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Prevalence, Organ Condemnation and Financial Losses Due to Fasciolosis and Hydatidosis in Cattle Slaughtered in Adama Municipal Abattoir, Ethiopia

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Abstract: Cross sectional survey was carried out from December 2009 to April 2010 with the objective of determining the prevalence, organ condemnation and financial losses due to fasciolosis and hydatidosis in cattle slaughtered in Adama Municipal Abattoir. Thorough meat inspection of the total 300 cattle slaughtered in the abattoir revealed that 97 (32.3%) and 146 (48.7%) animals were found harboring fasciola species and hydatid cysts, respectively and an overall of 206 (68.7%) of cattle were found positive for different cases of diseases. The result obtained from post mortem examination indicated that a total of 190 visceral organs were found harboring hydatid cysts. The infection of the lung, liver, spleen, kidney and heart were found to be 42.7%, 12.3%, 2.7%, 3.3%, 2.3% respectively. There is significant difference ($p<0.05$) for all causes of organ condemnation. Differences in prevalence rates for organs condemnation among the organs of cattle were statistically significant ($P<0.05$). The annual direct financial loss from organs condemnation estimated due to liver condemnation caused by bovine fasciolosis in the study area was on average 87,210.00 Ethiopian Birr/year and due to hydatidosis was estimated to be 39,868.00 Ethiopian Birr. The total financial losses due to organ condemnation caused by fasciolosis and hydatidosis were estimated to be 127,078.00 Ethiopian Birr. Therefore, the current findings indicated that fasciolosis and hydatidosis were prevalent and caused significant financial losses from organ condemnation in the study area. These losses can be reduced substantially by fasciolosis and hydatidosis control programmes that may include the use of anthelmintics, grazing management and intervention taken on the intermediate hosts.

Key words: Adama · Fasciolosis · Hydatidosis · Prevalence · Financial loss · Meat inspection · Cattle

INTRODUCTION

Fasciolosis and hydatidosis are the important parasitic diseases of livestock that have both financial and public health significance. They are associated with severe morbidity and disability and are the world's most geographically widespread zoonotic diseases. Fasciolosis is an important helminth disease caused by two species of trematodes *Fasciola hepatica* (the common liver fluke) and *Fasciola gigantica.* This disease belongs to the plant-born trematodes zoonosis [1]. The definitive host range is very broad and includes many herbivorous mammals, including humans. The life cycle includes freshwater snails as an intermediate host of the parasite [2]. In Ethiopia, *F. gigantica* is found at altitudes below 1800 m.a.s.l. and *F. hepatica* is found at altitude between 1200-2560 m.a.s.l [3]. Mixed infections by both species can be encountered at 1200-1800 m.a.s.l [4]. In Ethiopia, various reports suggest that fasciolosis is a highly prevalent disease [5], where livestock represent the pillar of the local economy and plays a vital role in livelihood of the farming communities [6]. The financial significance of fasciolosis in the highlands of Ethiopia has been reported by several workers (Yilma, [7]; Yadeta, [8]; Mezgebu, [9]; Wassie, [10]). In Ethiopia, farmers loose an estimated at 48.8 million Ethiopian birr/annum worth of production [11].

Echinococcosis/hydatidosis is a zoonosis caused by adult or larval (metacestode) stage of Cestodes belonging to the genus Echinococcus (family Taeniidae) [12]. Two major species of veterinary and public health importance

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are *E.granulosus* and *E. multilocularis* that, respectively, cause cystic echinococcosis (CE) and alveolar echinococcosis (AE). Both CE and AE are serious and severe diseases, the latter especially so, with high fatality rates and poor prognosis if managed incorrectly. Unilocular hydatid disease, hydatidosis, caused by the larval stage of *E.granulosus* is recognized as being one of the world's major zoonosis [13]. In Ethiopia several reports indicate that hydatid cyst is prevalent in livestock. However, the status of hydatidosis in animals is not well documented and explored in the country. Therefore, knowledge on the prevalence and financial lose due to condemnation of carcases caused by these parasites would be of prime importance in targeting an effective control scheme in the country.

MATERIALS AND METHODS

Study Area: The study was conducted in Adama municipal abattoir. Adama town is located in the East Shewa Zone of Oromiya, centeral Ethioipia at lat. 8°33'39°16'E and long. °N 39.27°E at an elevation of 1712 meters, 99 km Southeast of Addis Ababa. The city sits between the base of an escarpment to the west and the top of the Great Rift Valley to the East (Gascon, 2003)[14]. Based on figures from the Central Statistical Agency in 2005, this city has an estimated total population of 228,623 of whom 114,255 were males and were 114,368 females [15]. The average annual rainfall is 760 mm while average monthly ambient temperature is 21°C. The livestock population of the Adama district surrounding Adama town comprises about 61,069 cattle, 36,142 sheep, 42,968goats, 286 equines, 14 camels and 201,196 poultry. Smallholder mixed farming dominates (80%) and livestock is an integral part of the farming system. Almost all of the animals usually cattle to be slaughtered are continuously coming from the surroundings locality and nearby major livestock markets of different districts [15].

Source and Study animals: The source animals were cattle brought for slaughter from various localities to Adama town municipality abattoir. The Study animals were sampled from those animals that were destined for slaughter.

Sampling Technique and Sample Size: Using random sampling method, the study animals were selected from cattle registered for slaughter following the ante mortem inspection. The sample size was determined by 95% confidence interval at a desired accuracy level of 5% and with expected prevalence of 20% [16]. For the study area the determined sample size was 246; however, in order to increase the accuracy the sample was increased to 300.

Study Design: The study design employed was a cross sectional type, which was used to investigate the occurrence of fasciolosis and hydatidosis. Hence, postmortem inspection at the abattoir was conducted, the rate of occurrence of condemnation was calculated and financial losses estimation was done.

Abattoir Survey: During ante mortem examination each study animal was given an identification number and age, sex, breed and origin of animals were recorded. The age was determined based on visual observation of teeth and information that was obtained from the owners. All cattle presented to the abattoir and slaughtered were males, local breed (zebu) and above 6 years of age. After slaughter, the different visceral organs of cattle including liver, lungs, kidneys, heart and spleen were carefully examined by inspection, palpation and incision for the presence of hydatid cysts; liver and bile duct were incised and inspected for fasciolosis.

Financial Losses Estimation: The annual direct financial losses due to organ condemnation in the study area was calculated on the basis of condemned organs (liver, lung, spleen, kidney, heart), which were the parameters taken in to consideration [17]. The annual average cattle slaughtering rate of the abattoir was calculated from the abattoir records. Based on survey work, the estimated price for the organs was obtained from the local market. The financial lose due to condemnation of the liver caused by fasciolosis was estimated by the formula set by Ogunrinade and Ogunrinade, [18] as follows:

$$A = \Sigma (S_r \text{ X } C_L \text{ x R c}))$$

where:

A = Annual financial lose due to liver condemnation
S_r = Annual cattle slaughter rate of the abattoir
C_L = Average cost of each cattle liver
Rc = Condemnation rates of cattle liver

Annual financial lose due to organs condemnation caused by cystic echinococcosis was estimated using the following formula [19],

$$B= \Sigma (P_h \text{ x } S_r \text{ x } I_o \text{ x C})$$

where:
B = The annual financial lose caused by hydatidosis
P_h = The mean prevalence of hydatidosis
S_r = Estimated annual cattle slaughter rate
I_o = Percent involvement of organ
C_o = The mean retail price of an organ

Total direct financial losses will be:

TDFL=A+B

Data Management and Analysis: From each sampled animal, for fasciolosis and hydatidosis, post mortem inspection results were recorded in Microsoft Excel program. Descriptive statistics was used to determine the level of organs condemnation. Rates defined as proportion of condemned organs to the total number of organs. The data obtained during the study was subjected to 95% confidence interval; a statistical method Pearson's Chi-square test was applied to analyze the results.

RESULTS

General Causes of Organ Condemnation: During the study period (December 2009 - April 2010) a total of 300 local zebu study cattle were slaughtered and 206 (68.7%) of cattle were found positive for different cases of diseases which were accounted for their organs condemnation (Table 1 and 2).

From the total organs (358) examined 151(42.2%) livers, 150 (42.0%) lungs, 8(2.2%) spleen, 22(6.1%) kidney and 27(7.5%) heart were condemned (Table 1).

The principal causes of condemnation of liver were hydatidosis 37 (10.3%), fasciolosis 97 (27.1%), calcification 12 (3.4%) and cirrhosis 5 (1.4%). Out of the total condemned 151 (42.2%) livers, calcification and cirrhosis were found to be the causes for the condemnation of 17(4.8%) livers and this could be accounted to be due to chronic fasciolosis. The causes of condemnation of lung were hydatidosis 128 (35.8%), emphysema 9 (2.5%), Pneumonia 8 (2.2%), Tuberculosis (T.B) 5 (1.4%).The cause of condemnation of spleen was hydatidosis 8 (2.2%).The causes of condemnation of kidney were hydatidosis 10 (2.8%) and nephritis 12(3.4%).The causes of condemnation of heart were hydatidosis 7 (2%), calcification 6 (1.7%), cystecercus bovis 5 (1.4%) and pericarditis 9 (2.5%) (Table 1). There is significant difference ($p<0.05$) for all causes of organs condemnation. Differences in prevalence rates for organs condemnation among the organs of cattle were statistically significant ($P<0.05$).

The condemnation of organ caused by fasciolosis resulted in the rejection of liver was found to be 97 (32.3 %) out of 300 slaughtered cattle (Table 2).From this 97 livers, 37 levers were also found infected with hydatid cysts. Among 300 cattle 146 (48.7%) were found positive for hydatidosis and different organs of these animals lung 128 (42.7%), liver 37(12.3%), spleen 8 (2.7%), kidney 10(3.3%), heart 7 (2.3%) a total of 190 (53.5%) visceral organs were condemned due to hydatidosis (Table 4).

Prevalence of Fasciolosis and Hydatidosis

Fasciolosis: Prevalence of fasciolosis was calculated as the number of cattle found to be infected with fasciola expressed as percentage of a total number of cattle inspected (Thrusfield, 2005).

Table 1: Distribution, number and reasons for rate of organ condemnation

	Condemned organs											
	Lung		Liver		Spleen		Kidney		Heart		Total	
Reasons for organ condemnation	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Hydatidosis	128	36.1	37	10.4	8	2.2	10	2.8	7	2.0	190	53.5
Fasciolosis	__	__	97	27.1	__	__	__	__	__	__	97	27.1
Emphysema	9	2.5	__	__	__	__	__	__	__	__	9	2.5
Pneumonia	8	2.2	__	__	__	__	__	__	__	__	8	2.6
Tuberculosis (T.B)	5	1.4	__	__	__	__	__	__	__	__	5	1.4
Calcification	__	__	12	3.4	__	__	__	__	6	1.7	18	5.1
Cirrhosis	__	__	5	1.4	__	__	__	__	__	__	5	1.4
Nephritis	__	__	__	__	__	__	12	3.4	__	__	12	3.4
Cystecerus bovis	__	__	__	__	__	__	__	__	5	1.4	5	1.4
Pericarditis	__	__	__	__	__	__	__	__	9	2.5	9	2.5
Total	150	42.2	151	42.2	8	2.0	22	6.1	27	7.5	358	100

Table 2: Prevalence of fasciolosis and hydatidosis

Number of cattle slaughtered	Slaughtered cattle positive for	Number	%
300	Different cases (all)	206	68.7
	Fasciolosis	97	32.3
	Hydatidosis	146	48.7

Table 3: Comparison of Liver condemnation due to fasciolosis and hydatidosis and its rejection rate

Causes of condemnation	Number of condemned	Relative percentage (%)
Fasciolosis	97	72.4
Hydatidosis	37	27.6
Total	134	100.0

Table 4: Prevalence, distribution and number of organs with hydatid cysts

No. of cattle Slaughtered examined	Slaughtered cattle Positive for hydatidosis		Organs involvement with hydatid cyst			
			Organs	Number	Prevalence (%)	Relative prevalence (%)
300	Number	%	Lung	128	42.7	67.4
	146	48.7	Liver	37	12.3	19.5
			Spleen	8	2.7	4.2
			Kidney	10	3.3	5.2
			Heart	7	2.3	3.7
			Total	190	-------	100

Table 5: Distribution of hydatid cysts in organs

	Cattle	
Organs infected	Number of cases	%
Lung	87	59.6
Liver	7	4.8
Heart	4	2.7
Lung and liver	27	18.5
Lung and spleen	3	2.0
Lung and kidney	7	4.8
Lung and heart	3	2.0
Liver and spleen	1	0.7
Liver and kidney	1	0.7
Lung, liver and spleen	1	0.7
kidney	2	1.4
Spleen	3	2.0
Total	146	100.0

Out of the 300 cattle examined 97 (32.3%) were found infected with fasciolosis (Table 2). Liver was observed to be affected highly both by fasciola and hydatid cysts but the relative infection rate due to fasciolasis is by far greater than hydatidosis (Table 3). There is statistically significance difference ($p<0.05$) of rate of infection of liver due to fasciolosis and hydatidosis as a cause of liver condemnation.

Hydatidosis/echinococcosis: The abattoir based hydatidosis / echinococcosis survey in the intermediate host (cattle) revealed that 146 (48.7%) of the total 300 cattle viscera examined had hydatid cyst. In this study, lungs were the most frequently infected (42.7%) followed by liver (12.3%) and among the different organs affected by hydatidosis, lung and liver constituted almost 86.8 % of the overall organs (Table 4). Single and multiple infections of organs were recorded. Out of a total of 146 cattle harboring hydatid cysts 103 (70.5%) were found involving only a single organ and the remaining 43 (29.5%) had a multiple organ involvement (Table 5). The distributions of hydatid cyst between organs of infected animals were significantly different in cattle ($p<0.05$).

Financial loss estimation (Direct losses)

Fasciolosis: Direct financial losses were roughly calculated on a yearly basis.

Annual (average) cattle slaughter rate (S r) of the abattoir during the last two years =13,500.
Condemnation rates of cattle liver (R c) =32.3%
Average cost of each cattle liver (C_L) =20.00 birr
Therefore,
A (Annual financial lose due to liver condemnation) = Σ (S_r X C_L x R c)
A = 1(13500x20.00x32.3%)
`A = 87,210 birr.

Hydatidosis /Echinococcosis: Direct financial losses were roughly calculated on a yearly basis.

Estimated annual cattle slaughter rate (S r) = 13,500.
The mean prevalence of hydatidosis (P h) = 48.7%
Percent involvement of organ (Io) = (lung 67.4%, liver 19.5%, spleen 4.2%, kidney 5.3% and heart 3.6%).

The mean retail price of an organ (Co) = (lung, liver, spleen, kidney and heart was found to be 5.00, 20.00, 2.00, 20.00, 5.00 birr respectively).

Therefore,
$B = \Sigma (P_h \times S_r \times I_o \times Co)$
B = (48.7% x 13,500 x 67.4% x 5.00) + (48.7% x13, 500x19.5% x 20.00) + (48.7% x13, 500 x 4.2% x 2.00) + (48.7% x13, 500 x 5.3% x 20) + (48.7% x13, 500 x 3.6% x 5).

B = 5,522.58 + 25,640.55 + 552.26 + 6,968.97 + 1,183.41 birr.
B = 39,867.77 birr.

Total direct financial losses

Total direct financial losses will be:
TDFL = A+B,
TDFL = 87,210.00+39,868.00
TDFL = 127,078.00 Eth. Birr.

DISCUSSIONS

Fasciolosis: In the present study 32.3% prevalence rate of Fasciola was recorded in Adama abattoir. This finding is comparable with the finding of Adem, (1994) who had reported the prevalence rate of 30.2 % in cattle slaughtered around Ziway and with Yimam, (2003) who had reported the prevalence rate of 33.42 % in North Gondar.

Different studies indicated that infection prevalence of fasciolosis varied from region to region. Higher prevalence rate of bovine fasciolosis were recorded by a number of authorize in different part of Ethiopia, the highest being that of Brook *et al*., (1985) in which they have reported prevalence rate of 88.6% in Debre Berhan, one of the well known high land area of the country. Bahru and Ephrem, (1979) reported 86% in Keffa. Yadeta, (1994) countered 70.4% % in Western Shoa. Prevalence of 61% in cattle was reported by Bahru and Ephrem, (1979) for 8 provinces of Ethiopia. Yilma, (1985) has reported prevalence rates of 49 % in Holeta. Wassie, (1995) has reported prevalence rate of 18.99% in Nekemte Municipality abattoir. The reasons for these variations may be attributed to the prevalence of favorable factors required for the propagation and maintenance of infection in the snail intermediate host, high rain fall, acid soil and abundant water logged, marshy areas and the local husbandry condition and may be due to differences in resistance to infection, grazing habits and breed of the host are some of the possible reasons (Urquhart *et al*., 1996).

Out of the total condemned 151 (50.3%) livers, calcification and cirrhosis were found to be the causes for the condemnation of 17(5.6%) livers and this could be accounted to be due to chronic fasciolosis. Financial loss estimated due to liver condemnation caused by bovine fasciolosis in the study area was on average 87,210.00 ETB/year and 6.46 ETB per slaughtered animal. Therefore, the current finding indicated that fasciolosis was prevalent and caused significant financial loss from liver condemnation in the study area. This estimate does not actually include the great majority of cattle slaughtered at backyard. Therefore the crude estimate was actually far lower than the real financial loss. In general, the studied area may represent important endemic regions in cattle and it is necessary to study the epidemiology of the parasite in different regions in order to achieve a cost-effective control and obtain further information about the host, the parasite and its habitat.

Hydatidosis/Echinococcosis: The occurrence of hydatidosis in cattle during the study period was found to be 48.7%. This finding is comparable with the finding of Jobre *et al*., (1996) who had reported the prevalence rate of 46.5% in cattle slaughtered in Gondar abattoir. Almost all of the slaughtered animals in Adama abattoir were old and hence they were exposed to the disease (parasitic ova) over a long period of time with an increasing possibility of acquiring the infections. Generally, there are wide variations in the prevalence of *E.granulosus* in livestock populations in various countries and regions (Ulutas *et al*., 2007) Prevalence ranging from 7.2% to 75.1% have been reported in Ethiopia by Tsegaye, (1995) and Roman, (1987) respectively. Generally the variation in prevalence rate among different geographical locations could be ascribed to the strain differences of *E.granulosus* that exists in different geographical locations (McManus, 2006). Additionally variability could be related with age factors. Other factors like different in culture, social activities and attitudes to dogs in different region may contribute to variation (Arbabi and Hooshyr, 2006).

In the present study it has been established that hydatid cysts occur predominately in the lung and liver with prevalence rate of 86.8%.This is explained by the fact that lungs and livers possess the first great capillaries sites encountered by the migrating Echinococcus oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved. In addition, the lungs were mostly infected than any other organ this might be due to the fact

that ruminants are slaughtered at older age. At this particular period the liver capillaries are dilated as the result it makes easy access for the cysts to the lung and exacanth embryos to enter the lymphatic circulation and carried to the heart and lungs, then the lungs may be infected before or instead of the liver. Arene, (1985), Mitiku, (2007) and Zeleke, (2008) reported similarly that the lungs were more affected than liver in aged animals.

Higher numbers of medium and large sized cysts were found in lungs of cattle than in the liver while the liver harbored higher number of small sized and calcified cysts. The reason for higher percentage of medium and large cysts in the lungs is due to softer consistency of the lung while the higher yield of calcified cysts in liver could be attributed to relatively higher reticuloendothelial cells and abundant connective tissue reaction of the organ. The high proportion of small cysts may be due to immunological response of the host which might preclude expansion of cyst size (Torgerson *et al*., 1998; Lahmar et *al*., 1999; Larrieu *et al*., 2001; Torgerson, 2002).

The rough estimation of annual financial loss due to organs condemnation caused by bovine hydatidosis in Adama slaughter house is 39,868.00 ETB/year and 2.95 birr per slaughter animal. This estimate does not actually include the great majority of cattle slaughtered at backyard. Therefore the crude estimate was actually far lower than the real financial loss. In general, the situation of bovine hydatidosis around Adama is suitable for maintaining the infection and taking into consideration the financial losses and zoonotic importance of the disease, attention should be given to its prevention and control.

CONCLUSION

The current findings indicated that fasciolosis and hydatidosis were prevalent and caused significant financial losses from organ condemnation in the study area. These losses can be reduced substantially by fasciolosis and hydatidosis control programmes that may include the use of anthelmintics ,grazing management intervention taken on the intermediate hosts Slaughter houses facilities should have properly trained meat inspector, dog proof fencing and have adequate, deep and wide disposal pits. prevention of practice of back yard slaughtering coupled with provision of infected offal to dogs and control of dogs including registration and elimination of un wanted (stray) dogs and quarantine of premises with infected life stocks, public education program (create awareness) , continual commitment and the collaboration of several professional categories such as veterinarians, physicians, public health personals, teachers, polices, waste disposal personals, community leaders and public administrators are recommended.

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