Bovine Hydatidosis: Prevalence and Economic Significance at Asella Municipality Abattoir, Asella, South Eastern Ethiopia

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Abstract
A cross-sectional study was conducted in cattle slaughtered at the Asella municipal abattoir to determine the prevalence of bovine hydatidosis and to assess its economic significance. Anatomical distribution, size, fertility, sterility and viability of cysts were also determined. A total of 498 carcasses were inspected; of which 189 (37.9%) were found infected with hydatid cysts. Aged cattle (($p<0.001$, OR= 6.571); cattle originated from East Shoa ($p < 0.01$, OR = 3.776) and poor body condition scores ($p < 0.001$, OR= 3.842) had shown to have a significant effect on the prevalence of bovine hydatidosis. Of the total visceral organs examined, 129 were found harboring one or more hydatid cyst. The highest percentage of cysts were encountered in lungs (68.71%) followed by liver (27.89%) while the rest were in kidneys (1.70%), spleen (1.02%) and heart (0.68%) origins. From the total of 294 hydatid cysts recovered, 144(48.98%), 131(44.56%) and 19(6.46%) were found to be small, medium and large size, respectively. Of the total hydatid cysts collected, 54(18.37%) were fertile, 143(48.64%) sterile and 97(32.99%) were calcified. Likewise, out of the 54 fertile cysts subjected for viability test, 30 (55.56%) were viable. A greater proportion of fertile and viable cysts were found in the lungs than in other organs. The annual economic losses from organ condemnation and carcass weight loss due to bovine hydatidosis at Asella municipality abattoir were estimated to be 3,660,599.65 Ethiopian Birr (ETB). It was concluded that this zoonotic cestode deserves due attention on proper disposal of infected offals in abattoir and general public awareness about the diseases to safeguard public health and economic losses, and that further studies are needed on genotyping, epidemiology and public health importance of *Echinococcus granulosus* in the study area.
Keywords: Abattoir, Asella, Bovine, Economic significance, Hydatidosis, Municipality Prevalence, south eastern Ethiopia**.**

INTRODUCTION

Hydatidosis / Echinococcosis is cosmopolitan Zoonosis caused by the larval stages of cestodes belonging to the genus Echinococcus (Family *Taeniidae*) (Urquhart et al., 2007). Larval infection (Hydatidosis) is characterized by long term growth of metacestode (hydatid cysts) in the intermediate host (Gracey, 1986). The two major species of veterinary importance are *E.granulosus* and *E. multilocularis* which cause *Cystic Echinococcosis* (CE) and *Alveolar Echinococcosis* (AE), respectively (Eckert and Deplazes, 2004; OIE, 2004). Both CE and AE are serious diseases, the latter especially so, with a high fatality rate and poor prognosis if managed inappropriately. Hydatid cysts of *E. granulosus* develop in internal organs (mainly the liver and lungs) of humans and intermediate hosts (herbivores such as sheep, horses, cattle, pigs, goats and camels) as unilocular fluid filled bladders (Schantz, 1990). The definitive host of the parasite, *E. granulosus*, is dog which harbor the adult parasite and excrete the parasite eggs along with their feces, while livestock and human are the intermediate hosts (Okua et al., 2004). Hydatid disease is characterized by cyst containing numerous tiny protoscolices that most often develop in the liver and lungs and also develop in the kidneys, spleen, nervous tissue, bone and other organs (Magambo et al., 2006).

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 disease has been reported from many African countries including Uganda, Rwanda, Burundi, Togo, Nigeria, Zimbabwe, Zair, Kenya and South Africa (Gracey, 1986). Hydatidosis of cattle is the major disease frequently reported from various parts of Ethiopia (Kebede et al., 2009; Zewdu et al., 2010; Regassa et al., 2010).

Hydatidosis is a serious concern in public health which is much more common on the rural areas of Ethiopia where dogs and domestic animals live in a very close association usually sharing the same accommodation with human. Man becomes infected by an accidental injection of onchospheres from contaminated food, water and environments, where as the dog is the commonest final host (FH) which becomes infected by ingestion of infected offals (Urquahart *et al.* 2007). The disease has also an adverse effect on the productivity of animal with huge economic losses to the level of which has not until now been precisely determined (Polydorous, 1981). In addition to its direct effect on livelihood of domestic animals and man, *Echinococcus* damaged the economy. The economic losses due to this parasite is considerable when one considers its effect on the productivity of animals, the condemnation of infected viscera or even the whole carcass and costs incurred for its control (Hubbert et al, 1975).

Several workers have shown the importance and existence of the disease in Ethiopia in different aspects (Abunna et al., 2008; Tolosa et al., 2009). To establish the prevalence and estimated economic loss of hydatid disease in animals depend on mainly collection of data in slaughter houses. Prevalence of the disease in domestic food animals' show that sheep are the most commonly infected domestic intermediated host (IH), though cattle and various other types of live stock are also affected. Infection does not usually result in any sign in live stock (soulsby, 1986).

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., 2009).

Various researchers indicated that hydatidosis is widespread in Ethiopia with great economic and public health significance (Jobre et al., 1996; Sissay et al., 2008; Kebede et al., 2009; Kebede, 2010). However, there is no current information regarding the prevalence and economic significance of hydatidosis in cattle in Asella, Central Ethiopia. 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 prevalence of the hydatidosis in cattle; (2) studying the localization and fertility, viability/sterility rates of hydatid cysts and (3) estimating the annual economic loss attributed to the condemned organs and due to weight loss in Asella, municipality abattoir, Central Ethiopia.

MATERIALS AND METHODS

Study Area

The study was conducted in Asella town, Arsi zone of Oromia regional state, south easten Ethiopia. It is located at 175 km south east of Addis Ababa at 6^0 59' to 8^0 49' N and 38^0 41' to 40^o 44' E. The area has an altitude ranged from 2500 to 3000 meter above sea level, receiving mean annual rainfall and temperature of 200-400 mm and 22.5°C respectively. Agricultural production system of the area is mixed (livestock and crop production) farming system. Asella is one of the most populous town in the country with important multi directional trade routes. The town has one municipality Abattoir that supplies the inspected meat to more than 160,000 inhabitants and 49 legally registered butcheries. Backyard slaughter is also significant in spite of some pressure from the government authorities to ban this activity. The major livestock reared in Asella town and its surrounding is cattle, sheep, goats, equine and poultry.

Study animals

The study was conducted on cattle breeds that originated from Asella district and neighboring provinces such as East Shoa, Arsi, West Arsi and Borena zone of Oromia regional state, Ethiopia. The breeds of cattle slaughtered were the local zebu. The animals included in the study consist of cattle of different age, sex, breed and origin.

Study design

A cross-sectional study type was carried out that involves active abattoir surveys, cyst fertility/sterility tests by collecting data on events associated with hydatidosis to establish prevalence of bovine hydatidosis and to estimate economic losses incurred due to hydatidosis in cattle slaughtered at Asella municipality abattoir.

Sampling method and sample size determination

Regular visits were made to the Asella municipality abattoir. During each visit systematic random sampling method was employed to select study animals. The sample size was determined using a method recommended by Thrusfield (2007):

$$n = \frac{1.96^2 \times Pex\,(1 - Pexp)}{d^2}$$

Where: n = required sample sample size,
Pexp = expected prevalence, and
d = desired absolute precision

Since there is no reasonable research done in these areas so far; the sample size was calculated using a method recommended by Thrusfield (2007), with 95% confidence interval, at 5% desired absolute precision and expected prevalence of 50%. Accordingly; the total numbers of sample required for this study were 384 cattle, but to increase the precision level a total of 498 cattle were sampled randomly and examined for the presence of hydatid cyst.

Study Methodology

Ante-mortem Examination

During ante-mortem inspection, each of the study animals was given an identification number (with a paint mark on their body). Age, sex, breed, origin and body condition scoring of the study animals were recorded. Estimation of age was carried out by examination of the teeth eruption using the approach forwarded by De

Lahunta and Habel (1986). The body condition scoring was classified into three categories as poor, medium and good according to Nicholson and Butterworth (1986).

Post-mortem examination

A total of 498 cattle presented for slaughter at Asella municipality 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 cysts were found. The liver, lungs, heart, spleen, kidneys, 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 carefully, placed in clean containers separately (in organ basis), labeled and taken to the laboratory for further examination (cyst characterization).

Identification of cysts was done in the parasitology laboratory of Asella woreda veterinary clinic based on the criteria described by Soulsby (1982). During the study, detailed records of the individual animal data, number, size, location, fertility and viability tests of the hydatid cysts were made.

Cyst characterization

Individual cysts were examined for fertility, viability and sterility. In brief, the pressure of the cyst fluid was reduced by using a sterile hypodermic needle. Then, the cyst was incised with a sterile scalpel blade and the content was poured into a glass petridish and 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 (Macpherson et al., 1985). Fertile cysts were further subjected to viability test. A drop of fluid from cyst containing the protoscolices were placed on the microscope glass slide and covered with cover slip and observed for amoeboid like peristaltic movements with ×40 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 (Macpherson et al., 1985; Smyth and Barret, 1980). Sterile hydatid cysts are characterized by their smooth inner lining, usually with a slight turbidity of the contained fluid and typical calcified cyst that produced a gritty sound feeling upon incision (Parijia, 2004; Solusby, 1982).

Economic loss assessment

An attempt was made to estimate the economic significance of hydatidosis on cattle slaughtered at Asella Municipality abattoir. 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).

Direct losses

The mean retail market price of condemned organs due to hydatidosis such as lung, liver, heart, kidney and spleen were estimated based on the information gathered from local butchers in Asella town. The economic losses due to total/partial condemnation of organs due to bovine hydatidosis was then assessed using the formula recommended by Ogunrinade and Ogunrinade (1980).

$ACL_1L_2HKC = P\ (CSR \times PL_1c \times L1c) + P\ (CSR \times PL_2C \times L_2C) + P\ (CSR \times PHC \times HC) + P\ (CSR \times PKC \times KC) + P\ (CSR \times PSC \times SC)$.

Where ACL_1L_2HKSC = Annual cost of live, lung, heart, kidney and spleen condemned.

CSR – Average number of cattle slaughtered per year at abattoir.

P – Prevalence of Hydatidosis at Asella municipality abattoir.

PL_1C – percentage of lungs condemned.

L_1C – mean cost of one lung in Asella town.

PL_2C – percentage of liver condemned.

L_2C – mean cost of one lung in Asella town.

PHC – percentage of heart condemned.

HC – mean cost of one heart in Asella town.

PKC – percentage of kidney condemned.

KC – mean cost of one kidney in Asella town.

PSC – percentage of spleen condemned.

SC – mean cost of spleen in Asella town.

Indirect loss

A 5 % estimated carcass weight loss due to bovine hydatidosis as described by Polydorous (1981) was used for the indirect loss. One hundred twenty five kg was taken as a dressing weight for local zebu cattle (ILCA, 1979) to calculate the direct loss by the formula described below as recommended by Ogunrinade and Ogunrinade (1980). Hence, the annual economic loss due to carcass weight reduction as a result of bovine hydatidosis was calculated as:

ACW = CSR x P x BC x CL x 126 kg.

Where, ACW = annual loss from carcass weight loss due to Hydatidosis.

CSR = Average no of cattle slaughtered per annum in Asella.

CL = Carcass weight loss in individual cattle due to Hydatidosis.

BC = Average market price of 1kg beef in Asella town.

P = prevalence rate of hydatidosis at Asella abattoir

Total economic loss (TL)

The total economic loss can be evaluated by considering both direct loss (DL) and indirect loss (IL) as: TL = DL + IL

Data analysis

Data obtained from ante-mortem and postmortem findings in the abattoir and further characterization of cysts in the laboratory was coded and uploaded into Microsoft Excel spreadsheet. After validation, data were transferred to STATA version 11.0 for Windows (Stata Corp. College Station, TX, USA) for analysis. Prevalence was calculated as a percentage value. The economic losses were estimated by the formula recommended by (Ogunrinade and Ogunrinade, 1980; Polydorou, 1981; Torgerson and Dowling, 2001). The association between the independent factors and response variable was evaluated using the Chi-square test ($\chi 2$). Multivariate logistic regression analyses were used to analyze the effects of different potential risk factors on the prevalence of hydatidosis. The 95% confidence interval and a p-value < 0.05 was considered statistically significant.

RESULTS

Prevalence of hydatidosis

Out of the total 498 carcasses inspected, 189 (37.9%) were infected with hydatid cyst with varying numbers involving different visceral organs (lung, liver, heart, spleen and kidney). Of the 498 carcasses examined, 477 were from males and 21 from females. Although more males than females were examined, the occurrence of infection was more in female (12/21, 57.14%) than male (176/477, 37.00%) carcasses. However, there was no statistically significant difference (p > 0.05) in prevalence of bovine hydatidosis between sexes of animals (Table 1). Higher bovine hydatidosis prevalence was observed within the older cattle (greater than or equal to 5 years of old: 47.28%) whereas this parameter remained low in older cattle (less than 5 years of old: 12.88%). Statistical analysis showed that the disease was significantly associated with age (p < 0.001). The frequency of hydatid cyst was also significantly varied with origin (p < 0.05). Prevalence of bovine hydatidosis was significantly associated with the age groups (P<0.001), origin (P<0.05) and body condition scores (p < 0.001) while its association with sex of animal was not statistically significant (P>0.05) as presented in Table 1.

Table 1: Association of bovine hydatidosis with animal-level risk factors

Variables	Level (group)	No inspected	No infected (%)	*χ2(p*-value)
Age (year)	< 5	131	16 (12.88)	48.709(0.000)
	≥ 5	367	173 (47.28)	
Sex	Male	477	176 (37.03)	
	Female	21	12 (54.55)	2.604(0.107)
Origin	East Shoa	148	71 (48.32)	
	Arsi	131	49 (37.88)	
	Bale	98	37 (37.76)	15.073(0.005)
	Harar	83	25 (30.12)	
	Borena	35	7 (20.00)	
Body condition	Poor	65	37 (58.46)	
	Medium	270	107 (39.85)	19.661(0.000)
	Good	163	45 (27.44)	

Multivariable logistic regression analysis of risk factors associated hydatidosis

Logistic regression analysis of the effect of different risk factors on the prevalence of bovine hydatidosis is depicted in Table 2. Accordingly, age, origin and body condition significantly enhances the risk for hydatidosis infection. Hence, aged cattle (OR= 6.571, 95%CI: 3.718, 11.614), cattle originated from east Shoa (OR = 3.776, 95%CI: 1.483, 9.615) and poor body condition scores (OR= 3.842, 95%CI: 2.016, 7.324) were more likely to be infected with bovine hydatidosis than their counter parts.

Table 2: Multivariable logistic regression analysis of risk factors associated with hydatidosis

Factor	Hydatidosis Test result			Odds ratio		
	Total tested	**No.**	**Prevalence (%)**	**COR (95%CI)**	**AOR (95% CI)**	**P value**
Age (year)						
< 5	132		17 (12.88)	1	1	
≥ 5	368		174 (47.28)	6.067 (3.505, 10.504)	6.571 (3.718, 11.614)	0.000
Origin						
East Shoa	149		72 (48.32)	4.414 (1.716, 9.992)	3.776 (1.483, 9.615)	0.001
Arsi	132		50 (37.88)	2.700 (1.106, 6.591)	2.124 (0.826, 5.462)	0.118
Bale	98		37 (37.76)	2.686 (1.075, 6.715)	2.112 (0.806, 5.584)	0.128
West Arsi	83		25 (30.12)	1.909 (0.742, 4.910)	1.825 (0.670, 4.975)	0.239
Borana	35		7 (20.00)	1	1	
Body condition						
Poor	65		38 (58.46)	3.722 (2.041, 6.787)	3.842 (2.016, 7.324)	0.000
Medium	271		108 (39.85)	1.752 (1.151, 2.668)	1.827 (1.168, 2.589)	0.008
Good	164		45 (27.44)	1	1	

COR, Crude Odds Ratio; AOR, Adjusted Odds Ratio; CI, Confidence Interval; 1, Reference.

Anatomical distribution of hydatid cysts in different organs

During inspection of carcasses, hydatid cysts were recovered from different organs with varying proportions. The highest numbers of cysts were encountered in lungs (68.71%) followed by liver (27.89%), kidneys (1.70%), spleen (1.02%) and heart (0.68%) origins as depicted in Table 3.

Table 3: Distribution of hydatid cysts in different organs among infected animals

Organs inspected	Total No. of organs infected	Relative prevalence (%)	Total No. of cysts recovered	Relative prevalence (%)
Lung	81	62.79	202	68.71
Liver	39	30.23	82	27.89
Kidney	4	3.10	5	1.70
Spleen	3	2.33	3	1.02
Heart	2	1.55	2	0.68
Total	**129**	**100**	**294**	**100**

Cyst Characterization

Cyst size

Individual cyst diameter was measured and classified into three groups as small (< 4cm), medium (4-6 cm) and large (> 8cm) according to Oostburg et al. (2000). Out of the 294 hydatid cysts collected, 144(48.98%) were small, 131(44.56%) medium and 19(6.46%) large as illustrated in Table 4.

Table 4: Cyst size and organ involvement frequency distribution among infected animals

Organs involved	Small (%)	Medium (%)	Large (%)	Total (%)
Lung	91 (45.05)	97 (48.02)	14 (6.93)	202 (68.71)
Liver	47 (57.32)	31 (37.80)	4 (4.88)	82 (27.89)
Spleen	1 (20.00)	3 (60.00)	1 (20.00)	5 (1.70)
Kidney	3 (100.00)	-	-	3 (1.02)
Heart	2 (100.00)	-	-	2 (0.68)
Total	**144 (48.98)**	**131 (44.56)**	**19 (6.46)**	**294 (100)**

Fertility and sterility of cyst

Out of the total cysts tested for fertility, 46 (22.77%) cysts of lung and 8 (9.76%) cysts of liver origins had protoscolices detected and hence, fertile. The rest were either sterile or calcified (Table 5).

Table 5: Cyst fertility and sterility test among infected organs

Organs involved	Fertile cyst (%)	Sterile cyst (%)	Calcified cyst (%)	Total (%)
Lung	46 (22.77)	103 (51.00)	53 (26.24)	202 (68.71)
Liver	8 (9.76)	28 (34.15)	38 (46.34)	82 (27.89)
Spleen	-	3 (60.00)	2 (40.00)	5 (1.70)
Kidney	-	1 (33.33)	2 (66.67)	3 (1.02)
Heart	-	-	2 (100.00)	2 (0.68)
Total	**54 (18.37)**	**143 (48.64)**	**97 (32.99)**	**294 (100)**

Cyst Viability

Out of the total fertile cysts originating from lung and liver were tested for viability. The examination indicated that 27 cysts from lung and 3 cysts from liver origin had viable protoscolices showing the amoeboid like peristaltic movement (flame cell motility) and up on staining with 0.1% aqueous eosin solution, the viable protoscolices partially/totally excluded the dye while the dead ones take it up (Table 6).

Table 6: Viability status of fertile cysts collected from organs of cattle

Organ involved	Viable cyst (%)	Nonviable cysts (%)	Total (%)
Lung	27 (58.70)	19 (41.30)	46 (85.19)
Liver	3 (37.50)	5 (62.50)	8 (14.81)
Total	**30 (55.56)**	**24 (44.44)**	**54 (100)**

Economic loss Assessment

Direct financial loss from organs condemnation

The estimated annual loss of lungs, livers, hearts, kidneys and spleen condemned due to hydatidosis **= [**P(CSR x PL_1c x L1c) + P (CSR x PL_2C x L_2C) + P (CSR x PHC x HC) + P (CSR x PKC x KC) P (CSR x PSC x SC)**].** The mean price of one lung (L1c), liver (L_2C), heart (HC), kidney (KC) and spleen (SC) was 11.00, 40.00, 15.00, 13.00 and 8.00 ETB, respectively. The average number of cattle slaughtered per year at Asella municipality abattoir (CSR) was estimated to be 10,100. Hence, the estimated annual financial loss due to organs condemnation (ACL_1L_2HKC) = 37.9% (10,100 x 40.4% x 11) + 37.9% (10,100x 16.4% x 40) + 37.9% (10,100 x 0.4% x 15) + 37.9% (10,100 x 0.6% x 13) + 37.9% (10,100x 0.8% x 8) = 43,234.15 ETB.

Indirect loss from carcass weight reduction

The estimated annual cost of a carcass weight loss due to hydatidosis (ACW) = CSR x P x BC x CL x 126 kg = 10,100 x 37.9% x 5% x 150 x 126kg = 3,617,365.50 ETB.

The estimated annual economic loss from both direct and indirect losses equals the sum of the two, i.e. 43,234.15 + 3,617,365.50 = 3,660,599.65 Eth. Birr/annum. Hence, the total annual loss encountered due to hydatidosis in cattle slaughtered at Asella municipality abattoir was estimated at 3,660,599.65 ETB.

DISCUSSION

The current study revealed that an overall prevalence of bovine hydatidosis at Asella municipality abattoir was 38.2%. This result is in close agreement with the report of Kumsa (1994), who recorded 36.66% from Nekemte, western Ethiopia; Kebede et al. (2009), 34.05% from Bahir Dar, Northern thiopia and Khan et al. (1990), 38.9% from Pakistan. However, the present finding is higher than the findings of Regassa et al. (2009) (15.4%) in Hawassa, southern Ethiopia; Azlaf and Dakkak (2006) in Morocco (22.9%); Eisa et al. (1982) (19.14%) in Sudan and Dhote et al. (1992) (12.4%) in India. In other words, higher prevalence rates reported in other parts of Ethiopia and elsewhere [61% in Assela by Koskei (1998); 55.71% in Debrezeit (Abera, 2007) and 56.6% in Greece by Hi-Monas et al. (1994)]. The variation in prevalence reports of bovine hydatidosis could be attributable to the changes in the environmental and epidemiological factors, which could affect the rate of transmission of echinococcosis/ hydatidosis. Apart from the mentioned variables, factors such as, difference in culture, social activities, animal husbandry systems, lack of proper disposal of infected organs and attitude towards dogs contribute to the variations in prevalence rates (Arbabi and Hooshyr, 2006). The relatively high prevalence rates may be related to the presence of favorable factors such as intermixing of dogs and domestic animals usually sharing the same accommodation which favors the propagation and maintenance of high level of infection in the area.

The prevalence of bovine hydatidosis varied significantly ($p<0.001$) among age groups of animals, where higher prevalence was recorded in older cattle (47.28%) than younger (12.88%). Aged cattle had shown to have a significant effect ($p<0.001$, OR= 6.571, 95%CI: 3.718, 11.614) on the prevalence of bovine hydatidosis. This finding is in agreement with reports of Azlaff and Dakkak (2006) and Regassa et al. (2009) from different corner of the world. This could be due to the fact that aged animals have longer exposure time to eggs of *E. granulosus*, hence increased possibility of acquiring the infection (Himonas, 1987; Elemo et al., 2017). Moreover, most of the cattle slaughtered at Asella municipality abattoir were aged and probably culled from productivity, hence anticipated as one of the reason contributing to the high prevalence of the disease in the area.

The prevalence of hydatidosis was significantly associated with origin of animals ($p < 0.001$). Thus, prevalence was relatively higher in east Shoa (OR = 3.776) than their counters. Significant association of origin with bovine hydatidosis was reported by other author (Kebede et al., 2009). The difference in prevalence reports of hydatidosis in the present study could be due to differences in proper disposal of infected organs and attitude towards dogs contribute to the variations in prevalence rates (Arena, 1985).

The prevalence of hydatidosis was higher in cattle having poor body condition score (58.46%) followed by medium (39.85%) and good (27.44%). Odds ratio indicated that animals with poor body condition score were 3.842 times more likely to be exposed to hydatidosis than those with good body condition. Polydrous (1981) explained that in moderate to severe infections, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss.

In the current study, hydatid cysts were found predominantly in lung and liver representing 68.71 and 27.89%, respectively. In similar abattoir studies done previously, the liver and the lungs are the most commonly infected organs by hydatid cysts in cattle (Njoroge et al., 2002; Eckert and Deplazes, 2004; Abebe, 2007 and Haftay, 2008). The reason is that they are the first large capillary fields encountered by the blood borne migrating *Echinococcus* onchospheres (Angus, 1978 and Urquhart et al., 2007). Moreover, majority of the cattle are slaughtered at older age, at this stage the liver capillaries are dilated and hence, most oncospheres directly pass to the lungs (Arena, 1985; Elemo et al., 2017).

Majority of the cysts recovered during the study were found to be small (48.98%) and large (44.56%) sized cysts. Similar findings were reported by Kebede et al. (2009), Abera (2007) and Hagos (2007). The reason for the considerable and high proportion of the small size cysts could be associated with the host immunological response, which might prevent further expansion of the cyst (Torgreson et al., 1998 and Larrieu et al., 2001).

The overall percentage of fertile cysts in the present study was 18.37%. This finding was comparable to the fertility rate of 19.3% of Zelalem (2008) and 19% of Tolosa et al. (2009). However, this finding is quite lower compared to the finding of 70% in Great Britain, 96.9% in South Africa and 95% in Belgium (Arena, 1985). Yet much lower fertility rates of 1.76% around Wolayita Soddo, southern Ethiopia (Kebede et al., 2009), was reported. The variation in fertility rates among different geographical zones could be related to differences in strain of *echinococcus granulosus* and the age of the intermediate hosts (McManus, 2006). The fertility rate of lung (22.7%) was higher than that of liver (9.76%). This might be due to the softer consistency of the lung tissues that allows easier development of the cyst. Moreover, the variation between tissue resistances of the affected organs may also influence the fertility rate of cysts. In liver, hosts reaction may limit fertility rate of hydatid cysts (Larrieu et al., 2001). Of the fertile cysts tested for viability, 55.56% have viable protoscolices and this indicates that cattle are an important intermediate host for the perpetuation of the life cycle of the parasite (Himona et al., 1994; Elemo et al., 2017).

Current study revealed that the annual economic loss due to bovine hydatidos at Asella municipality abattoir from organs condemnation and carcass weight loss, estimated to be about 2,108,181.60 ETB. This is comparable with the report of Regassa et al. (2010) who estimated the annual financial losses of 1,791,625.89 ETB. This figure is by far greater than the previous study by Kebede et al. (2009) who reported 25,608 ETB. The differences in the estimated economic losses in various abattoirs/ regions might be due to the variations in the number of slaughtered animals, prevalence the disease and variations in the retail market price of organs (Polydorous, 1981). The disease has an adverse effect on the productivity of animal with huge economic losses to the level of which has not until now been precisely determined (Polydorous, 1981).

CONCLUSIONS

In the present study, bovine hydatidosis was prevalent in cattle slaughtered at Asella municipality abattoir implies that cattle are an important intermediate host for the perpetuation of the life cycle of the parasite. Moreover, our investigation provided estimated annual economic losses due to bovine hydatidosis. The relatively higher prevalence of hydatidosis in cattle and financial losses due to the disease in cattle indicates that hydatidosis appear to be potential zoonosis and economically important disease in the study area. To reduce infection and prevent transmission of the disease to cattle, attention should be given to proper disposal of infected offal in abattoir, general public awareness about the diseases, control of stray dogs' population and cestocidal treatment for household dogs in the study area. Further studies are needed on genotyping, epidemiology and public health importance of *Echinococcus granulosus* in the study area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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