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Full Length Research Paper

Occurrences and financial significance of bovine cystic echinococcosis in Southern Wollo, Northeastern Ethiopia

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The study was carried out in Kombolcha ELFORA Industrial Abattoir to assess the current status and economic importance of bovine hydatidosis. Hyatid cyst count, characterization and economic loss assessment were conducted out of a total of 535 cattles slaughtered in Kombolcha ELFORA Industrial Abattoir. 93 (17.4%) animals were found harboring hydatid cysts. Thorough meat inspection in the abattoir revealed that 101 visceral organs were found harboring one or more hydatid cyst. The infection of the lung, liver, spleen, heart and kidney were found to be 50.5, 40.6, 1.98, 4.95 and 1.98%, respectively. From the total of 276 hydatid cysts counted, 135 (49.6%), 47 (17%), 20 (7.24%) and 72 (26%) were found to be small, medium, large and calcified cysts, respectively and 178 (67.9%), 12 (4.3%) and 72 (26%) were sterile, fertile and calcified, respectively. The rate of cyst calcification was higher in the liver than in the lung while fertility rate was higher among the cysts of the lung. The annual financial losses from organ condemnation and carcass weight loss due to bovine hydatidosis at Kombolcha ELFORA Industrial Abattoir were estimated to be 288,473.60 Ethiopian Birr (ETB) ($1 = 17.00 ETB). Thus, echinococcosis/hydatidosis is considerably a prevalent disease in cattle, with serious public health concern reflections and causes substantial visible and invisible losses in cattle in the study area.

Key words: Bovine hydatidosis, economic loss, Kombolcha ELFORA, meat inspection, prevalence.

INTRODUCTION

Among the many prevalent livestock diseases, parasitosis represent a major drawback to livestock development in the tropics in general and hydatidosis is among the major parasite diseases contributing to low productivity of meat production due to carcass or organ condemnation,in particular (Lemm et al., 1985). Infection, with the metacestode hydatid cyst of *Echonococos granulosus,* stage of parasite tape worms is recognized as one of the world's major zoonosis affecting both humans and domestic animals (Cringoli et al., 2007).

The definitive host of the parasite, *E. granulosus,* is dogs which harbor adult tape worms and excrete the parasite eggs along with their feces, while livestock and and human are the main intermediate hosts (Oku et al., 2004) for whom the outcome of infection is the development of hydatid cysts in lung, liver or other organs (Muller, 2001; Budke et al., 2006). The incidence of human hydatidosis and the prevalence of the hydatidosis in domestic animals are the highest in countries where there is a large dog population and high sheep production (Gracey, 1986). The absence of proper meat inspection procedures and the presence of large stray dog population are thought to contribute significantly to the prevalence of the disease in Ethiopia (Kebede et al., 2009a). In Ethiopia, a number of researchers reported high prevalence of hydatidosis in different parts of the country. Fuller and Fuller (1981) documented a hyperendemic focus of hydatid disease in South-western Ethiopia in Dassanetch and Nyangatom people. In abattoirs of various locations, researchers indicated that hydatidosis is widespread in

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Ethiopia with great economic and public health significance (Jobre et al., 1996; Sissay et al., 2008; Kebede et al., 2009a, b, c, d, Kebede, 2010). However, there is no current information regarding the prevalence and economic significance of hydatidosis in livestock in South Wollo zone, northeastern part of the country. Hence, it would be essential to have information on the status of hydatidosis with regard to its magnitude of occurrence and economic significance of this disease in the region. Therefore, the present study was aimed at (1) determining the magnitude of the hydatidosis in cattle; (2) studying the localization and fertility/sterility rates of hydatid cysts; and (3) estimating the annual economic loss attributed to the condemned carcasses and organs and duet to weight loss in Kombolcha ELFORA Industrial Abattoir, Northeastern Ethiopia.

MATERIALS AND METHODS

Study area

This study was conducted at Kombolcha ELFORA Industries Abattoir. The abattoir is privately owned which supplies lean meat to Kombolcha Meat Factory for canning. The abattoir is located at Kombolcha, South Wollo, at an altitude of 1500 to 1840 m above sea level and about 375 km away from Addis Ababa in the northeast direction (DoARD, 2006).

Study animals and sampling

A total of 535 cattle presented for slaughter at Kombolcha ELFORA Industrial Abattoir were examined for hydatid cyst in the period between August 2010 and May 2011. The study was an active abattoir survey which included cattle brought from different livestock markets to Kombolcha ELFORA Industrial Abattoir. The sample size was determined by 95% confidence interval at a desired accuracy level of 5% (Thrusfield, 1995) and with expected prevalence of 28.4% (Asrat, 1996). Using purposive sampling method, the samples were selected from cattle registered for slaughtering following the antemortem inspection.

$$n = \frac{1.96^2\, p_{exp}\,(1-p_{exp})}{d^2}$$

Where n = required sample size; p_{exp} = expected prevalence; d = desired absolute precision.

Study design

Postmortem examination

A total of 535 cattle presented for slaughter at Kombolcha ELFORA Industrial Abattoir were examined for the presence of hydatid cyst following the routine meat inspection procedures. The inspection procedure used during the postmortem examination consisted of two steps, namely primary and secondary examination. Primary examination involved usual inspection and palpation of organs and viscera followed by a secondary examination if evidence of metacestode was found. The secondary examination involved further incision into each organ if single or more hydatid cyst(s) were found. The liver, lungs, heart, spleen, mesentery and omentum of each animal were examined grossly. Each organ was also incised once or twice with knife. Whenever the cysts were present they were removed, placed in polyethyline bags separately, labeled and taken to the laboratory for further examination.

Identification of cysts was done in the parasitology laboratory of Kombolcha Regional Veterinary Laboratory based on the criteria described by Soulsby (1982). During the study, detailed records of the species, age of the animals, number, size, location and viability of the cyst(s) were made. All animals slaughtered were local zebu breed of cattle at the age of 4 years and above.

Hydatid cyst characterization

The infected organs from each positive animal were collected and recorded. The total number of hydatid cysts was counted and recorded for each infected organ. The size of the diameter of collected hydatid cysts was measured and classified as small (diameter less than 5 cm), medium (diameter between 5 and 10 cm) and large (diameter greater than 10 cm) (Kebede et al., 2009a,c; Oostburg et al., 2000).

Individual hydatid cysts were carefully incised and examined for protoscolices, which resembled white dots on the germinal epithelium; such cysts were characterized as fertile cysts. Fertile cysts were subjected to viability test. A drop of the sediment containing the protoscolices were placed on the microscope glass slide and covered with cover slip and observed for amoeboid like peristaltic movements 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 exude the dye while the dead ones absorb it (Macpherson et al., 1985). Furthermore, infertile cysts were further classified as sterile or calcified. Sterile hydatid cysts were characterized by their smooth inner lining usually with slightly turbid fluid in their content. Typical calcified cysts produce a gritty-sound heard at incision (Soulsby, 1982).

Financial loss estimation

Direct and indirect losses were the basis for the estimation of the annual economic losses. Direct losses were calculated on the basis of condemned organs, whereas the indirect losses were estimated on the basis of live weight loss caused by hydatidosis (Polydorou, 1981; Torgerson and Dowling, 2001).

The parameters considered for the estimation of financial loss were five percent estimated carcass weight loss due to hydatidosis (Polydorou, 1981), slaughter rates of animals at Kombolcha ELFOR Industrial Abattoir, average carcass weight (dressing percentage) of Ethiopian Zebu cattle breed (126 kg) and the mean retail market price of condemned organs due to hydatidosis such as lung, liver, kidney, spleen. The total financial loss due to hydatidosis was the sum of direct and indirect losses.

Direct and indirect financial losses were calculated on a yearly basis. Average market price of lung, liver, spleen, kidney, heart and a kilogram of beef was found to be 30, 45, 15, 10, 15 and 80 Ethiopian Birr (ETB), respectively. The mean annual numbers of cattle slaughtered during the last one year were 5000. Average number of cattle positive for hydatidosis as it was extrapolated from prevalence findings on ELFORA abattoir were 17.4%.

Direct losses were calculated as follows:

$$DL = (AS \times CLu \times PLu) + (AS \times CLi \times PLi) + (AS \times CSp \times PSp) + (AS \times CKid \times PKid) + (AS \times CHr \times PHr)$$

Where DL = direct losses associated with hydatidosis, AS =

estimated mean annual slaughter; PLu = percent involvement of the lung; CLu = local retail price of a lung; PLi = present involvement of the liver; CLi = local retail price of a liver; PSp = present involvement of the spleen; CSp = local retail price of a spleen; PKid = percent involvement of the kidney; CKid = local retail price of a kidney; PHr = percent involvement of the heart; CHr = local retail price of a heart.

Indirect losses (IL) = 5% NAS × PH × CPB × 126 kg

Where 5% = A reduction of 5% in meat production due to hydatidosis established by Polydorou (1981); NAS = average number of cattle slaughtered annually; PH = prevalence rate of hydatidosis; CPB = current average price of 1 kg of beef at Kombolcha; 126 kg is the dressed average carcass weight of adult Zebu cattle (ILCA, 1979).

Total economic loss (TL)

The total economic loss can be evaluated by considering both DL and IL as follows:

TL = DL + IL

Data analysis

Data collected from antemortem, postmortem and laboratory finding were entered in to MS Excel and statistical packages (SPSS Version 18) were employed to analyze the results.

RESULTS

This study demonstrated that at Kombolcha ELFORA Industrial Abattoir, 93 (17.4%) were found harboring one or more hydrated cyst. The result obtained from postmortem examination indicated that different organs were affected with hydatid cyst.

Single and multiple infection of organs were recorded out of the total 93 cattle harboring hydatid cysts; 87 (93.5%) were found involving only a single organ and the remaining 6 (6.5%) had a multiple organ involvement. Among the different organs affected, lung and liver constituted the highest infection rate (Table 1).

Cyst size

Exceptionally two large cysts were found in the lung and spleen of cattle measuring 18 and 17 cm in diameter and containing about 1.5 and 1.3 L of fluid, respectively. The total cyst count with respect to size in each infected organ for cattle was described in Table 2.

Cyst fertility, viability and sterility

Fertility and sterility of hydatid cyst was described. The viability percentage of protoscolices was higher in the lung (5.9%) than in the other organs while the percentage of calcified cysts was 36.8%, the highest in the liver (Table 3).

Direct financial loss

Due to cattle hydatidosis, 51 lungs, 41 livers, 5 hearts, 2 kidneys and 2 spleens were condemned during the study period with an economic loss of 1530, 1845, 125, 20 and 30 ETB, respectively (Table 4). This was assessed from the mean retail market price of each organs and the total number of organs condemned during the study period. Annual economic loss on the other hand was estimated considering annual slaughter rate of cattle and prevalence of hydatidosis per organ and was calculated to be 24,423.6 ETB per annum.

Indirect loss

The estimated economic loss from carcass weight loss due to hydatidosis was estimated to be 274,050 ETB. Therefore, the total estimated annual economic loss in cattle at Kombolcha ELFORA Industrial Abattoir due to hydatidosis was 302,023.6ETB ($1 = 17.00 ETB).

DISCUSSION

The occurrence of hydatidosis in cattle was found to be 17.4% during the study period in Kombolcha ELFORA Industrial Abattoir. The current finding is almost similar to that reported as 16.85% (Jemere and Butako, 2011) in Wolaita Sodo, 15.4% (Regassa et al., 2009) in Hawassa and 16% (Kebede et al., 2009b) in Wolaita Sodo. In general terms, throughout the world, there had been different magnitude records of hydatidosis in cattle with low medium and high rates of occurrences. High prevalence rates were registered in other areas of the country such as 61% in Assela (Koskei, 1998), 52.69% in Hawassa (Regassa et al., 2010), 34.05% in Bahir Dar (Kebede et al., 2009a), 46.5% in Debre Zeit (Jobre et al., 1996), 48.9% in Debre Markos (Kebede et al., 2009c), 32.1% in Mekelle (Berhe, 2009), and 22% in Tigray (Kebede et al., 2009d).

Factors such as difference in culture, social activity, animal husbandry systems, lack of proper removal of infectious carcass, and attitude to dogs in different regions might have contributed to the variation in prevalence in different areas of a country (Arbabi and Hooshyr, 2006) and strain differences of *E. granulosus* that exists in different geographical location (McManus, 2006).In the current study, hydatid cysts were found predominantly in lung and liver representing 50.5 and 40.6 %, respectively. Literature reveals that hydatid cysts are most commonly found in lungs and liver of ungulates (Hubbert et al., 1975) and it is in agreement with the

Table 1. The total number, relative prevalence and number of cysts harbored in affected organ.

Organ	Infected number of organ	Relative prevalence	Total number of cyst
Lung	51	50.5	135
Liver	41	40.6	125
Heart	5	5	10
Kidney	2	2	4
Spleen	2	2	2
Total	101	-	276

Table 2. Cyst size and counts in relation with organ involvements in infected cattle slaughtered in Kombolcha ELFORA.

Organ	Small	Percentage	Medium	Percentage	Large	Percentage	Total
Lung	70	51.9	30	22.2	15	11	115
Liver	58	46.4	17	13.6	4	3.2	79
Heart	4	40	-	-	1	10	5
Kidney	3	75	-	-	-	-	3
Spleen	2	100	-	-	-	-	2
Total	137	49.6	47	17	20	7.24	204

Table 3. Type of hydatid cyst sterile, fertile and calcified indifferent organs of infected cattle.

Organ	Sterile	Percentage	Fertile	Percentage	Calcified	Percentage	Total
Lung	107	79	8	5.9	20	14.8	135
Liver	61	48.8	4	3.2	46	36.8	125
Heart	5	50	-	-	5	50	10
Kidney	3	75	-	-	1	25	4
Spleen	2	100	-	-	0	0	2
Total	178	67.9	12	4.3	72	26	276

Table 4. Direct economic losses associated with CE in infected cattle in Kombolcha ELFORA industrial abattoir, Northeast Ethiopia.

Organ	No. of organs condemned	Price per organ	Total price ETB
Lung	51	20	1530
Liver	41	15	1845
Heart	5	25	125
Kidney	2	10	20
Spleen	2	15	30
Total	101	61	3,550

findings of Bekele and Butako (2011), Njoroge et al. (2002) and Eckert and Deplazes (2004), which show that the lung and liver are the most common sites of hydatid cyst in domestic animals. This could be justified by the fact that lungs and liver possess greater capillary fields, which allow these organs to efficiently filter the ingested oncospheres from the blood liver and lungs undergo sequential filtration of blood, liver undergoes primary filtration of blood from portal veins which is followed by pulmonary filtering actions before other organs are

invaded (Eckert and Deplazes, 2004). Only those oncospheres which transfer the blood will reach the systemic circulation and other tissues (Eckert and Deplazes, 2004; Matosain, 1977).

High numbers of small, medium and large size cysts were found in lungs than in the liver, while the liver harbored higher number of calcified cysts. The reason for higher percentage of small, medium and large cysts in the lungs is due to soft structure of the lung, while the higher yield of calcified cysts in liver could be attributed to relatively higher reticuloendothetial cells and abundant connective tissue reaction of the organ. The higher proportion of a small cysts may be due to immunological response of the host which might preclude expansion of cysts life (Torgerson et al., 1998; Lahmar et al., 1999; Larrieu et al., 2001; Torgerson, 2002).In examining the condition of cyst fertility and viability, the findings of 67.9% sterile, 4.3% fertile and 26% calcified were examined. It may be concluded that most of the cysts in cattle were infertile. The variation infertility rate among different species and in different geographical zone could be due to the differences in the strain of *E. granulosus* (McManus, 2006). Most of the hydatid cysts from cattle are considered to be sterile (Thompson et al., 1984).

In comparison of the fertility rate among the organs, it was higher in lungs than in liver. It has been stated that the relatively softer consistency of the lung tissue allows easier development of the cysts and the fertility rate of hydatid cysts may show a tendency to increase with advancing the age of the hosts (Himonas et al., 1987). This may be attributed to reduced immunological compatibility of animals at their older age of infection. The variation between tissue resistances of the infected organs may also influence the fertility rate of hydatid cysts. The fertility rates observed in this study are law; however, could serve as potential source to infection and per-petuate the cycle of hydatidosis when infected animals are slaughtered and raw offal fed to dogs and also leftovers during backyard slaughter are eaten by wild carnivores. It was observed that majority of the households had livestock, including cattle, sheep, goat, and donkeys, which are the intermediate host of the parasite. Similarly, many households had dogs and cats, which were not dewormed regularly and were managed under free-range system. In this study, hydatidosis was found to incur financial loss that is estimated to be 302,023.60 ETB to the cattle industry per year. Previous studies have also estimated the annual financial losses associated with bovine hydatidosis from other parts of the country. For instance, Bekele and Butamo (2011) reported 410,755.90 ETB (30,202.64 US$), Kebede et al. (2009b) reported 25,608 ETB, Regassa et al. (2010) reported 1,791,625.89 ETB. The difference in the calculated economic loss in the various abattoirs is either due to the variation in the number of slaughtered animals or variation in the prevalence rate of hydatidosis or due to variation in the retail market price of organs. Based on our results, we suggest that bovine hydatidosis is among many of the livestock diseases prevailing in the country incurring both direct and indirect losses to the cattle industry due to condemnation of organs and reduced live weight gain of infected cattle.

In Kombolcha ELFORA Industrial Abattoir, condemned organs and carcasses are buried and some of them are further processed for animal feed. This may reduce the contamination and infection in dogs and other carnivores. Therefore, the decreased prevalence of hydatidosis in this study as compared to the previous studies conducted in different areas of the country could be due to proper disposal of the condemned organ where dogs have no access to infected organs. However, there are backyard slaughter practices during local festivities, the tradition of offering uncooked infected offals to pet animals around homestead, poor public awareness about the diseases, and the habit of disposing dead wild or domestic animals unburied and left open for scavenging carnivores creates favorable condition for maintaining the life cycle of *E. granulosus* in stray dogs and wild carnivores in the area.

Conclusion

This study highlights the need for thorough investigation to obtain appropriate and more accurate information on the incidence of hydatidosis/echinoccosis in humans, dogs, both in domestic and wild animals to determine the scope and type of relevant control options. In spite of the low magnitude of infection detected, there seems to be an existing socioeconomic condition favorable for hydatidosis, and hence, it remains one of the most important diseases warranting serious attention for prevention and control actions.

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