysticercosis, adequate meat inspection, public education to avoid consumption of raw/undercooked meat, use of latrines and improved standards of human hygiene are recommended [7].

The total financial loss calculated in this study, due to organs and carcass condemnation was 21,565,849 ETB/year, of which 5,121,873 and 3,251,510 ETB/year was due to fasciolosis and hydatidosis, respectively. The financial loss encountered due to fasciolosis in this study is higher than the reports from different parts of Ethiopia [19, 23, 39]. Likewise, the loss due to hydatidosis observed in this study is higher than the reports from various parts of the country [27, 30, 40] and from Sudan [26]. The difference in the financial loss estimated in various abattoir and/or parts of Ethiopia would be due to the variations in the prevalence of disease, mean annual number of cattle slaughtered in the different abattoirs and also the variation in the retail market price of organs [41].

CONCLUSION

The results of the present study revealed that fasciolosis, hydatidosis, cysticercosis, abscesses, pneumonia, pericarditis, hydronephrosis and bruising were the major causes of partial and total condemnation of organs and carcasses in cattle in the surveyed abattoir resulting in considerable financial loss in cattle production which remain the most important diseases warranting serious attention for prevention and control actions. Hence, the current study may be valuable locally and nationally by providing data for monitoring disease conditions and management practices of animals that have public health hazard and aesthetic value.

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