

## Cyst Viability, Organ Distribution and Financial Losses due to Hydatidosis in Cattle Slaughtered At Dessie Municipal Abattoir, North-eastern Ethiopia

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### Abstract

A cross sectional study was conducted from October 2010 to March 2011 to assess the prevalence, cyst viability, organ distribution and financial losses of bovine hydatidosis in cattle slaughtered at Dessie municipal abattoir. Postmortem inspection, cyst characterization and financial loss estimations were conducted. Out of 610 inspected cattle, 83 (13.61%) were harbouring a single or multiple hydatid cysts. Significantly ( $P < 0.05$ ) higher infection rate was observed in poor (22.89%) than medium (12.99%) and good (10.40%) body condition scorings but significant variation ( $P > 0.05$ ) was not observed in different age groups. Anatomically, the cysts were distributed 68.67% in the lung, 14.46% in the liver, 6.02% in the kidneys, 1.2% in the heart and 9.64% were found both in the lung and liver. Of the total examined cysts (195) for fertility and viability, 27 (13.85%) were fertile, 44 (22.56%) were calcified, 124 (63.59%) were sterile. The rate of cyst calcification was higher in the liver (78.14%) than other organs whilst the fertility percentage was higher in the lung (14.65%). Of the total 27 fertile cysts subjected to viability test, 13 (6.67%) were viable. Size assessment made on 195 cysts indicated that 153 (78.46%) were small, 41 (21.03%) were medium and one (0.51%) were large sized cysts. In the present study, the total annual economic loss from organ condemnation and carcass weight loss due to hydatidosis was estimated as 681,333.87 Ethiopian birr which is about 39157.12 United States dollar per annum based on the local market prices in the study period. The result of this study revealed that hydatidosis is an economically important disease of cattle which necessitates designing of appropriate strategies for its control.

Keywords: Hydatid cyst; Hydatidosis; Economic loss; Prevalence; Cattle; Ethiopia.

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### Introduction

Hydatidosis, caused by the larval stages of a tiny tapeworm *Echinococcus granulosus*, is a serious problem for both livestock and public health in many part of the world. In livestock industry, it inflicts enormous economic losses due to condemnation of edible organs and lowering the quality and quantity of meat, milk and wool production (Craig *et al.*, 2007; Fromsa and Jobre, 2011). In human, the cyst can reside and grow in liver, lung and other visceral organs. The pathogenecity of hydatidosis depends on the extent and severity of infection and the organ on which it is situated. Occasional rupture of hydatid cysts often leads to sudden death due to anaphylaxis, haemorrhage and metastasis (White *et al.*, 2004; Getaw *et al.*, 2010).

The parasite spends most of its adult life in the intestine of the definitive host, particularly in dogs.

The adult parasite produces eggs that come with faeces and contaminate the pasture. The intermediate hosts, commonly herbivores ingest the egg while grazing and then hydatid cysts develop in their body. Human beings suffer from the disease if exposed to the egg accidentally or consumed with contaminated green food or water (Hendrix and Robinson, 2006). The definitive host is infected by ingestion of infected offals of herbivores. The infection rate to dogs is directly proportional to the fertility of cysts (Urquhart *et al.*, 2003). So cyst characterization is important to assess the infectivity of the parasite.

Hydatidosis is one of the major causes of organ condemnation in most Ethiopian abattoirs and slaughter houses (Kebede *et al.*, 2009<sup>a,b,c</sup>; Tolosa *et al.*, 2009; Getaw *et al.*, 2010; Fromsa and Jobre, 2011) and leads to huge economic losses. Human cases of hydatidosis are frequently reported from different

corner of the country (Biluts *et al.*, 2006; Kebede *et al.*, 2009<sup>d</sup>) and the disease is much more common in the rural areas of Ethiopia where dogs and domestic animals live in a very close association (Fromsa and Jobre, 2011). Despite these, the status of hydatidosis in livestock and the economic impact of the parasite were not studied so far in and around Dessie. Therefore, the objectives of this study were to determine the prevalence, cyst viability and organ distribution of bovine hydatidosis and to estimate the financial losses due to the disease in the area.

#### Materials and Methods

**Study Area:** The study was conducted from October 2010 to March 2011 at Dessie municipal abattoir, Northeast Ethiopia. Dessie town is situated at the North-east part of Ethiopia at a distance of about 400 km away from the capital (Addis Ababa), located at 11°08' North latitude and 39°38' East longitude and has an elevation of 2600 meter above sea level. The area gets 1936 to 1070 mm Hg rainfall annually. The mean monthly minimum and maximum temperatures were 12.37°C and 26.27°C, respectively. The livestock population of the area comprises of 18,724 cattle, 22,248 sheep, 2572 goats, 1879 horses, 833 mules, 3762 donkeys and 37,557 heads of chickens (DFEDB, 2007).

**Study Animals:** The study animals were local zebu cattle (*Bos indicus*) brought to the abattoir for slaughter from districts around the town (Tewuledere, Tenta, Dessie Zuria and Kutaber). All slaughtered animals were male. Extensive system is dominant husbandry practice in the area in which animals are allowed to graze freely and housed in poorly constructed barn at night.

**Sample size and Sampling Methods:** The total number of cattle required for sampling was calculated based on the formula given by Thrusfield (2005). Since there was no information about the prevalence of the disease in the area, 50% prevalence was taken to calculate the sample size with 5% absolute precision. So the calculated sample size was 384 cattle however, to increase the accuracy, the sample was increased to 610. During ante-mortem inspection, each animal was given an identification number. The age, sex and body condition of each individual animal was assessed and recorded. Based on the body condition, animals were grouped as poor, medium and good (Nicolson and Butterowrth, 1986). Animal's age was categorized into adult (3 to 5 years) and old ( $\geq 5$  years) based on the owners information and dental eruption (De Lahunta

and Habel, 1989) as animals less than three years old were not slaughtered during the study period. Simple random sampling was followed to select animals for sampling in the abattoir.

**Study design and Methodology:** A cross sectional study on cattle hydatidosis was conducted at Dessie municipal abattoir. Postmortem inspection, cyst characterization and financial loss estimation were carried out.

**Postmortem inspection:** Postmortem examination was conducted thorough visual inspection, palpation and systemic incision of each visceral organ particularly the lung, kidney, liver, spleen, and heart (Getaw *et al.*, 2010). The infected organs from each positive animal were collected; the total number of hydatid cysts were counted per infected organ and recorded.

**Cyst characterization:** Individual cyst was grossly examined for any evidence of degeneration and calcification. Cysts size measurement, cyst counting, cyst fertility and viability determination was also conducted. The size of the diameter of hydatid cyst was measured and classified as large (diameter >10cm), medium (5 - 10cm) and small (diameter < 5cm) (Oostburg *et al.*, 2000; Kebede *et al.*, 2009<sup>a</sup>). The volume of hydatid fluid was measured and classified as high (volume >20ml), medium (volume between 6 - 20ml) and low (volume <6ml). The collected cysts were carefully incised and examined for protoscolices, which looks like white dots on the germinal epithelium, in hydatid fluid so as to classify cysts as fertile or infertile. The infertile cysts were further classified as sterile (fluid filled cysts without any protoscolices) or calcified (Kebede *et al.*, 2009<sup>b</sup>). Fertile cysts were further subjected to viability test. A segment containing protoscolices was placed on the microscope glass slide and covers with cover slip and observed for amoeboid like peristaltic movement with (40x) objective. For clear vision, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead ones take it up (Dalimi *et al.*, 2002).

**Economic loss assessment:** An attempt was made to estimate the annual economic losses from hydatidosis in cattle taking into account losses from cost of organ condemnation and from carcass weight. The retail market price of average size offal (lung, liver, kidney, heart and spleen) and the cost of one kg

Table-1. Prevalence of hydatidosis based on age and body condition score of animals

Risk Factor	Number of observed	Number positive	Percentage	$\chi^2$ cal	p-value
<b>Age</b>					
<5 year	499	62	12.42	3.26	0.071
≥5 year	111	21	18.92		
<b>Body condition</b>					
Poor	83	19	22.89	7.71	0.021
Medium	354	46	12.99		
Good	173	18	10.40		

$\chi^2$ cal= Chi square calculated

beef were obtained from information gathered from local butchers. Annual economic loss due to organ condemnation was determined by considering annual slaughter rate of cattle and prevalence of hydatidosis per organ and an estimated 5 % carcass weight loss (Getaw *et al.*, 2010) was considered. Average carcass weight of Ethiopian local breed cattle is estimated as 108 kg (Negassa *et al.*, 2010). The total economic loss was calculated as the summation of cost of offal condemned plus the cost of carcass weight losses (Kebede *et al.*, 2009<sup>d</sup>; Getaw *et al.*, 2010).

Data analysis: Data were collected and recorded in Microsoft excel spread sheet and the prevalence of hydatid cyst was calculated by dividing the number of hydatid positive animals with the total number of animals examined. The associations of risk factors with the disease were assessed using Pearson's chi square. All statistical analyses were done using SPSS version 17 (SPSS, 2008). Probability (P) value less than 0.05 was set as statistically significant in all cases.

## Result

Prevalence of hydatidosis: Of the total 610 animals inspected, 83 (13.61%) animals were positive for bovine hydatidosis. The infection rate was 22.89% in poor, 12.99% in medium and 10.40% in good conditioned animals. The prevalence was statistically significant ( $P < 0.05$ ) among different body condition scores. The prevalence was 12.42% and 18.92% in adult and old animals, respectively, but there was no statistically significant ( $P > 0.05$ ) difference between age groups (Table 1).

Table-2: Proportion of organ infected with hydatid cyst.

No	Organ inspected	Number of cases	Percent (%)
1	Lung	57	68.67
2	Liver	12	14.46
3	Kidney	5	6.02
4	Heart	1	1.20
5	Lung and Liver	8	9.64
	Total	83	

## Organ distribution and cysts Evaluation

Organ distribution: The postmortem inspection revealed that different organs were affected with hydatid cyst(s). The highest proportions of hydatid cyst were recorded in the lungs (68.67%) followed by liver (14.46%), kidney (6.02%), heart (1.2%), spleen whereas 9.64% were found both in the lung and liver (Table 2).

Number and Viability test: Both single and multiple infections of organs were recorded. Out of the total cattle (83) harbouring hydatid cyst, 75 (%) were involving a single organ whereas the remaining 8 (%) had multiple organ involvement. A maximum of 20 cysts were encountered from a single lung of cattle and totally 195 cysts were counted and evaluated. Of these cysts, 27 (13.85%) were fertile and contained protoscolices whereas the remaining 124 (63.6%) and 44 (22.6%) were sterile and calcified cysts, respectively. Of the fertile cysts (27), 13 (6.7%) were viable while 14 (7.18%) were non-viable. More fertile (14.65%) and sterile (73.25%) cysts were observed in lungs. The rate of cyst calcification was higher in the liver (78.14%) than in the other organs (Table 3).

Cyst size and volume: Out of the 195 recorded hydatid cysts, 153 (78.46%) were small, 41 (21.03%) medium and one (0.51%) large in size while 62 (31.79%) were low, 72 (36.92%) medium and 7 (3.59%) large in volume (Table 4).

Financial losses: The economic loss due to hydatidosis was the summation of the loss due to carcass weight and the loss due to organ condemnation. Therefore, the estimated economic loss in cattle slaughtered at Dessie municipal abattoir due to hydatidosis was estimated to be 681,333.87 Ethiopian birr (ETB) (equivalent of 39,157.12 US dollar).

## Discussion

The present cross sectional study which was conducted at Dessie municipal abattoir to assess the prevalence of bovine hydatidosis, indicated that the

Table-3: cyst fertility and viability in different organs

Organ	Total Cyst Count	Fertile		Fertility Test Sterile		Calcified		Viability Test			
		n	%	n	%	n	%	Viable n	Viability %	Non-Viable n	Non-Viable %
Lung	157	23	14.65	115	73.25	19	12.1	11	7	12	7.64
Liver	32	2	6.25	5	15.63	25	78.13	1	3.12	1	3.12
Kidney	5	1	20	4	80.00	0	---	0	---	1	20
Heart	1	1	100	0	---	0	---	1	100	0	0
Total	195	27	13.85	124	63.59	44	22.56	13	6.67	14	7.18

n=number, %=percentage

Table-4: cyst fertility and viability in different organs

Organ	Cyst Count	Small		Cyst size Medium		Large		Low		Cyst volume Medium		High	
		n	%	n	%	n	%	n	%	n	%	n	%
Lung	157	126	80.25	30	19.1	1	0.63	55	35.03	65	41.4	7	4.46
Liver	32	25	78.1	7	21.88	0	---	6	18.75	2	6.25	0	0
Kidney	5	1	20	4	80	0	---	1	20	4	80	0	0
Heart	1	1	100	0	---	0	---	0	---	1	100	0	0
Total	195	153	78.46	41	21.03	1	0.51	62	31.79	72	36.92	7	3.59

n=number, %=percentage

prevalence of 13.61% which agrees with the findings of Kebede *et al.* (2009<sup>a</sup>) 16% in Wolaita Sodo town and Kebede *et al.* (2009<sup>b</sup>) 15.2% in Birre-Sheleko and Dangila abattoirs.

However, the present study disagree with reports of Kebede *et al.* (2009<sup>c</sup>) 34.05% in Bahir Dar town and Tolosa *et al.* (2009) 31.44% in Jimma town. Jobre *et al.* (1996) studied hydatidosis in three selected regions of Ethiopia and reported the prevalence of 46 % in medium, 24 % in high and 25 % low altitude zones. As high as 68% prevalence was also reported in sheep by Sissay *et al.* (2008). A possible reason for the difference in the prevalence of hydatidosis might be due to the contact between large numbers of stray dogs with the herd of cattle. Dogs, which are the primary factor for the disease transmission, are used as guards for herds and are routinely fed with uncooked offal which deemed unfit for human consumption (Getaw *et al.*, 2010). The other possible reason for the variation in prevalence rate in different countries and regions may be attributed mainly to strain difference of *E. granulosus* that exist in different geographical situation. Moreover, other factors like difference in culture and social activities in different regions may contribute to these variations (Kebede *et al.*, 2009<sup>a</sup>).

In this study, an attempt was made to assess the relationship between body condition score and cyst infection. The result indicated that there was a significant difference ( $P<0.05$ ) in rate of infection among different the body condition scores. Animals having poor body condition were found to have high

cyst infection. Polydorou (1981) explained that in moderate to severe infection the parasite may cause retarded performance and growth, reduced quality and yield of meat and milk as well as live weight loss and estimated a 5 and 16% weight loss in Yugoslavia and Bulgaria, respectively.

In this study, it had been found that hydatid cyst occur predominantly in lungs and liver. Immature parasites have no selective affinity for any particular organ, and location of hydatid cyst in animal is controlled by filtering action of capillaries. This could be due to the fact that lungs and liver possesses the first great capillaries sites encountered by the migrating *Echinococcus* onchosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved, but onchospheres which traverse these will reach the systemic circulation and hydatid have been found in many organs and tissues (Urquhart *et al.*, 2003; Kebede *et al.*, 2009<sup>a</sup>; Getaw *et al.* 2010). Lungs were more infected than liver, probably due to the presence of greater capillary beds in the lungs than liver.

From single to 20 cysts were encountered from a single lung of cattle. Such variations in cyst abundance are mainly due to the spatial distribution and the infectivity of *E. granulosus* eggs and the susceptibility and defence capability of the host (Kebede *et al.*, 2009<sup>a</sup>). The cyst count is highest in lung followed by liver, kidney and heart. Lungs harboured higher

number of medium and large sized cysts than liver. Larger size of cysts in the lungs may be due to relatively softer constancy (Getaw *et al.*, 2010). Higher numbers of small sized and calcified cysts were found in liver and this could be due to the reticulo-endothelial and connective tissue reaction of the organ (Kebede *et al.*, 2009<sup>b</sup>). The liver infection may be a reflection of the route of parasite entry and seems to support the hypotheses of hepatic portal distribution of the oncosphere leading to the liver infection. Out of 195 hydatid cysts 153 (78.46%), 41 (21.03%) and one (0.51%) were small, medium and large, respectively. The higher proportion of small cyst may indicate late infection of the animals as a result of heavy rainfall and continuous grazing in the past raining season or due to immunological response of the hosts which might preclude expansion of cyst size. Rainfall and moisture favour the survival of eggs of *Echinococcus* species and at the same time eggs may get chance to be disseminated by flood (Urquhart *et al.*, 2003).

A lower fertility percentage (13.85%) was identified out of the total cysts examined and relatively high percentage (63.59%) and (22.56%) of the total cysts were sterile and calcified which showed the importance of cattle in maintaining the cycle in minimal level and it may imply that most of the cysts in cattle are infertile. This finding is inline with that of Kebede *et al.* (2009<sup>b</sup>). The variation in fertility, sterility and calcification may be related with the strain difference (McManus, 2006). The fertility rate was higher among the cysts of lung. Since lung has relatively softer constancy which allows easier development of the pressure cysts and fertility of hydatid cyst may show a tendency to increase in advanced age of host. This may be related with reduced immunological compatibility of the hosts at their old age of infections (Getaw, *et al* 2010; Ibrahim, 2010).

In this study significant financial loss was registered due to hydatidosis with an estimated loss of 681,333.87 ETB which is about 39,157.12 United States dollar (USD) per annum. Different financial losses regarding bovine hydatidosis were also reported from different part of the country. For example, Getaw, *et al.*, (2010) reported 5869.80 USD in Adama municipal abattoir and Kebede *et al.*, 2009<sup>d</sup> reported 3,201 USD losses per annum in Mekele municipal abattoir, North Ethiopia. The difference in the amount of economic loss could be due to the variation in the prevalence of the disease, retail market price of organs and mean annual slaughter rate in different abattoirs.

## Conclusion

In conclusion, hydatidosis is prevalent and causes considerable economic loss in livestock production in and around Dessie. Therefore, proper meat inspection and disposal of condemned organs are essential to reduce the financial losses and safeguard the public. In addition to this, the construction of well equipped abattoirs and enhancement of awareness of people about the economic and public health importance of the disease are also crucial.

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## Conflict of interest

Authors declare that they have no conflict of interest.

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