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Full Length Research Paper

Prevalence, cyst characterization and economic importance of bovine hydatidosis in Mekelle municipality abattoir, Northern Ethiopia

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A cross-sectional survey of bovine hydatidosis was carried out on 840 local zebu cattle slaughtered at Mekelle municipal abattoir to determine the prevalence, fertility of hydatid cysts and to assess economic loss. The total prevalence rate was found to be 28.09% at the study period of 8 months from October to May. Observation during the survey period also revealed that the infection rate among different age groups of examined animals were found to be statistically significant ($p<0.05$), with the highest in old aged cattle (31.98%) followed by adult (21.63%) and young (17.65%). There was statistically significant difference between infection rate and body condition score of the animals with 37.24% lean, 26.27% medium and 21.64% fat body condition. More than 98% of the infected organs were lungs and livers, with higher prevalence in lungs than liver. Out of the total 949 cyst identified, 65.54% were found in lung, 32.88% in liver, 1.01% in heart and 0.53% in kidney. Four hundred and eighty nine of the cysts were small, 160 were medium, 180 were large and 115 were calcified. The fertile, sterile and calcified cysts were found to be 17.44, 45.27 and 37.29%, respectively. Twenty three percent of the fertile cysts were viable and the rest were not. The total annual economic loss was estimated to be 5,200 US Dollar. Furthermore, attempts were made to correlate the origin of the animal and there was no significance between highland and lowland areas.

Key words: Abattoir, economic loss, hydatidosis, prevalence, zebu cattle.

INTRODUCTION

Echinococcosis/hydatidosis is a zoonotic disease that occurs throughout the world and causes considerable economic losses and public health problems in many countries (Daryani et al., 2006). The disease caused by *Echinococcus granulosus*, cystic echinococcosis, is one of the neglected zoonotic diseases recognized. It represents a significant global human disease burden in resource poor pastoral communities (WHO, 2011). This multi host parasite is prevalent all over the world, and annually, the economic loss in livestock due to this parasite is significant (Lahmar et al., 2004; Tappe et al., 2011). Hydatidosis or larval *Echinococcus* is defined as the cystic stage of *Echinococcus,* a very small tapeworm of dogs and canids. At its intermediate stage, it forms cysts in the internal organs, especially in liver and lungs and some infections can be fatal in humans if the cyst ruptures and causes anaphylactic shock (Acha and Szyfres, 2003; Eckert and Deplazes, 2004; CFSPH, 2011).

E. granulosus and *Echinococcus multilocularis* are the most important members of the genus in respect of their economic loss, public health significance and their geographical distribution. Approximately 60 to 70% of *E. granulosus* cysts occur in the liver and 20 to 25% in the

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lungs. The remaining cysts can be found almost anywhere in the body including the bones, kidneys, spleen, muscles, central nervous system (CNS) and behind the eye (CFSPH, 2011). The definitive host is infected by ingestion of offal containing fertile cysts and the intermediate hosts are infected by ingesting contaminated feeds, and water with dog feces contains egg of the parasite (Acha and Szyfres, 2003; Jenkins, 2004). The cycle is completed when an intermediate host or its infected organ is eaten by a suitable carnivore (Thompson and McManus, 2002), and man is usually a dead end intermediate host (Zhang et al., 2003).

Different studies have shown that cystic echinococcosis (*E. granulosus*) represented considerable economic and public health significance in different countries (Azlaf and Dakkak, 2006; Berhe, 2009; Kebede et al., 2009). Present estimates suggest that cystic hydatid disease, caused by *E. granulosus*, results in the loss of 1 to 3 million disability-adjusted life years per annum. The annual cost of treating cases and economic losses to the livestock industry probably amounts to 2 billion US$. *Alveolar echinococcosis* caused by *E. multilocularis,* results in the loss of about 650,000 disability adjusted life years per year as reported by WHO (2011).

In Africa, hydatid disease is reported more commonly in cattle, which are communally owned or raised on free range, and associated more intimately with domestic dogs. Hydatidosis in domestic ruminants inflicts enormous economic damage due to the condemnation of affected organs and lowering of the meat, milk and wool production. In Ethiopia, hydatidosis have been known and documented as early as 1970s. Hydatidosis is the major cause of organ condemnation in most Ethiopian abattoirs and leads huge economic losses (Berhe, 2009; Kebede et al., 2009; Fikire et al., 2012; Terefe et al., 2012).

Certain deeply rooted traditional activities could be commonly described as factors substantiating the spread and high prevalence rates of the disease. These include the wide spread back yard animals slaughter practice, the absence of rigorous meat inspection procedure and the long standing habit of most Ethiopian people to feed their dogs with condemned offal which in effect facilitate the maintenance of the perfect life cycle of *Echinococcus* (Kebede et al., 2009). Despite the large efforts that have been put into the research and control of echinococcosis, it still remains a disease of worldwide significance. In some areas of the world, cystic echinococcosis caused by *E. granulosus* is a re-emerging disease in places where it was at low levels (Torgerson et al., 2002; Torgerson and Budke, 2003; Endrias et al., 2010; CFSPH, 2011).

The fertility of hydatid cysts occurring in various intermediate host species is one of the most important factors in the epidemiology of the disease (Acha and Szyfres, 2003). The fertility of hydatid cysts varies depending on intermediate host species and geographical areas (Saeed et al., 2000; Mcmannus and Smith, 2006), and the status of the problem is not well known especially in developing countries (Torgerson et al., 2002). Despite these, the recent status of hydatidosis in bovine and its economic impact is not well known at different areas of Ethiopia including Mekelle municipal abattoir; though very few attempts were made before 4 years back. Therefore, it is necessary to determine the situation on annual bases. The objectives of this study were therefore to estimate the prevalence and fertility of hydatidosis in bovine slaughtered at Mekelle municipal abattoir and determine the economic impact due to direct and indirect loss during the study period.

MATERIALS AND METHODS

Study area and animals

The study was conducted in Mekelle districts of the Tigray regional state located in the Northern Ethiopia. Mekelle is the largest town of the region and is 783 km North of Addis Ababa. The climate is highland and conducive for animals rearing. The annual average rainfall is 506.47 mm. The annual minimum and maximum temperature was 11.89 to 26.49°C (CSA, 2011).

The study animals comprised indigenous zebu cattle slaughtered at Mekelle municipal abattoir. The slaughtered animals were originated from the Central highlands and from Southern lowlands (Alamata, Raya, Azobo and Mekonni). All cattle presented for slaughter were local breed. The sample size for bovine is calculated according to Thrusfield (2007) by considering 50% expected prevalence and 95° confidence interval with a 5% desired absolute precision. The calculated sample size is 384 and for the higher accuracy, the total numbers of sampling animals were increased to 840. It could have been possible to consider the prevalence in that specific abattoir to calculate the sample size. However, we prefer the 50% to maximize our sample size.

Study design and methodology

A cross sectional study design was followed to study the prevalence hydatidosis from the study animals slaughtered in Mekelle abattoir.

Ante-mortem inspection

Each week, three days visit was made for ante-mortem inspection on individual animals for assessment of animals' origins, age and body conditions. During every visit, each animal were identified based on enumerated marks on its body tagging before slaughter. Animal origin was also recorded as highland (>1500 masl), from central highlands and lowland (<1500 masl), from Southern lowlands (Alamata, Raya, Azobo and Mekonni). The age of the animals was estimated on the basis of the dentitions (Kelly, 1975) and was conventionally classified as young (<2 years), adult (2 to 5 years) and old (>5years). The method described for zebu cattle body condition were three: lean (1 to 3), medium (4 to 6) and fat (7 to 9), and were used based on Nicholson and Butterworth (1986).

Post-mortem examination

Following a through visual inspection, palpation and incision of

Table 1. The distribution and number of organs infected with hydatid cysts from cattle slaughtered at Mekelle municipality abattoir.

Organ	No. infected organs	Frequency (%)
Lung only	127	53.81
Liver only	37	15.68
Lung and liver	63	26.69
Heart	3	1.27
Kidney	2	0.85
Lung and kidney	2	0.85
Lung and heart	1	0.42
Lung, liver and kidney	1	0.42
Total	236	100

suspected organs such as liver, lung, heart and kidney and all the hydatid cyst found in these organs were collected to conduct cyst measurement, cyst count and cyst fertility according to Macpherson (1985). The diameter of the collected hydatid cysts was measured and classified as small (diameter <4 cm), medium (diameter between 4 and 8 cm) and large (diameter >8 cm) (Schantz, 1990; Oostburg et al., 2000).

The collected hydatid cysts were taken to Mekelle regional laboratory. Individual cyst was carefully incised and examined for protoscolices which look like white dots on the germinal epithelium; such cysts were characterized as fertile cysts (Soulsby, 1982). Fertile cysts were subjected for viability test. A drop of the sediment, containing the protoscoleces was placed on microscopic glass slide and covered with coverslip and observed for amoeboid like movement (flame cell activity) with 40X objective. A drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on a microscopic slide with the principle that protoscolices should completely or partially exclude the dye while the dead once take it up (Macpherson, 1985). Furthermore, infertile hydatid cysts were classified as sterile or calcified by their smooth inner lining usually with slight turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling upon incision (Soulsby, 1982; Parija, 2004).

Financial loss assessment

Annual cost of the condemned organs due to bovine hydatidosis was assessed using the following formula set by Ogunirade and Ogunirade (1980). The mean retail market price of condemned organs due to hydatidosis such as liver (35 Ethiopian Birr (ETB)), lung (10 ETB), heart (7 ETB) and kidney (6 ETB) were the parameters considered.

Direct organ condemnation

Annual economic loss due to organ condemnation = $(PI_1 \times T_k \times C_1) + (PI_2 \times T_k \times C_2) + (PI_3 \times T_k \times C_3) + (PI_4 \times T_k \times C_4)$

where: PI_1 = Percent involvement of liver out of the total examined; PI_2 = Percent involvement of lung out of the total examined; PI_3 = Percent involvement of heart out of the total examined; PI_4 = Percent involvement of kidney out of the total examined; C_1 = Average market price of liver; C_2 = Average market price of lung; C_3 = Average market price of heart; C_4 = Average market price of kidney; T_k = Average annual kill of bovines; Carcass weight loss due to hydatidosis.

Five percent estimated carcass weight was lost due to hydatidosis (Polydorous, 1981), slaughter rates of animals at Mekelle municipal abattoir, average carcass weight (dressing percentage) of Ethiopian zebu cattle breed was 126 kg and the carcass value of beef during the study period was about 32 ETB/kg. The annual carcass weight loss due to hydatidosis was:

$ACW = CSR \times CL \times BC \times P$
$ACW = CSR \times 126 \times 5\% \times BC \times P$

Where: ACW = Annual cost from carcass weight loss; CSR = average slaughtered cattle per annual in the abattoir; CL = carcass weight loss in the individual = (126×5%); BC = average price of 1 kg carcass at Mekelle town; P = prevalence rate of hydatidosis at Mekelle municipal abattoir.

Therefore, the total financial loss due to hydatidosis was the sum of organ condemned (direct) and the cost of carcass weight (indirect) losses.

Data analysis

Data collected from post-mortem, laboratory findings and other factors like age, body condition and origin were entered into MS Excel sheet for storage; Statistical Package for Social Science-15 (SPSS Inc., Chicago, IL, USA) was employed for the analysis. The significant cut point is set to be 0.05. The result is presented in tabulations and narrations.

RESULTS

The present study revealed that the prevalence of bovine hydatidosis at Mekelle municipal abattoir was found to be 28.09%. The distribution and number of organs infected with hydatid cysts in cattle were described and additionally mixed infestation rates were also calculated. The appearance of the cyst in one animal more than one organ also is common where majority of the cysts lodge on the lungs and liver (Table 1).

Observation during the survey period also revealed that the infection rate among different age groups of examined animals were found to be statistically significant ($p<0.05$) with the highest in old aged cattle (31.98%), followed by adult (21.63%) and young (17.65%). There was statistically significant difference

Table 2. The prevalence and effect of risk of hydatidosis based on different variable categories in cattle slaughtered in Mekelle municipal abattoir.

Variable categories	Number of examined	Number of positive	Prevalence (%)	95% CI	P value
Body condition					
Lean	196	73	37.24	37.24±1.67	
Medium	510	134	26.27	26.27±1.52	0.06
Fat	134	29	21.64	21.64±1.42	
Age					
Young	17	3	17.65	17.65±1.32	
Adult	282	61	21.63	21.63±1.42	0.02
Old	541	173	31.98	31.98±1.61	
Origin					
Highland	559	158	28.26	28.26±1.55	0.86
Lowland	281	78	27.76	27.76±1.55	

between infection rate and body condition score of the animals with 37.24% lean, 26.27% medium and 21.64% fat body condition (Table 2).

Most of the cysts were sterile accounting for 45.27%, and 37.29 were calcified whereas 17.44% were fertile cysts. The cysts were classified as small, medium, large and calcification as described in Figure 1.

The study revealed that in relation to other organs, lungs and liver are the most commonly affected and rejected from local market place, and costing too much loss to the livestock industry of the area. This holds true as in this was reported. The rejection rate of heart, spleen and kidney was however not as significant as that of lungs and liver.

Annual economic loss was determined by considering annual slaughter rate of cattle and prevalence of hydatidosis, and calculated to be 50,060.47 Ethiopian Birr (2,800 USD) due to organ condemnation. A total of about 306 organs were condemned during the study period as shown in Table 3 above. A 5% carcass weight loss due to hydatidosis (Polydorous, 1981) was considered and average total number of slaughtered animals in Mekelle municipality abattoir were 7600 and resulted 42,900.48 Ethiopian Birr (2300 USD) per annum. Total economic loss in the abattoir was 92960.95 Ethiopian Birr (5100 USD) per annum due to both direct and indirect economic loss. This economic loss is increased from the previous study even if the prevalence is almost the same due to increasing cost of organs (offals) and increased number of animals slaughtered in the abattoir. The result of the study shows that the diseases among animals were highly distributed.

DISCUSSION

This study showed similar conclusion which signifies high prevalence of the disease. From a study conducted in Tigray region reported that echinococcosis/hydatidosis is considerably a prevalent disease in cattle. From 5,194 cattle examined at slaughter houses, 1146 (22.1%) of them were found harboring hydatid cyst (Kebede et al., 2009). The prevalence of cattle hydatidosis study on cattle slaughtered in Mekelle municipal abattoir was 32.1% (Berhe, 2009), Addis Ababa abattoir enterprise was 19.7% (Fikire et al., 2012), Ambo municipal abattoir was 29.69% (Endrias et al., 2010), Dessie municipal abattoir was 13.61% (Melaku et al., 2012) and Kebede et al. (2009a, 2009b) found a prevalence of 34.5 and 16% hydatid cysts in cattle slaughtered in Bahir Dar and Wolaita Sodo abattoir, respectively. The variation in prevalence rate within the same species of animals could be attributed to the differences in seasonal variation, geographical locations and strain differences. Even if monthly studies data report is not included in this research, the prevalence of hydatidosis varies form year to year and from place to place may be ascribed to differences in environmental conditions, hygienic status of slaughter houses, climatic conditions, contamination rate in the intermediate host, dog in each place, slaughtering manner and feeding status of animals, livestock stocking intensity and livestock movement that contribute to the differences in prevalence rates (Njoroge et al., 2002; Tappe et al., 2011). However, the monthly reports interpretation does not signify the actual infestation in that particular month since the disease has chronic nature and makes difficult as to which months of the year the animals acquire the disease.

In the fertility study of the parasite, the rate in the current study is very high as compared to previous reports. In other study, the percentage of fertile cysts: 31.39 (Endrias et al., 2010), 19.3 (Fikire et al., 2012), 10.66 (Berhe, et al., 2010) and 14.95% (Terefe et al., 2012) were documented. Information about prevalence

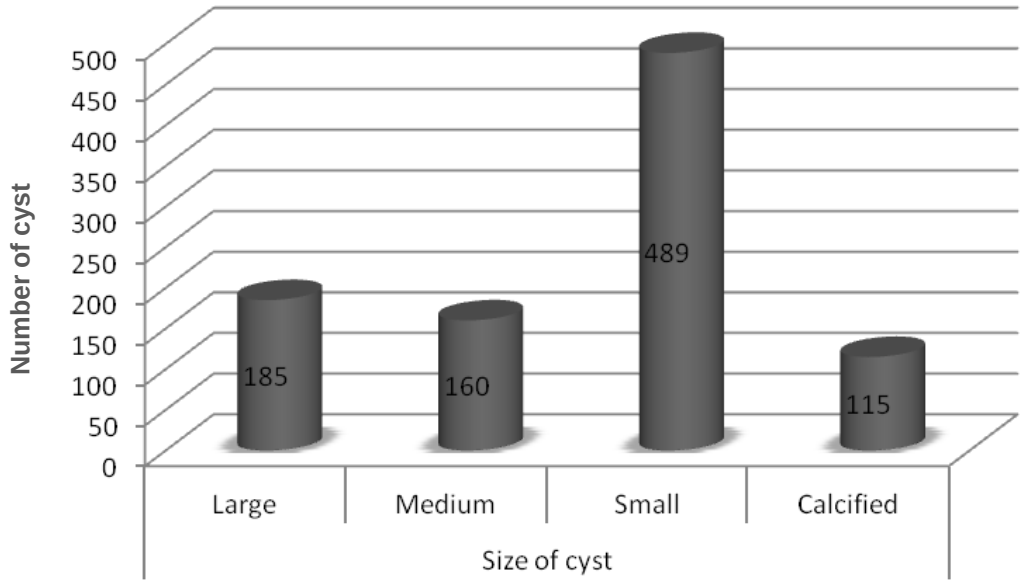

Figure 1. Hydatid cyst size characterization from different organs of cattle slaughtered at Mekelle municipality abattoir.

Table 3. Total number of organs condemned due to bovine hydatidosis in Mekelle municipality abattoir.

Organs condemned	Number of organs condemned	Prevalence (%)
Lung	194	63.82
Liver	101	33.22
Kidney	5	1.64
Heart	4	1.316
Total	304	100

and fertility of hydatid cysts in various organs of cattle are important indicators of potential source of infection to perpetuate the disease to dogs (Endrias et al., 2010). Genotype of infecting strain affects the fertility rate of the cysts in the intermediate hosts and thereby the infectivity of strain for subsequent hosts (Mwambete et al., 2004). The fertile cyst was found higher in the lung due to soft consistency and favors to development, but the per-centage of calcified cyst was found to be higher in the liver than in the lung. This may be associated with the higher reticuloendothelial cell and abundant connective tissue reaction of the organ (Gemmel and Lawson, 1986). The high proportion of small cysts may be due to immunological response of the host, which might preclude expansion of cyst size (Larrieu et al., 2001).

Organ condemnation was commonly seen in this study due to hydatidosis in majority of the cases. Hydatidosis is the major cause of organ condemnation next to *Fasciola* and the first cause of lung condemnation in most Ethiopian abattoirs. In general, the widespread practice of offering dogs with uncooked infected offal, the absence of well-constructed abattoir and the habit of leaving the dead unburied are important factors that favor the maintenance and widespread existence of the disease in the study areas (Kebede et al., 2009).

In such areas, bovine hydatidosis in domestic animals can result in significant production losses, including reduction in live weight gain, yield of milk, fertility rates, the value of hide and skin and in decreased edible offals (Torgerson and Budke, 2003). In addition to losses incurred in the abattoir, hydatidosis could have economic impact due to invisible losses like impaired productivity; for example, reduced traction power of oxen which results in reduced crop production (Endrias et al., 2010). The economic loss seems lower especially for countries with high prevalence of the parasite. However, it is a huge loss per animal annually in a country like Ethiopia where the daily earning per capita is less than one dollar. It is necessary to carry out epidemiological investi-gations such as possible chain of infections between the final and intermediate hosts and the role of wild animals in the life cycle of the parasite under local conditions are necessary

Parasites in animals can regulate the disease. However, collaboration between veterinarian and public health workers is essential for successful control of hydatidosis (Thompson and Allsop, 1988; WHO, 2011).

CONCLUSION AND RECOMMENDATIONS

Hydatidosis is one of the most highly prevalent parasitic diseases of cattle in Ethiopia and incurring huge economic loss due to organ condemnation. In view of the present findings and available information, the following recommendations are forwarded. Awareness generating programs should be given for the butchers, abattoir workers, and dog owners to the dangers of hydatidosis to human and animal health. Appropriate control measure should be taken to stop the sale of infected offals for pet animals' consumption. Further studies including genotyping of the parasite species in that abattoir should be conducted. Government should give attention and building abattoirs with good facilities and control back yard slaughtering.

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