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Major Causes of Organ Condemnations and Its Economic Implications in Cattle Slauughtered at Kombolcha Elfora Abattoir, Northeastern, Ethiopia

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Abstract
A cross sectional study from November 2016 to April 2017 and two years retrospective study were conducted at Kombolcha ELFORA abattoir. Ante mortem examinations to the slaughtered cattle were carried out at the lairage during this their origin, sex, age and body conditions were recorded, followed by post mortem examinations using their identification numbers given at ante mortem. Potential risk factors were analyzed and found that there was statistically significant difference between body conditions of animals ($p< 0.05$). However no significant difference was seen in age and sex of animals. Out of 2000 organs belonging to 400 slaughtered animals examined at postmortem 105(26.25%) livers, 79 (19.75%) lungs, 33(8.25%) hearts, 35 (8.75%) kidneys and 25 (6.25%) tongue were rejected due to various causes. The major causes of these condemnations were cirrhosis (11%) for liver; pneumonia (5.25%) for lung; hemorrhage (3.25%) for kidney; hydated cyst (3%) for heart and ulcer (2.75%) for tongue. From a retrospective data of 9811 cattle slaughtered, it was found that lung (46.6%), kidney (42.6%), liver (38.3%), heart (19.22%) and tongue (6.5%) were condemned due to pneumonia, nephritis, hepatitis, oedema and abscess with respective rates of 13.6%, 10.8%, 15.64%, 4.56% and 2.1%. A direct annual financial loss of 342,574.98 ETB (9,578.55 USD) was estimated within three years 121,310.48 ETB (5,251.54 USD) per annum from the active abattoir survey study and 221,264.5 ETB (9578.55 USD) from the retrospective data investigation. The result warrants, the need of public awareness about the effects of animal disease and proper disposal of condemned organs must be practiced in order to break the life cycle of some of the parasitic disease.
Keywords: Abattoir, Ante and Postmortem inspection, Cattle, Condemnation, Economic loss, Kombolcha ELFORA.

1. Background

Ethiopia is believed to have the largest livestock population in Africa which contributing considerable portion to the economy of the country. The livestock population of Ethiopia has is estimated to be 59.5 million cattle, 30.70 million sheep and 30.20 million goats (CSA, 2017). Despite the large number of livestock in Ethiopia, the sector is characterized by low productivity due to several factors which includes disease, breed, poor management factors etc (Elsa *et al.,* 2012).

Abattoirs played an important role in surveillance of various diseases affecting human and animal health (Mellau *et al.,* 2010). The data from abattoirs can be a used as a source of information for animal disease, to appreciate extent the public is exposed to zoonotic diseases and estimate the financial losses incurred through condemnation of affected organs and carcasses (Raji *et al.,* 2010). Meat inspection is one great activity conducted in the abattoir for the purpose of screening animal products with abnormal pathological lesions that are unsafe for human consumption (Chhabra and Singla, 2009).

The main causes of organ condemnation during post mortem inspection are diseases caused by parasites, bacteria and viruses. Flukes in liver and hydatid cyst in lung, liver and kidney are mainly involved (Mezegebu, 2003). Studies conducted in different abattoirs of Ethiopia revealed that parasitic infection of livers; lungs (pneumonia), pericarditis and pyelonephritis are the major cause of organs condemnation (Asmare *et al.,* 2012; Biu, and Adindu, 2004).

Many researchers reported economic losses associated with organ condemnation in different parts of Ethiopia (Genet *et al.,* 2012; Amen *et al.,* 2012; Fasil *et al.,* 2012; Lati *et al.,* 2015; Yalew *et al.,* 2016). Differences in the amount of money lost in various abattoirs could be attributed to differences in the prevalence

of diseases, differences in the rejection rate of organs, difference in the slaughtering capacity of abattoirs and also variations in the management of animals in different parts of the country (Amen *et al.,* 2012).

Except only a retrospective abattoir survey done (Yishak *et al.,* 2015) on beef organ and caracas condemnation which shows that poor bleeding (0.11%), abscess (0.06%), adhesion (0.06%), TB (0.03%), pneumonia (0.01%), C.bovis (0.01%) and bruises (0.01%) as a cause of organ and carcass condemnation, most of the studies at Kombolcha ELFORA abattoir were focusing on specific diseases such as fasciolosis (Ibrahim *et al.,* 2015), hydatidosis (Mulat, 2016) and cysticercus bovis (Tewodoros *et al.,* 2015). Hence, it would be essential to have comprehensive information on causes of organs condemnations and their economic loss to establish appropriate prevention and controls measures. Therefore, the study carried out with objectives to identify the major causes of organ condemnations of cattle and estimate direct economic losses associated with organ condemnations.

2. Methods

Study Area

The study was conducted from November 2016 to April 2017 at Kombolcha ELFORA abattoir. The town is located at about 110 6' N latitude and 390 45' E longitude, the area receive mean annual rainfall is 1046 mm while annual maximum and minimum temperatures are 26.5^{o}C and 12.3^{o}C, respectively. The town is located in a range of altitudes between 1,500 and 1,840 meter above sea level. The livestock population of the area contains 90,664 cattle, 12,975 sheep, 31,043 goats, 489 horses, 7,758 donkeys, 866 camel and 43,010 poultry (CSA, 2004).

Study Population and Sample Size

The study animals were local cattle breeds from different districts around the town mainly Kalu, Kemissie, Dessie Zuria, West Afar, Southern Tigray and South Gonder. Simple random sampling method was used for taking the required sample. Sample size for the present study was determined by using the formula described by Thrusfield 2005 with 5% precision and 95% confidence interval as follows:

$N= (1.96)^2 \times Pexp (1- Pexp)/d^2$

Where: N = required sample size, Pexp =expected prevalence, d =desired absolute precision

Substituting the values in the formula: $N= (1.96)^2 \times 0.5 (1- 0.5)/0.0025$

N=384

Accordingly, the sample size was 384. However, in order to increase the precision in the present study the sample size was increased to 400.

Study Design

The study type conducted was cross sectional which involves active abattoir survey and retrospective data investigation to estimate the major causes of organ condemnations and estimate the direct financial loss due to organ condemnation.

Study methodology

Ante mortem inspection: Three days per week regular visits were made to abattoir and animals that will be included to the study randomly selected then subjected to routine ante mortem inspection during which various risk factors such as origin, body condition, sex and age of animals were recorded. The body condition score of animals were classified according to (Nicholosen *et al.,* 1986). Accordingly, animals were grouped into poor, medium and good body conditioned. In addition estimation of age was carried out by dentition (DeLahunta *et al.,* 1986) then animals were classified to old age >7years old and adults if less than 7 years old.

Post mortem inspection*:* The post mortem inspection was conducted based on standard guidelines for meat inspection in developing countries (FAO, 2007). Accordingly, the liver, lung, heart, kidney and tongue were examined through visualization, palpation and systematic incision for any pathological lesion(s).

Retrospective data: A retrospective data which includes number of cattle slaughtered, type and number of condemned organs and causes for each condemnation was collected using postmortem meat inspection records of the abattoir from October 2014 to October 2016.

Assessment of direct financial loss

The total financial loss due to organ condemnation was computed based on the condemnation rate of each examined organs, average number of animals slaughtered per year and average local market price of each organ, which was collected from randomly interviewing abattoir workers; meat inspectors as well house holders. Accordingly, the total direct financial loss was calculated by using the formula set by Ogunrinade and Ogunrinade BI 1980:

$DAL = \sum AC \times AP \times CR$

Where; DAL = Direct annual financial loss due to organ condemnation from domestic market, AC =annual cattle slaughter rate of the abattoir, AP = average cost of each liver, lung, heart, kidney and tongue and CR= condemnation rate of liver, lung, heart, kidney and tongue.

Data Management and Analysis

The data was analyzed by using SPSS software version 16 program. The association between variables used in the study was considered statistically significant when P value is > 0.05. In addition descriptive statistics was used to determine the rate of condemnation.

3. RESULTS

Active abattoir survey

Out of 400 slaughtered cattle, 238 (59.5%) were found to be one or more organs condemned with difference in the degree of condemnation 105 (26.25%) liver, 79(19.75%) lung, 33(8.25%) heart, 35(8.75%) kidney and 25(6.25%) tongue were condemned. Regarding animal related risk factors though no statistically significant difference between age and sex group but there was significant difference between body condition animals (p=0.01) (table 1). Considering the cause cirrhosis for liver 44(41.9%), pneumonia 21(26.58%) for lung, H.cyst 12(36.4%) for heart, hemorrhage 13(37.14%) for kidney and ulcer 11(44.0 %) tongue (table 3) were the incriminated. The result also showed there is no great difference in the prevalence of disease based on animal origin except between Dessis Zuria and South Tigri (table 2).

Retrospective study

A retrospective data records of 9,811 cattle slaughtered was collected. It was found that lung, kidney, liver, heart and tongue were the most condemned organs with their respective condemnation rates of 46.6%, 42.6%, 38.3%, 19.22%, and 6.5%. The major causes of these condemnations were hepatitis (15.64%), pericarditis (15.6%), pneumonia (13.56%), emphysema (12.26%), pleuritis (12.31%) and H.cyst (7.32%) (table 4)

Economic loss estimation

The study considered direct economic losses associated with organ condemnation. Taking mean annual cattle slaughtered during the study period, a retrospective data of the past two years and the unit local price for liver, lung, heart, kidney and tongue were 50, 10, 15, 16.10 and 24.15 ETB respectively. Accordingly, the total direct annual cost of the condemned organs for active abattoir survey was estimated to be 121,310.48 ETB (5251.54 USD) (table 5) and from retrospective data estimated to be 221,264.5 ETB (9578.55 USD) (table 6). (1 USD=23.10 ETB during the study period)

Table 4 Animal age, sex, body condition, and rejection rate of specific organs

Variable		Animals examined	Animals with organs condemned	Prevalence (%)	χ^2	p-value
Age	Adult	82	48	58.3	.040	.842
	Old	318	190	59.7		
	Total	**400**	**238**	**59.5**		
Sex	Male	320	190	59.4	.010	.919
	Female	80	48	60		
	Total	**400**	**238**	**59.5**		
BCS	Poor	353	224	63.5	19.512	.001
	Medium	47	14	29.8		
	Total	**400**	**238**	**59.5**		

Table 5 Organ condemnation based on origin of animals

Variable		Animals examined	Animals with organs condemned	Prevalence (%)	χ^2	p-value	95% confidence interval	
							Lower boundary	Upper boundary
Origin	South Gonder	109	65	59.6	1.596	0.206	0.337	1.265
	Kalu	43	29	67.4	0.43	0.836	0.397	2.111
	Kemissie	81	47	58	1.920	0.166	0.304	1.227
	South Tigri	72	36	50	5.075	0.024	0.217	0.899
	West Afar	33	18	54.5	2.032	0.154	0.222	1.269
	Dessis Zuria	Ref***						

Table 6 Causes and percentage of organ condemnations

Condemned organ	Cause	No. and (%) organ condemned	Rejection rate	Money loss (ETB)
Liver	Cirrhosis	44(41.9)	11.0	2200
	Fasciola	18(17.14)	4.5	900
	C.bovis	12(11.43)	3.0	600
	H.cyst	11(10.5)	2.75	550
	Abscess	9(8.57)	2.25	450
	Calcification	7(6.66)	1.75	350
	Fasciola+H.cyst	4(38.1)	1.0	200
	Total	**105**(100)	**26.25**	**5250**
Lung	H.cyst	21(26.58)	5.25	201
	Pneumonia	21(26.58)	5.25	210
	Emphysema	19(24.05)	4.75	190
	Abscess	11(13.92)	2.75	110
	Pleuritis	5(6.33)	1.25	50
	CBPP	2(2.53)	0.75	20
	Total	**79**(100)	**19.75**	**790**
Heart	H.cyst	12(36.4)	3.0	180
	Pericarditis	9(27.3)	2.25	135
	C.bovis	6(18.2)	1.5	90
	Hemorrhage	6(18.2)	1.5	90
	Total	**33**(100)	**8.25**	**495**
Kidney	Hemorrhage	13(37.14)	3.25	209.3
	Hydronephrosis	6(17.14)	1.5	96.6
	H.cyst	5(14.3)	1.25	80.5
	Nephritis	5(14.3)	1.25	80.5
	Abscess	3(8.57)	0.75	48.3
	Calculi	3(8.57)	0.75	48.3
	Total	**35**(100)	**8.75**	**563.5**
Tongue	Ulcer	11(44)	2.75	265.65
	C.bovis	7(28)	1.75	169.05
	Abscess	6(24)	1.5	144.9
	Hemorrhage	1(4)	0.25	24.15
	Total	**25**(100%)	**6.25**	**603.75**

Table 7 Retrospective data of organ condemnation

Condemned organ	Cause of condemnation	Number and % of organ condemned
Liver	Abscess	585(5.96%)
	Hydated cyst	645(6.57%)
	Hepatitis	1535(15.64%)
	TB	28(0.28%)
	Cirrhosis	260(2.65%)
	Hemangioma	312(3.18%)
	C.bovis	303(3.1%)
	Tumor	89(0.91%)
	Total	**3757(38.3%)**
Lung	Abscess	28(0.28%)
	H.cyst	718(7.32%)
	TB	31(0.32%)
	Pneumonia	1331(13.56%)
	Pleuritis	1208(12.31%)
	Emphysema	1252(12.76%)
	CBPP	1(0.01%)
	Total	**4569(46.6%)**
Heart	Abscess	1(0.01%)
	H.cyst	31(0.32%)
	TB	16(0.16%)
	Odema	447(4.56%)
	Pericarditis	722(7.4%)
	Hemorrhage	382(0.84%)
	C.bovis	122(1.24%)
	Tumor	165(1.7%)
	Total	**1886(19.22%)**
Kidney	Abscess	1(0.01%)
	H.cyst	168(1.71%)
	TB	57(0.58%)
	Con. Cyst	657(6.7%)
	Infarct	340(3.46%)
	Odema	698(7.11%)
	Caliculi	381(3.88%)
	Hemorrhage	539(5.5%)
	Hydronephrosis	275(2.81%)
	Tumor	4(0.041%)
	Nephritis	1059(10.8%)
	Total	**4179(42.6%)**
Tongue	Abscess	205(2.1%)
	Hydated cyst	8(0.081%)
	TB	29(0.3%)
	Odema	147(1.5%)
	Hemorrhage	56(0.57%)
	C.bovis	90(0.91%)
	Ulcer	101(1.02%)
	Total	**636(6.5%)**

Table 8 direct financial loss assessment for active abattoir survey

Type of organ	Average rejection rate of organs	Average cattle slaughtered	Annual loss ETB
Liver	26.25		82,687.5
Lung	19.75	6300	12,442.5
Heart	8.25		7,796.25
Kidney	8.75		8,875.13
Tongue	6.25		9509.1
Total Loss			121,310.48

Table 9 direct financial assessment loss for retrospective data

Type of organ	Average rejection rate of organs	Average cattle slaughtered	Annual loss ETB
Liver	38.3		120,645
Lung	46.6	6300	29,358
Heart	19.22		18,162.9
Kidney	42.6		43,209.2
Tongue	6.5		9.889.4
Total Loss			221,264.5

4. Discussion

Several animal diseases reported during abattoir survey and many of them cause organ lesion which make unfit for human consumption. The present 238 (59.5%) prevalence was higher as compared to reports of several authors (Lati *et al.,* 2015; Yalew *et al.,* 2016) and lower than Wale *et al*. 2017 who reported 71.4%. Taking animal related risk factors for organ condemned a study revealed that there was statistically significant difference between body condition score of animals (p=0.01), were poor body condition animals with higher rate of condemnation than medium. But the result showed no statistically significant difference between age and sex of cattle (table 1). This was may be due to animals brought to abattoir were mostly old aged and proportionally more males. Poor body condition animals having higher rate organ condemnation could show the disease process affecting the weight gain of the animals. Based on origin of animals statistically significance difference (p=0.024) between animals originated from around Dessie and South Tigri was observed. The differences could be due to difference in husbandry practices for animals.

This study also showed that cirrhosis, hydrated cyst, pneumonia, emphysema, fasciolosis, hemorrhage, cysticercus bovis, ulcer, abscission, pericarditis, calcification, hydronephrosis, calculi, nephritis, pleuritis, oedemas and hepatitis were the causes of condemnations of organs (table 3). The 26.25% rejection rates of liver in this study in relative agreement with (Jatenie *et al.,* 2014; Alembrhan and Hylegebriel 2013; Alembrhan *et al.,* 2016) but lower than the reports in different parts of the country (Amen *et al.,* 2012; Nurit *et al.,* 2012; Shitaye *et al.,* 2016). Cirrhosis was the major cause for liver condemnation which was also reported by (Haimanot *et al.,* 2016; Nurit *et al.,* 2012; Solomon *et al.,* 2016).

The rejection rate of different organs were compared with previous reports and showed relative low and higher values for example lung (19.75%), heart (8.25%) kidney (8.75 %) in this study was lower as compared to the reports (Asmare *et al.,* 2012; Amen *et al.,* 2012; Jatenie *et al.,* 2014; Shitaye *et al.,* 2016; Solomon *et al.,* 2016) but was higher as compared (Lati *et al.,* 2015; Jatenie *et al.,* 2014; Alembrhan and Hylegebriel 2013; Haimanot *et al.,* 2016). Tongue rejection (6.25%), it was higher as compared to the reports of Lati *et al*., 2015 of 0.37%. The cause of condemnation may be due to the frequent contact between the infection, backyard slaughtering, poor public awareness and other factors like difference in culture, ecological conditions, social activity and attitude to dogs, poor health care and extensive cattle husbandry

From the retrospective data study lung, kidney and liver were the most condemned organs with their respective rejection rates of 46.57%, 42.6% and 38.3% (table 4). This result was higher when compared to the active abattoir survey in which liver, lung and kidney were the most condemned organs with respective rates of 26.25%, 19.75% and 8.75%. Hepatitis for liver, pneumonia for lung, pericarditis for heart, nephritis for kidney and abscess for tongue similar findings were reported indifferent parts of Ethiopia (Jatenie *et al.,* 2014; Alembrhan *et al.,* 2016; Shitaye *et al.,* 2016). This investigation was in relative agreement with the active abattoir survey investigation.

A total financial loss of 342,574.98 ETB (9,578.55 USD) was estimated due to condemnations of organs. This loss was the result of both active abattoir survey and retrospective data investigation (table 5 and 6). This result was in relative agreement to the reports of Yalew *et al*., 2016 but the report is higher than Alembrhan and Hylegebriel 2013. This report was less than Alembrhan *et al.,* 2016; Lati *et al*., 2015 and Genet *et al*., 2012. These differences in the amount of economic loss may be due to difference in rejection rate of organs, the slaughtering capacity of abattoirs, price of organs, careful inspection and prevalence of diseases in different study areas.

5. Conclusion

Abattoirs play important role in surveillance of disease conditions of animals both at ante mortem and post mortem. Organ condemnations cause big economic losses in the cattle industry. In this study, the most condemned organs were liver, lung, kidney, heart and tongue, which were condemned due to cirrhosis, fasciola, H. cyst, pneumonia, emphysema, pericarditis, C.bovis, hemorrhage and ulcer as major causes of condemnations. The total financial loss estimated in this study was 342,574.98 ETB (9,578.55 USD) from both active and retrospective studies. Based on the finding the following points are forwarded: animals should get enough rest so that animals can minimize their exposure to stress factors, which intern avoids their exposure to respiratory diseases like pneumonia, emphysema and others. Public awareness should be given to economic loss, zoonotic importance and effective disease control. Care must be taken during organ disposal in order to break the life cycle of some of the parasitic disease as to minimize organ condemnation.

Consent for publication

All authors agreed on the publication of this manuscript Hindawi Publishing Corporation journal of veterinary medicine and possible to send their consent if needed.

Competing Interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

Ethical clearance not needed for this particular research.

Declaration

I, the undersigned, declare that this research is original work, has not been submitted for publication anywhere and that all sources of materials used for this research have been duly acknowledged.

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