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Infection Rates and Economic Significance of Bovine Hydatidosis Slaughtered in Soddo Municipality Abattoir

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Abstract: A cross-sectional survey of bovine hydatidosis was carried out on 400 cattle from November 2007 to April 2008 in Soddo municipality abattoir. The main aim of the study was to determine the prevalence and economic significance of bovine hydatidosis. Eighty animals were found positive for hydatid infection (hydatidosis) with an overall prevalence of 20%. Analysis of infection rate on the basis of age of cattle and there was also insignificant difference (P>0.05) between different age groups. The percent involvement of organs, namely: lungs, liver, heart, spleen and kidney was found to be 77.5%, 48.75%, 3.75%, 2.5% and 2.5% respectively. Of the total 370 cysts observed during the study period, 162 (43.78%), 78 (21.08%), 22 (5.95%) and 108 (29.19%) were small, medium, large and calcified cysts, respectively. 16.55% and 4.07% were fertile and 86.96% and 40% of the fertile cysts were viable in lung and liver, respectively. The annual economic loss incurred during this study as a result of organ condemnation and carcass weight reduction due to bovine hydatidosis was estimated to be about 251,133.75 Ethiopian Birr (13,952US$). Based on the present result and local factors, appropriate control strategies should be conducted to reduce the disease problem on livestock production and human life.

Key words: Cattle · Economic Significance · Hydatidosis · Infection Rates · Sodo Municipality Abattoir

INTRODUCTION

Ethiopia's livestock productivity, despite its population size, remains marginal due to prevalent diseases, malnutrition and management constrains. Parasitism represents a major setback to the development of the sub-sector. However, data on epidemiology, economic losses and relative hierarchy of individual parasitic infections are hardly available, which otherwise were of paramount importance to determine the type and scope of control investigations to be envisaged [1].

Echinococcosis/hydatidosis is a zoonotic disease that occurs throughout the world and causes considerable economic losses and public health problems in many countries [2]. The disease caused by *Echinococcus* (*E*) *granulosus,* cystic echinococcosis, is one of the neglected zoonotic diseases recognized. It represents a significant global human disease burden in resource poor pastoral communities [3]. This multi host parasite is prevalent all over the world and annually, the economic loss in livestock due to this parasite is significant [4, 5].

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 [6, 7].

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 lungs.

Different studies have shown that cystic echinococcosis (*E. granulosus*) represented considerable economic and public health significance in different countries [8]. Present estimates suggest that cystic

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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$ [3].

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 [8, 9]. 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* [10].

Regarding the situation of bovine hydatidosis in Soddo municipality abattoir of Ethiopia information is scant, except the work of Abdul [11] who reported the prevalence of 32.6%. Apart from this work, no study has been conducted to assess the dynamics of the disease in relation to the efforts made to minimize the prevalence since then. Furthermore, there is no single documented work of investigation regarding the economic losses as a result of this disease in Soddo municipality abattoir. Therefore, in order to fill this gap, decision was made to study the prevalence and economic significance of bovine hydatidosis slaughtered at Soddo municipality abattoir.

MATERIALS AND METHODS

Study Area: The study was carried out in and around Soddo, South Nations Nationalities and People's Region (SNNPR) from November 2007 to April 2008. Soddo is 383kms South of Addis Ababa and located between 6°36' North to 7°18' North latitude and 37°12' East up to 38°24' East longitude. The annual rainfall in Soddo ranges from 1200mm-1300mm with mean average temperature 21°C. The area is characterized by bimodal rainfall, long period (June to mid-October) and short rainy period (March and April). Livestock in Wolayita include cattle, sheep, goats, horses, mules, donkeys and poultry [12].

Study Population: Cattle presented to Soddo municipality abattoir for routine meat inspection were used for the cross-sectional survey. During the abattoir survey post mortem examinations were carried out on a total of 400 cattle. Most of the cattle slaughtered at the study abattoir were local / indigenous breeds.

Study Design: A cross-sectional study type was carried out from November 2007 to April 2008 to collect data on events associated with hydatidosis in cattle slaughtered at Soddo municipality abattoir.

Sample Size Determination: Since there was one previous survey conducted in Soddo municipality abattoir to establish the prevalence of hydatidosis in cattle slaughtered at the abattoir, the sample size was determined according to Thrusfield [13]. Accordingly, assuming the expected prevalence of hydatidosis in cattle slaughtered at Soddo municipality abattoir to be 32.6% based on previous survey conducted in the study abattoir [11], the sample size required was 338 cattle at 95% confidence level and 5% expected error. But in order to increase the accuracy of the study, the sample size was increased to 400 cattle. Thus, a total of 400 cattle were randomly sampled and examined for the presence of hydatid cysts.

Study Methodology

Antemortem Inspection: Each week, four 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. The age of the animals was estimated on the basis of the dentitions [14] 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 [15].

Postmortem Examination: Postmortem examination was carried out on slaughtered animals through visual inspection, palpation and incision of suspected organs (lung, liver, heart, spleen etc.). Hydatid cysts were carefully removed by a circular incisions around the cysts and separately collected (for each organ) in clean containers for further cyst characterization. The cysts were then subjected to systematic size measurements (diameter) using a ruler and classified as small cyst (<4cm), medium cyst (4-8 cm) and large cyst (>8cm) [16].

Cyst Fertility and Viability: Individual cysts were grossly examined for degeneration and calcification. Then, 30% of non-calcified hydatid cysts (85 from the liver and a similar number from the lungs) were randomly selected for fertility and viability tests. The surface of each cyst was sterilized with alcoholic iodine solution. The pressure of

the cyst fluid was reduced by using a sterile hypodermic needle. Then cysts were incised with a sterile scalpel blade and the content was poured into a glass petridish to be examined. The presence of protoscolices either attached to the germinal layer in the form of brood capsule or its presence in the cyst fluid was considered as indicative of fertility by using a light microscope at 10x to 40x objective [17].

Fertile cysts were further subjected to viability test. 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 and observed under 40x objective [18].

Economic Loss Assessment: The total economic loss due to hydatidosis in cattle slaughtered at Soddo municipality abattoir was estimated from the summation of annual organ condemnation cost (direct loss) and cost due to carcass weight reduction (indirect loss).

Direct Loss Due to Organ Condemnation: All organs namely liver, lungs, heart, spleen and kidney which are positive for hydatidosis were totally condemned and the economic loss due to total / partial condemnation of organs due to bovine hydatidosis was then assessed using the following formula set by Ogunrinade and Ogunrinade [19].

$ACL_1L_2HKC = P (CSR \times PL_1C \times L_1C) + P (CSR \times PL_2C \times L_2C) + P (CSR \times PHC \times HC) + P (CSR \times PKC \times KC) + P (CSR \times PSC \times SC)$

Where, ACL_1L_2HKSC= Annual loss of liver, lung, heart, kidney and spleen condemned
CSR= Average number of cattle slaughtered per year at the abattoir
P = Prevalence of hydatidosis in Soddo municipality abattoir
PL_1C= Percentage of lungs condemned
L_1C = Mean cost of one lung in Sodo town
PL_2C= Percentage of liver condemned
L_2C= Mean cost of one liver in Sodo town
PHC= Percentage of heart condemned
HC= Mean cost of one heart in Sodo town
PKC= Percentage of kidney condemned
KC= Mean cost of one kidney in Sodo town
PSC = Percentage of spleen condemned
SC = Mean cost of one spleen in Sodo town

Indirect Loss Due to Carcass Weight Reduction: A 5% carcass weight loss, due to hydatidosis in cattle, has been described by Polydrous [20], average carcass weight (dressing percentage) of Ethiopian zebu cattle breed was 126kg and the carcass value of beef during the study period was about 32ETB/kg. The annual carcass weight loss due to hydatidosis was:

$$ACW = CSR \times P \times BC \times CL \times 126 \text{ kg}.$$

Where, ACW= Annual loss from carcass weight loss due to hydatidosis
CSR= Average number of cattle slaughter per annum in the study abattoir
CL= Carcass weight loss in individual cattle due to hydatidosis (5%).
BC= Average market price of 1kg beef in Soddo town
P= Prevalence of hydatidosis in the study abattoir

Data Management and Analysis: The data collected from the study abattoir were recorded in the format developed for this purpose later on entered into the Microsoft Excel 2010 program of the computer and analyzed using STATA 11.0. The overall prevalence and the prevalence on the basis of age were computed. The Pearson X^2 was used to test the existence of association between age groups.

RESULTS

Overall Prevalence: Four hundred cattle were inspected during the study period. The overall prevalence of bovine hydatidosis slaughtered at Soddo municipality abattoir was found to be 20%. Univariable logistic regression analysis revealed that the odds of probability acquiring hydatidosis infection that the infection rate among different age groups of examined animals were found to be statistically insignificant ($P>0.05$) (Table 1).

Organ Distribution of Hydatid Cysts in Infected Cattle: 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. The rejection rate of heart, spleen and kidney was however not as significant as that of lungs and liver (Table 2).

Characterization of Cysts on the Basis of Their Size: As the data on the size of cysts were analyzed and summarized, it had been found that most of the recovered cysts were small in size and some were calcified. Only few medium sized and large sized cysts were found (Table 3).

Table 1: Prevalence of bovine hydatidosis according to age category slaughtered at Sodo municipal abattoir

Age of examined animal (in year)	No. examined	No. positive	Prevalence (%)
Young (<6years)	32	9	28.13
Middle age(6-9)	182	37	20.33
Old age(>9 years)	186	34	18.28
Total	400	80	20

Pearson chi square (X^2) = 1.4768, P = 0.432

Table 2: Distribution of hydatid cysts in different visceral organs of infected cattle

Infected organs	Number	Percent
Lungs only	41	51.25
Liver only	18	22.50
Lungs and liver only	14	17.50
Lungs liver and heart	3	3.75
Lungs liver and spleen	2	2.50
Lungs liver and kidney	2	2.50

Table 3: The size of recovered hydatid cysts from infected cattle slaughtered at Wolaita Sodo abattoir

Size of cysts	Frequency	Percent
Small	162	43.78
Medium	78	21.08
Large	22	5.95
Calcified	108	29.19
Total	370	100.00

Fertility and Viability Study: Among the noncalcified cysts, 262 cysts (139 from lungs and 123 from liver) were randomly examined for fertility tests. The results show that fertile cysts were more prevalent in the lungs than in the liver. Viability test was done on all the fertile cysts examined above. At this stage, percent viability of fertile cysts was higher in lung than liver (Table 4).

Economic Loss Assessment: Direct loss from organ condemnation: Generally, all infected organs such as liver, lungs, heart, spleen and kidneys are totally condemned. In the study abattoir the average annual cattle slaughter rate was estimated to be 5250. In order to calculate the direct economic loss encountered, the average current price of various organs were sought from butcheries found in and around Soddo. Therefore, the estimated annual loss from organ condemnation was 39,453.75 Ethiopian Birr.

Indirect Loss from Carcass Weight Reduction: In the study area the average price 1 kg beef was 32 Ethiopian Birr and a 5% carcass weight loss due to hydatidosis (Polydorous, 1981) was considered and average total number of slaughtered animals in Sodo municipality abattoir and resulted 211,680 Ethiopian Birr per annum. Total economic loss in the abattoir was 251,133.75 Ethiopian Birr (13,952US$) per annum due to both direct and indirect economic loss. This indicates that about 84.29% of the overall estimated economic loss was found attributable to carcass weight reduction while only 15.75% of the losses account for organ condemnation.

DISCUSSION

In the study area carcass of domestic animals that have died due to various causes are left unburied / unburned in the field for scavenging dogs and related wild carnivorous, like hyena. This also exposed the animals (cattle) to hydatid disease. It is established fact that dogs and wild canines routinely feed on infected offals result in the maintenance of *E. granulosus* life cycle [3].There are some evidences that hydatid disease is spreading because of lack of meat control, dog management and appropriate legislation [21].

Table 4: The fertility and viability rate of cysts randomly selected hydatid cysts from livers and lungs of cattle slaughtered at Sodo municipal abattoir

		Fertile cyst		Sterile cyst	
Organ involved	No. of cysts examined	No.	%	No.	%
Lung	139	23	16.55	116	83.45
Liver	123	5	4.07	118	95.93
Total	262	28	10.69	234	89.31
		Viable cyst	Non-viable cysts		
Organ involved	No. of cysts examined	No.	%	No.	%
Lung	23	20	86.96	3	13.04
Liver	5	2	40	3	60
Total	28	22	78.57	6	21.43

The findings of this study indicated higher prevalence of hydatidosis in cattle slaughtered at different abattoirs. The overall prevalence of bovine hydatidosis in the study area showed that 20% which is lower than that reported by Dawit *et al.* [9] in Mekelle municipal abattoir (28.09%), Fikire *et al*. [22] in Addis Ababa abattoir enterprise (19.7%), Endrias *et al*. [23] in Ambo municipal abattoir (29.69%) and Birhanu *et al*. [24] in Bahir Dar Municipal Abattoir (31.8%). On the other hand, lower prevalence was recorded 13.61% at Dessie municipal abattoir [25] and 16% at Wolaita Sodo abattoir [8]. 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. The prevalence of hydatidosis varies from 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 [5, 26, 27].

The reduction of the prevalence of bovine hydatidosis in this study could also be due to an incidental benefit from the destruction of stray dogs from the study area for the control of rabies. This argument is further supported by Urquhart *et al*. [28] that in countries where there is no specific measure for hydatid control, it has been found that an incidental benefit from the destruction of stray dogs for rabies control has been a great reduction in the incidence of hydatid infection in humans and animals.

The prevalence of hydatidosis in the three age groups of cattle was found insignificance but the prevalence decreases as the age increases. Thus, the reason for the lower prevalence of hydatidosis in older cattle may be early culling of the infected young cattle through selling or slaughtering before they reach old age. The other reason for this could also be due to the presence of acquired immunity against hydatid infection in older / aged cattle. Gemmell *et al*. [21]) suggested that moist *Taenid* eggs are not capable of developing to mature metacestodes in older animals.

The most the cysts were found higher in the lung due to soft consistency and favors to development, but the percentage 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. The high proportion of small cysts may be due to immunological response of the host, which might preclude expansion of cyst size [9].

In the fertility study of the parasite, the rate in the current study is low as compared to previous reports. In other study, the percentage of fertile cysts: 31.39% [23], 19.3% [22], 17.44% [9] and 14.95% [29] were documented. Information about prevalence and fertility of hydatid cysts in various organs of cattle are important indicators of potential source of infection to perpetuate the disease to dogs. Genotype of infecting strain affects the fertility rate of the cysts in the intermediate hosts and thereby the infectivity of strain for subsequent hosts [30]. The fertile cyst was found higher in the lung due to soft consistency and favors to development, but the percentage 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. The high proportion of small cysts may be due to immunological response of the host, which might preclude expansion of cyst size [31, 32].

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 [8, 9].

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 [33, 34]. 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 [23]. The economic loss seems lower especially for countries with high prevalence of the parasite. On the other hand, about 84.29% of the overall estimated economic loss was found attributable to carcass weight reduction while only 15.75% of the losses accounts for organ condemnation. The annual economic loss incurred in this study is higher than most of those reported by other investigators in different area of Ethiopia [9].This is due to high demand of edible offals and beef in the study area and the current situation of market price in the country.

In conclusion, 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. It is essential to have adequate knowledge of the epidemiology of the disease as to the management, habit, customs, occupation, diagnostic techniques and attitude to dogs. Public education of zoonotic and economic importance of the disease should be applied through teachers, extension workers and mass media. Government should give attention and building abattoirs with good facilities and control back yard slaughtering.

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