



RESEARCH ARTICLE

ECONOMIC IMPACT OF PARASITIC, BACTERIAL DISEASES AND OTHER CAUSES OF ORGAN CONDEMNATION OF CATTLE SLAUGHTERED IN ABATTOIRS OF TIGRAY REGION, ETHIOPIA

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ABSTRACT

Zoonotic diseases and other abnormalities are considered to be major health problem and causing a huge economic loss. A cross sectional active abattoir survey was conducted from May 2014 to January, 2015 to estimate direct financial losses due to organ condemnation in cattle slaughtered in abattoirs of Tigray, northern Ethiopia. A total of 479 cattle were examined through ante mortem and postmortem examinations. Postmortem examinations revealed that out of the total organs examined, 150 (31.3%) livers, 59 (12.3%) lungs, 15 (3.1%) kidneys and 4 (0.8%) hearts were totally condemned due to different parasitic, bacterial diseases and other abnormalities. A significant difference was observed in the rejection rate of liver, lung and kidney between different body condition scores of slaughtered cattle. Similarly, there was statistically significant difference in the rejection rate of liver between breed of cattle. The annual financial loss due to organ condemnation was estimated to be 10,375,900.00 Ethiopian Birr (522,452.16 USD). Liver condemnation was responsible for high financial loss followed by lung and kidney condemnation, respectively. The result of this study revealed the economical impact of the parasitic, bacterial diseases and other abnormalities is high, which necessitates designing of appropriate strategies for their control.

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INTRODUCTION

Animal production is the main component of agricultural development in most developing countries and cattle play an important role in improving the national economy of Ethiopia (EASE, 2003; CSA, 2008). Ethiopia owns huge number of livestock, about 52.1 million heads of cattle (CSA, 2008). The income derived from the agricultural sector could not impart significant role in the development of the country's economy due to the low productivity of cattle by different constraints such as animal diseases, poor husbandry system, lack of governmental policies for disease prevention and control, low genetic potential of indigenous breeds, poor nutrition, poor reproductive performance and infrastructure problems (Elsa et al., 2012). Each year a significant financial loss results from death of cattle, inferior weight gain, condemnation of edible organs and carcass were observed at slaughter houses due to different parasitic, bacterial diseases and other causes (Genet et al., 2012; Alembrian and Haylegebriel, 2013; Amene et al.,

2012; Miheret et al., 2013). This production loss to the livestock industry in the country is estimated at more than 500 million United State of American Dollar (USD) annually (Melaku et al., 2012; Jemere et al., 2013; Endalew and Nuraddis., 2013 and Dechassa et al., 2012). Several studies have been conducted in different parts of Ethiopia to estimate the financial loss due condemnation of edible organs via parasitic diseases and other abnormalities. However, in Tigray region there seems little work notifying the extent and degree of financial loss associated with organ condemnation due to different diseases and other abnormalities extensively. Therefore, this study was under taken to determine the direct economical losses as a result of organ condemnation.

MATERIALS AND METHODS

The study was conducted in Tigray regional state, Northern Ethiopia. Four zones of the region namely, southern, eastern, central and north western zones were selected for the study. A total of 479 cattle were selected and examined through ante mortem and postmortem examinations. During ante mortem examination the age, sex, breeds and body condition each of the study cattle were recorded. Postmortem examination was

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conducted through visual inspection, palpation and systematic incision of each visceral organ particularly the liver, lung, heart and kidney for the presence of various parasites, bacteria and lesions of abnormalities (Getaw *et al.*, 2010). Economical analysis was conducted based on annual slaughter capacity of the abattoirs, rejection rate and average market price of each organ in the areas. Annual slaughtered rate of abattoirs was estimated from their retrospective record of the last recent years, while average market price of each organ was determined by interviewing personnel of the abattoirs and butchers. The annual economic loss due to organs condemnation was estimated using the formula described by Ogunrinade and Ogunrinade (1980) as follows.

$$EL = E \text{ srx} * \text{Coy} * \text{Roz} \quad \text{Where,}$$

EL = Annual economic loss estimated due to organ condemnation,

E srx = Annual number of cattle slaughtered in the abattoirs,

Coy = Average cost of each organ

Roz = Condemnation rate of each organ.

Data were analyzed using SPSS version 20 and descriptive statistics such as percentage was used to determine organs condemnation rate. The association between condemnation rate of each organ and host related risk factors such as sex, age, body condition and breed was evaluated by chi-square test (χ^2) and p value less than 0.05 was considered as statistically significant.

RESULTS

Out of 479 cattle slaughtered and examined, 150 (31.3%) livers were condemned due to different causes and of these condemned livers, cysticercosis was responsible for 73 (15.2%) liver condemnation followed by fasciolosis 30 (6.26%) and hydatidosis 25 (5.23%), respectively (Table 1 and 2). Statistical analysis indicated that there was a significant difference in the condemnation rates of liver between the body condition scores of cattle ($\chi^2 = 41.044$, $P = 0.001$) and it was higher in animals with poor body condition score. Significant difference ($\chi^2 = 32.72$, $P = 0.048$) was also recorded between breeds of the animals and cross cattle were affected more. A total of 59 (12.3%) lungs were condemned due to different causes (Table 3 and 4). Hydatidosis (4.8%), emphysema (4.4%) and pneumonia (2.5%) were major causes of lung condemnation. Body condition affected significantly the lung rejection rate ($\chi^2 = 19.099$, $P = 0.039$), the rejection rate was higher in animals with poor body condition (18.4%) than that of medium (12 %) and good body condition scores (10.2%). However, there was no statistically significant variation in relation to the sex, age and breed of cattle ($P > 0.05$). In this study, kidneys of 15 (3.1%) cattle were condemned due to gross abnormalities. hydronephrosis 12 (2.5%) and hydatidosis 3 (0.6%) were the main causes of kidney condemnation (Table 5 and 6). Condemnation rate of kidneys varied significantly ($\chi^2 = 24.912$, $P = 0.023$) between body condition of the animals and it was highest in poor body condition animals.

Table 1. Parasitic, bacterial and other causes of liver condemnation by sex and age

Diseases	No of infected cattle (%)					
	Sex			Age		
	M	F	T	< 5	> 5	T
	396	83	479	79	400	479
Parasitic						
Cysticercosis	69(17.4)	4(4.8)	73 (15.2)	11(13.9)	62(15.5)	73 (15.2)
Fasciolosis	26(6.6)	4(4.8)	30(6.26)	5(6.33)	25(6.25)	30(6.26)
Hydatidosis	24(6.1)	1(1.2)	25(5.23)	2(2.5)	23(5.75)	25(5.23)
Bacterial						
Tuberculosis	1(0.25)	-	1(0.21)	-	1(0.25)	1(0.21)
Abnormality						
Calcification	13(3.3)	1(1.2)	14(2.9)	3(3.8)	11(2.75)	14(2.9)
Abscess	4(1)	-	4(0.83)	-	4(1)	4(0.83)
Cirrhosis	2(0.5)	1(1.2)	3(0.63)	-	3(0.75)	3(0.63)
Total	139(35)	11(12.3)	150 (31.3)	21(26.6)	129(32.25)	150 (31.3)
	$\chi^2 = 18.29$ p = 0.19			$\chi^2 = 8.495$ p = 0.387		

M = male, F = female, T = total

Table 2. Parasitic, bacterial & other causes of liver condemnation by body condition and breed

Diseases	No of infected cattle (%)						
	P	Body Condition			T	Breed	
		M	G	L		C	T
	38	382	59	479	384	95	479
Parasitic							
Cistecercosis	8(21.1)	62(16.2)	3(5.1)	73 (15.2)	56(14.6)	17(17.9)	73 (15.2)
Fasciolosis	5(13.16)	21(5.5)	4(6.8)	30(6.26)	18(4.7)	12(12.6)	30(6.26)
Hydatidosis	4(10.55)	20(5.2)	1(1.7)	25(5.23)	21(5.5)	4(4.2)	25(5.23)
Bacterial							
Tuberculosis	-	1(0.3)	-	1(0.21)	1(0.34)	-	1(0.21)
Abnormalities							
Calcification	4(10.55)	7(1.8)	3(5.1)	14(2.9)	13(3.4)	1(1.1)	14(2.9)
Abscess	1(2.6)	3(0.78)	-	4(0.83)	4(1)	-	4(0.83)
Cirrhosis	1(2.6)	1(0.3)	1(1.7)	3(0.63)	3(0.78)	-	3(0.63)
Total	23(60.5)	115(30.1)	12(20.3)	150(31)	116(30)	34(35.8)	150 (31.3)
	$\chi^2 = 41.044$ p = 0.001			$\chi^2 = 32.72$ p = 0.048			

T = total P = poor M = medium G = good L = local C = cross

Table 3. Parasitic, bacterial and other causes of lung condemnation by sex and age

Diseases	No of infected cattle (%)					
	M 396	Sex F 83	T 479	< 5 79	Age > 5 400	T 479
Parasitic						
Hydatidosis	21(5.3)	2(2.4)	23(4.8)	1(1.3)	22(5.5)	23(4.8)
Bacterial						
Tuberculosis	1(0.25)	-	1(0.2)	-	1(0.25)	1(0.2)
Abnormalities						
Emphysema	20(5.1)	1(1.2)	21(4.4)	5(6.3)	16(4)	21(4.4)
Pneumonia	10(2.5)	2(2.4)	12(2.5)	2(2.6)	10(2.5)	12(2.5)
Abscess	2(0.5)	-	2(0.4)	-	2(0.5)	2(0.4)
Total	54(13.6)	5(6)	59(12.3)	8(10.1)	51(12.75)	59(12.3)
	$\chi^2 = 4.597$ p = 0.467		$\chi^2 = 3.924$ p = 0.59			

Table 4. Parasitic, bacterial diseases & other causes of lung condemnation by body condition & breed

Diseases	No of infected cattle (%)						
	P 38	Body Condition			Breed		
		M 382	G 59	T 479	L 384	C 95	T 479
Parasitic							
Hydatidosis	3(7.9)	18(4.7)	2(3.4)	23(4.8)	20(5.2)	3(3.2)	23(4.8)
Bacterial							
Tuberculosis	1(2.6)	-	-	1(0.2)	1(0.3)	-	1(0.2)
Abnormalities							
Emphysema	2(5.2)	17(4.5)	2(3.4)	21(4.4)	17(4.4)	4(4.2)	21(4.4)
Pneumonia	-	10(2.6)	2(3.4)	12(2.5)	10(2.6)	2(2.1)	12(2.5)
Abscession	1(2.6)	1(0.26)	-	2(0.4)	1(0.3)	1(0.5)	2(0.4)
Total	7(18.4)	46(12)	6(10.2)	59(12.3)	49(12.7)	10(10.5)	59(12.3)
	$\chi^2 = 19.099$ p = 0.039			$\chi^2 = 6.854$ p = 0.576			

Table 5. Parasitic diseases and other causes of kidney condemnation by sex and age

Diseases	No of infected cattle (%)					
	M 396	Sex F 83	T 479	< 5 79	Age > 5 400	T 479
Parasitic						
Hydatidosis	3(0.8)	-	3(0.6)	1(1.3)	2(0.5)	3(0.6)
Abnormalities						
Hydronephrosis	10(2.5)	2(2.4)	12(2.5)	3(3.8)	9(2.3)	12(2.5)
Total	13(3.3)	2(2.4)	15(3.1)	4(5.1)	11(2.8)	15(3.1)
	$\chi^2 = 0.638$ p = 0.727			$\chi^2 = 1.285$ p = 0.526		

Table 6. Parasitic diseases & other causes of kidney condemnation by body condition & breed

Diseases	No of infected cattle (%)						
	P 38	Body Condition			Breed		
		M 382	G 59	T 479	L 384	C 95	T 479
Parasitic							
Hydatidosis	2(5.3)	-	1(1.7)	3(0.6)	2(0.5)	1(1.1)	3(0.6)
Abnormalities							
Hydronephrosis	7(18.4)	3(0.8)	2(3.4)	12(2.5)	9(2.3)	3(3.2)	12(2.5)
Total	9(23.7)	3(0.8)	3(5.1)	15(3.1)	11(2.8)	4(4.2)	15(3.1)
	$\chi^2 = 24.912$ p = 0.023			$\chi^2 = 1.612$ p = 0.807			

Table 7. Parasitic diseases and other causes of heart condemnation by sex and age

Diseases	No of infected cattle (%)					
	M 396	Sex F 83	T 479	< 5 79	Age > 5 400	T 479
Parasitic						
Hydatidosis	2(0.51)	-	2(0.4)	-	2(0.5)	2(0.4)
C.bovis	2(0.51)	-	2(0.4)	1(1.3)	1(0.25)	2(0.4)
Total	4(1)	-	4(0.8)	1(1.3)	3(0.75)	4(0.8)
	$\chi^2 = 0.845$ p = 0.655			$\chi^2 = 2.027$ p = 0.363		

Table 8. Parasitic diseases & other causes of heart condemnation by body condition & breed

Diseases	No of infected cattle (%)						
	P	Body Condition		Breed			
	38	M	G	T	L	C	T
		382	59	479	384	95	479
Parasitic							
Hydatidosis	-	2(0.5)	-	2(0.4)	2(0.5)	-	2(0.4)
<i>C.bovis</i>	-	1(0.25)	1(1.7)	2(0.4)	-	2(2.1)	2(0.4)
Total	-	3(0.8)	1(1.7)	4(0.8)	2(0.5)	2(2.1)	4(0.8)
		$\chi^2 = 3.21$	$p = 0.525$			$\chi^2 = 9.388$	$p = 0.052$

Table 9. Direct financial loss assessment

Type of organ	Rejection rate of organ (%)	Average annual slaughtered cattle /year	Average price of organs at local market (ETB)	Annual financial loss estimation (ETB)
Liver	31.3	2150	140	9,421,300.00
Lung	12.3	2150	25	661,125.00
Kidney	3.1	2150	35	233,275.00
Heart	0.8	2150	35	60,200.00
Total Estimated Loss (ETB)			10,375,900.00	

ETB = Ethiopian Birr USD = United State of America's Dolar

However, such variation with respect to sex, age and breeds of animals was not statistically significant ($P > 0.05$).

The condemnation rate of heart due to different causes was found to be 4 (0.8%). The main causes of heart condemnation were hydatidosis and cisticercosis, which they account 2 (0.4%) for each (Table 7 and 8). There was no statistically significant difference between the hosts related risk factors and condemnation rate of heart. Using all the necessary information in the formula set by Ogurinate and Ogunrinade (1980), the annual financial loss due to condemnation of edible organs in abattoirs of Tigray was estimated to be 10,375,900.00 ETB (522,452.165 USD) (when 1 USD ~ 19.86 ETB) (Table 9). The highest economic loss was recorded due to liver condemnation followed by lung and kidney condemnation, respectively.

DISCUSSION

The present study showed that high number of livers 150 (31.3%) was condemned due to various causes. High liver was condemned due to bovine cysticercosis (15.2%) and this finding was higher than reports from different parts of Ethiopia (Ashwani and Gebretsadik, 2008; Nurraddis and Frew, 2012; Nurit *et al.*, 2012 and from Iran by Gholam *et al.* (2012). On the contrary the rejection rate of liver due to cysticercosis in this study was lower than those reported by Fufa *et al.* (2008) and Genet *et al.*, (2012) with an infection rate of 26.3, and 42.85% from Hawassa, and Gondar abattoirs, respectively. These variations in the reported prevalence rates might be due to variation in the habit of raw meat consumption of the population, personal and environmental hygiene and control measures and eradication programs. Liver condemnation due to fasciolosis (6.26%) was inconsistent with the studies conducted by Dechassa *et al.* (2012) in Jimma and Alembrhan and Haylegebriel, (2013) in Adigrat municipal abattoirs. The rate of liver rejection in this study due to fasciolosis was lower than the studies conducted in different abattoirs of Ethiopia (Yifat *et al.*, 2011; Amene *et al.*, 2012; Nurit *et al.*, 2012). These differences might be due to variation in the ecological

conditions for distribution of the parasite and its intermediate host. Liver condemnation by hydatidosis was (5.25%) and this finding is in consistent with the findings of Gebretsadik (2009) and Alembrhan and Haylegebriel (2013) in Tigray region at Mekelle and Adigrat municipal abattoirs. However, it was lower than studies conducted by Mihret *et al.* (2013) who reported 20.05% from Dire Dawa, Zelalem *et al.* (2012), 19.7% from Addis Ababa and Yifat *et al.* (2011) from Gondar municipal abattoirs. Lungs of 59 (12.3%) cattle were condemned due to hydatidosis, emphysema, pneumonia and abscess. From the total lung rejected, hydatidosis accounts for 4.8% as a principal cause of lung condemnation. This finding is agreement with the study conducted in Adigrat by Alembrhan and Haylegebriel (2013) who reported 5.1%. However, it is lower than reports from Mekelle, Debremarkos, Adama, Hawassa, Ambo, Nekemte and Dire Dawa abattoirs by Gebremeskel and Kalayou (2009), Kebede *et al.* (2009), Getaw *et al.* (2010), Regassa *et al.* (2010) and Endrias *et al.* (2010), Fufa *et al.* (2011) and Mihret *et al.* (2013), respectively.

The rejection rate of lung due to emphysema (4.4%) was in consistent with the studies conducted different part of the country (Yifat *et al.*, 2011; Asmare *et al.*, 2012) and it was lower than the rate reported in Gondar abattoir (Genet *et al.*, 2012). Pneumonia was identified as other cause of lung condemnation and it was observed at a rate of 2.5% which is in agreement with results reported by Shegaw *et al.* (2009) at Mekelle, Asmare *et al.* (2012) at Bahri Dar and Alembrhan and Haylegebriel (2013) at Adigrat abattoirs. The occurrence of emphysema and pneumonia in lungs could be due to exposure of cattle to bacterial or viral infections, exposure to dust from the environment during long treks of pastoral livestock in search of pasture and water and when animals are taken to livestock markets or abattoirs (Benard *et al.*, 2011). Moreover, penetration of lung by foreign body, adverse weather condition or accidental inhalation of liquid may cause pneumonia. Tuberculosis (0.2%) was also responsible for lung condemnation and this finding was in agreement with the study conducted by Shegaw *et al.* (2009) in Mekelle and Nurit *et al.* (2012) in South Wollo. The possible reasons for diseases and

abnormalities causing lung condemnation could be poor management system, lack of disposal of infected organs, epidemiological and environmental factors.

The current study revealed that the condemnation rate of kidney (2.5%) due to hydronephrosis was lower than the study conducted in Gondar abattoir i.e.79.1% (Yifat *et al.*, 2011). But it was higher than the studies conducted in different parts of Ethiopia (Amene *et al.*, 2012, Alembrhan and Haylegebriel, 2013). Shegaw *et al.* (2009) and Genet *et al.* (2012) reported that the higher rejection rate of kidney was due to hydatidosis and pyonephritis. The differences in the rejections rates could be attributed to the differences in the prevalence of different pathogens in different areas, their virulence and variation in animal management systems. The present study showed that a total of 4 (0.8%) hearts were condemned due to hydatidosis and cysticercosis and this condemnation rate of heart was relatively similar with previous studies conducted in different abattoirs of Ethiopia (Gebretsadik, 2009; Nuraddis and Frew, 2012; Amene *et al.* 2012). However, higher rejection rate of heart due to hydatidosis was reported by Genet *et al.* (2012) and Fufa and Debele (2013) from Gondar and Wolaita Soddo abattoirs and via cysticercosis was also reported by Jemal and Haileleul (2011) and Hussein *et al.*(2011), who reported 20.6 and 28.1% in Kombolcha and Ziway, respectively. The differences in the rejection rate of heart with relation to these parasitic diseases may be due to the differences in the prevalence, variation in animal management systems, and strategic control of parasites.

According to the statistical analysis of this study, organ condemnation was significantly associated with the body condition score of the cattle. High liver, lung and kidney condemnation was observed in cattle with poor body condition. This finding is in agreement with different studies conducted in different parts of Ethiopia (Shegaw *et al.*, 2009; Mihreteab *et al.*, 2010; Genet *et al.*, 2012; Miheret *et al.*, 2013). This could be animals with poor body condition are consequently susceptible to infectious diseases. Similarly, higher liver condemnation was also recorded in cattle with exotic breed. This might be the cross/exotic animals have no re-stimulation of immunity to combat the infection due to lack of following invasion of the infections. In the current study the overall condemnation rate of liver (31.3%) and lung (12.3%) were much higher than that of kidney (3.1%) and heart (0.8%). This finding is in agreement with studies conducted by Shegaw *et al.* (2009) and Genet *et al.* (2012) in Mekelle and Gondor municipal abattoirs, respectively. The reasons could be the lung and liver contain the highest capillary bed in the body and therefore, the majority of the onchospheres are filtered out and trapped in the fine blood capillaries and the only small number of onchospheres reach the remaining organs (Gracey,1986).

The total annual financial loss due to edible organ condemnation in the present study estimated to be 10, 375,900.00 ETB and this finding was by far higher than the lost reported from different parts of Ethiopia (Yifat *et al.*, 2011; Genet *et al.*, 2012; Amene *et al.*, 2012 and Asmare *et al.*, 2012; Alembrhan and Haylegebriel, 2013). The financial loss due to liver condemnation (9,421,300 ETB) in this study was relatively in consistent with report of Genet *et al.* (2012) from municipal Gondar. However, it was much higher than the

reports of many researchers (Yifat *et al.*, 2011; Amene *et al.*, 2012, Alembrhan and Haylegebriel, 2013; Nurit *et al.*, 2012). Likewise, the loss due to lung condemnation (661,125.00 ETB) observed also higher than the previously conducted researches in the country (Amene *et al.*, 2012; Genet *et al.*, 2012; Asmare *et al.*, 2012). The financial loss due to kidney and heart condemnation was also higher as compared with the loss reported from Jimma, Gondar and Adigrat municipal abattoirs (Amene *et al.*, 2012; Genet *et al.*, 2012; Alembrhan and Haylegebriel, 2013). The difference in the financial loss estimated in various abattoirs of Ethiopia would be due to the variations in the prevalence of diseases, mean annual number of cattle slaughtered in the abattoirs, meat inspection techniques and the retail market price of organs.

CONCLUSION AND RECOMMENDATION

Zoonotic diseases and other abnormalities are causing an extensive financial loss as a result of edible organ condemnation. The results of the present study revealed that high number of edible organs such as liver (31.3%), lung (12.3%), kidney (3.1%) and heart (0.8%) were condemned due to different diseases and abnormalities as a result a total of 10, 375,900.00 ETB was lost annually. The highest financial loss was recorded due to liver condemnation followed by lung and kidney condemnation, respectively. Therefore, to mitigate the economic and public health impacts of diseases and abnormalities of cattle, proper disposal of offal, prohibition of backyard slaughter of cattle, construction of slaughterhouses, better disease control strategies and prompt chemotherapy of live animals before slaughter with improved meat inspection qualities are critical.

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