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Prevalence and Economic Significance of Hydatidosis in Cattle Slaughtered at Dodola Municipality Abattoir, West Arsi Zone, Oromia, Ethiopia

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Abstract: Hydatidosis is an economically important parasitic disease of cattle responsible for considerable economic losses in the cattle industry, mainly through condemnation of organs. A cross-sectional study was conducted from November 2018 to April 2019 at Dodola municipal abattoir with the objective of assessing the prevalence, organ distribution and cyst characterization of bovine hydatidosis as well as estimating the financial loss occurred due to the disease. Out of the total 768 examined animals selected through systematic random sampling, 309 (40.2%) cattle were found harboring one or more hydatid cysts. There was statistically significant association ($p<0.05$) between age, sex, breed, origin and body condition of the cattle slaughtered and the occurrence of hydatidosis. The prevalence of hydatidosis was higher among animals >5 years old (51.06%), animals brought from Dodola (47.9%) and animals with poor body condition (63.8%). From infected (309), 176 (22.9%), 17 (2.2%), 15 (2%), 10 (1.3%) and 5 (0.7%) had hydatid cysts only in their lung, liver, spleen, heart and kidney, respectively while the rest 86 (27.8%) had multiple organ infections. From the total 692 cysts collected for laboratory examination, 284 (41.04%), 229 (33.09%) and 179 (25.9%) were small, medium and large cysts, respectively and 285 (41.2%) fertile, 230 (33.2%) sterile and 177 (25.6%) calcified cysts were obtained. Of 285 fertile cysts, 180 (63.1%) and 105 (36.8%) were viable and non-viable cysts, respectively. The total annual financial loss from organ condemnation and carcass weight due to bovine hydatidosis at Dodola municipal abattoir was estimated to be 860, 489.8 ETB. This study revealed that hydatidosis is economically important disease of cattle with implication of public health importance. Hence, application of the conventional preventive and control measures like detail meat inspection, proper disposal of infected organs and control of stray dogs are recommended to control the disease.

Key words: Hydatid Cyst · Organ Condemnation · Zoonotic Risk

INTRODUCTION

Ethiopia is the second most populous country in Africa, located in the Horn of Africa and known to have the largest livestock population in the continent, Africa [1]. Livestock sector contributes about 16.5% and 35.6% of Ethiopian national GDP and agricultural GDP, respectively [2]. However, Ethiopian livestock potential is not suitably utilized, chiefly owing to the existing traditional management systems, limited genetic potential and rampant diseases [3].

Animal diseases are among the factors responsible for poor production and productivity of livestock's thereby leading to a lesser contribution to the Ethiopian national economy [4]. Parasitic diseases are considered as a major obstacle in health and product performance of livestock consequently leading to economic loss and public health hazards in Ethiopia [5]. Among known parasites, hydatidosis is one of the neglected cyclozoonotic disease affecting humans and their livestock, thereby causing significant socioeconomic impacts through reducing meat production, carcass and

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organ condemnations and public health impacts via morbidity and mortality of human beings, mostly in developing countries [6].

Hydatidosis is a zoonotic parasitic disease caused by cestode parasites in the genus *Echinococcus*, dog tape worm, in which domestic intermediate hosts (IH) are the major reservoirs for its transmission to human beings. Echinococcus is classified under the class (Cestoda), order (Cyclophyllidea), genus (Echinococcus) and species (*E. granulosus*) [7, 8]. The distribution of *E. granulosus* is higher in developing countries, especially in rural communities where there is close contact between the dog, the definitive host and various domestic animals, which may act as intermediate hosts [9].

The life cycles of *E. granulosus* can be classified as domestic, involving the domestic dog as the principal definitive host and various species of domestic ungulates as intermediate hosts; or as sylvatic, involving wild carnivores and ungulates as hosts (the wildlife cycle) [10]. Man becomes infected accidentally by ingestion of the eggs of the parasites through hand, foods, drink or other materials contaminated with dog's feces. The adult cestode inhabits the small intestine of definitive hosts and produces eggs containing infective onchospheres which are released into the environment with feces. After the ingestion of eggs by an intermediate hosts the larval stage, metacestod or hydatid cyst, develop in the liver, lungs and also develop in the kidneys, spleen, heart and other organs [11]. The pathology of *E. granulosus* cysts in intermediate hosts, with primary infections, is typically asymptomatic, except a few cases of long-standing and heavy infections [12].

Echinococcus granulosus infection is endemic in East and South Africa Central and South America, South Eastern and Central Europe, Middle East, Russia and China [13]. *E. granulosus* has been reported in most countries of Africa. Previous and recent reports described the endemic occurrence of *E. granulosus* in dogs and livestock [12, 13]. Njoroge *et al.* [14] found prevalence of 19.4%, 3.6%, 4.5% and 61.4% in cattle, sheep, goats and camels, respectively in Kenya. EImahadi *et al.* [15] reported prevalence of 45%, 3% and 7% in camels, cattle and sheep, respectively in Sudan.

Ethiopia has been noted for a high prevalence of hydatid disease since 1970s [16] during which it was reported that it occurs "time and again" in all parts of the country. Hydatidosis is prevalent in cattle and small ruminant population of Ethiopia in a range of 3.1% to 72.44%. In some regions, the prevalence of hydatid cyst was found to be 46.5%, 25.7% and 24.3% in cattle and 2.45%, 25.7% and 0% in sheep slaughtered in Debre Zeit, South Omo and Gondar Abattoirs, respectively [17]. The abattoir based studies in different parts of the Ethiopia showed that hydatidosis is an endemic and prevalent parasitic disease. In Adama, the prevalence of hydatidosis in goat and sheep slaughtered at Adama abattoir was 46.8%, 29% and 6.7%, respectively [18]. Insufficient facilities for slaughter houses, lack of adequate health education, economic instability and financial restrictions for control and prevention and the presence of large number of stray dogs are paramount importance for high prevalence of CE in many parts of Ethiopia. Backyard slaughtering of domestic animals particularly cattle, sheep, goats and feeding stray dogs with condemned organs are common practices in Ethiopia [19, 20].

Investigating the status of hydatidosis is important for assisting the prevention and control measures and also used for minimizing the economic impact and public health hazards of the disease. However, the current status of the prevalence and financial loss of bovine hydatidosis at Dodola Municipality Abattoir was not well known. Therefore, the objectives of this study were to assess the prevalence and its associated risk factors of bovine hydatidosis, to estimate the financial losses of bovine hydatidosis, to show the distribution of hydatid cysts in different organs among cattle slaughtered at Dodola town municipal abattoir and to gather base line data that will help in designing the control and prevention strategies of hydatidosis in cattle slaughtered at Dodola town Municipal Abattoir, West Arsi Zone, Oromia, Ethiopia.

MATERIALS AND METHODS

Description of the Study Area: The study was undertaken from November 2018 to April 2019, at Dodola Municipality Abattoir, West Arsi Zone, Oromia, Ethiopia. Dodola town is located at 328km Southeast of Addis Ababa. The area is found at a longitude of 39°11'E and latitude of 6°59'N and the altitude with an elevation ranging from 2362 to 2493 meters above sea level. It is the administrative center of Dodola woreda. The climatic pattern of the study site is typical of that of the central part of the central plateau with main wet season from June to September usually preceded by a less pronounced wet period in March and April. The mean annual rainfall is 940 mm. The rainfall increases with altitude. The minimum and maximum temperatures are 3.8°C and 24.8°C, respectively. The farming systems are mainly characterized by the presence of subsistence mixed

farming, of both livestock and agricultural crop production. Extensive system of livestock management predominate the area [21]. Dodola town has only one abattoir which is administered by the Dodola town Municipality.

Study Population: The study animals were presented to the abattoir from November 2018 to April 2019 for slaughtering. From those animals which were brought to the municipal abattoir, study animals were taken randomly and routinely inspected for hydatidosis. They were transported to the abattoir using vehicles and on foot. Almost all of the cattle slaughtered were brought from adjacent or nearby major livestock markets of different districts. This population comprised of cattle of different body condition, sex and age groups. Most of the study animals were males though females with reproductive problem, poor performance and end productive life were also encountered. The main livestock markets which serve as a major source of animals for Dodola municipal abattoir includes Adaba, Gedeb, Dodola and Nensebo districts and their surrounding areas.

Study Design: A cross-sectional study was conducted to determine up to date information on the prevalence, economic impact and cyst characteristics of bovine hydatidosis at Dodola town municipal abattoir. Systematic (three slaughtering days per week) visits were made to Dodola town municipal abattoir from November 2018 to April 2019. All cattle presented on each visit day were examined. Information's like origin, body conditions, age, sex and organ distribution as well as nature of the cyst was recorded using standard recording format before and after slaughter, respectively.

Sample Size Determination: Determination of sample size was done according to Thrusfield [22] and taking a 50.78% expected prevalence which was reported by Tolosa *et al*. [23], 95% confidence interval and 5% desired absolute precision. Thus:

$$N = \frac{1.96^2 P\exp(1 - p\exp)}{d^2}$$

where: N= is the required sample size, Pexp = is the expected prevalence (50.78%), d = is the desired absolute precision (0.05), z = value at 95% (1.96)

Accordingly, the calculated sample size was found to be 384. However, to increase the precision of the study, a total of 768 cattle were randomly sampled and examined in the study for a better conclusion. Sampling of cysts for physical size and fertility characterization study was done purposively by taking the most prominent superficial hydatid cysts from randomly selected hydatidosis positive bovine visceral organs.

Active Abattoir Survey

Ante-Mortem Examination: During ante mortem inspection, every study animals were given an identification number with a paint mark on their body. Age, sex, breed, body condition scoring and origin of the study animals were also recorded. Estimation of age was carried out by examination of the teeth eruption using the approach forwarded by De Lahunta and Habel [24]. Two age groups were considered; less or equal to 5 years and greater than 5 years old. The body condition scoring was classified into three categories as poor, medium and good according to Nicholson and Butterworth [25]. Interview was also conducted to obtain data on animal's origin. Finally, apparently healthy animals were passed for slaughter during the study period.

Post-Mortem Examination: During post mortem examination organs especially lung, liver, spleens, kidney, heart, muscle and head part as a whole were systematically inspected for the presence of hydatid cyst by applying the routine meat inspection procedure of primary examination followed by secondary examination [26]. The primary examination involves visualizations of the organs whereas secondary examination involves further incision of each organ into pieces and whenever evidence of the cyst was found, it was classified as live or calcified and the cyst distribution to organs was also recorded. Cysts were carefully removed from each infected organ of all affected animals and collected in clean containers, to allow the number and characteristics of the cysts to be determined. Individual cysts were carefully incised and examined for presence of protoscolices.

Fertility and Viability Tests: Positive samples were taken to the laboratory for the cyst identification, fertility and viability tests were performed. Of the collected hydatid cysts, individual cysts where carefully incised and examined for protoscoleces, which are similar to the appearance of white dots on the germinal epithelium; such cysts were characterized as fertile cysts; fertile cysts was subjected to viability test. A drop of the sediment containing the protoscoleces was placed on the microscopic glass slide and covered with a cover slip and

observed for amoeboid like peristaltic movements. For clear vision, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscoleces in hydatid fluid on the microscopic slide with the principle that viable protoscoleces should completely or partially exclude the dye while the dead ones took it up. Furthermore, infertile cysts were further classified as sterile or calcified [27].

Cyst Size Determination: The size of hydatid cysts on the affected organs was measured using the approach forwarded by Schantz [28]. The size of the diameter of the collected hydatid cyst was measured and classified as small (diameter less than 4 cm), medium (diameter between 4 and 8 cm) and large (diameter greater than 8 cm).

Financial Loss Analysis: To study the economic losses due to hydatidosis in cattle, both direct and indirect losses were considered. The calculation of the direct losses is based on condemned organs (lung, liver, heart, spleen and kidney) and the indirect losses were assessed on the basis of live weight reduction due to hydatidosis.

Direct Financial Loss: The direct economic loss was calculated on the basis of number of condemned organs like (lung, heart, kidney, liver and spleen), annual slaughter rate of the abattoir and average market prices for each of the organs. Average market price was determined based on the interview made with 15 personnel of the abattoir and butchers. Average market price of lung, liver, heart, spleen, kidney and a kilogram of beef at Dodola town was found to be 15, 30, 10, 5, 15 and 250 Ethiopian Birr (ETB), respectively. The average annual slaughter of Dodola municipal abattoir was estimated based on 2 years retrospective abattoir data, which was found to be 1322 cattle. The annual cost of the condemned organs due to bovine hydatidosis was assessed by the following formula set by Ogunirale [29].

$$LOC = (NAS \times Plu \times Cplu) + (NAS \times Phr \times Cphr) + (NAS \times Pli \times Cpli) + (NAS \times Psp \times Cpsp) + (NAS \times Pkid \times Cpkid)$$

where,

LOC = Loss due to organ condemnation
NAS = Mean number of cattle slaughtered annually
Plu = Percent involvement of lung
Cplu = Current mean retail price of lung
Phr = Percent involvement of heart
Cphr = Current mean retail price of heart
Pli = Percent involvement of liver
Cpli = Current mean retail of liver
Psp = Percent involvement of spleen
Cpsp = Current mean retail of spleen
Pkid = Percent involvement of kidney
Cpkid = Current mean retail price of kidney.

Indirect Financial Loss: Indirect losses were assessed on the basis of live weight reduction due to hydatidosis, average carcass weight of local zebu cattle, prevalence of bovine hydatidosis and average local price of one kg of beef in Dodola town were obtained from butchers during the study period. The average annual slaughter rate of cattle at Dodola town municipal abattoir was estimated from retrospective data of the last two years. A 5% estimated carcass weight loss due to bovine hydatidosis described by Getaw *et al*. [18] was taken into account to determine the carcass weight loss. Average carcass weight of an Ethiopian zebu was taken as 126 kg, as estimated by International Livestock Center for Africa [30]. Thus, indirect loss was calculated as:

$$LCWL = NAS \times Ph \times CPB \times 5\% \times 126\ kg$$

where:

LCWL = Loss from carcass weight loss,
5% = Estimated carcass weight loss due to hydatidosis
NAS = Average number of cattle slaughtered animals
Ph = Prevalence of hydatidosis
CPB = Current average price of 1 kg beef at Dodola town (300 Birr)
126kg = Average carcass weight of adult Zebu cattle.

Finally, the total economic loss was calculated by considering the loss from both organ condemnation and carcass weight loss.

Therefore, Total Economic Loss = LOC (Direct Loss) + LCWL (Indirect Loss)

Data Management and Analysis: Data for this particular study was collected using pre-designed ante-mortem and post mortem format as per the set objectives of explanatory variables such as age, origin and body condition of the animals. The data obtained was coded in Microsoft excel database system and subjected to descriptive statistics in order to assess the magnitude of the difference of comparable variables using SPSS version 17 software of computer program. Statistically significant association between variables was considered to exist if the p-value is less than 0.05. The prevalence of cystic

echinococcosis was computed with descriptive statistics (percentage). Chi-square statistical test was applied to determine the associations between the various potential risk factors and the prevalence of hydatid cyst in the examined animals. The economic loss from condemnation of organs and weight loss in the abattoir was made by taking the current selling price of organs and beef into consideration.

RESULTS

Overall Prevalence: From a total of 768 cattle slaughtered at Dodola town municipal abattoir, 309 (40.2%) of them were harbored hydatid cyst(s) in one or more of their visceral organs.

Risk Factors and Prevalence of Hydatidosis: Prevalence of bovine hydatidosis was determined based on the risk factors such as; age, body condition and origin of the study animals. All of these risk factors were statistically significant ($p<0.05$) in this study.

The prevalence of bovine hydatidosis according to different age groups of animals slaughtered at Dodola municipal abattoir were 19 (19.0%) and 290 (43.4%) in animals of less or equal to five years (≤5 years) and greater than five years old (>5 years), respectively. The rate of infection within different age groups was proportionally higher in cattle of above five (5) years old and the age specific prevalence among age groups were statistically significant ($p<0.05$) as indicated on Table 1. Statistically significant difference ($p>0.05$) in hydatid cyst prevalence was observed between breed types of animals in which higher prevalence was observed in local breeds (44.1%) than cross breeds of cattle (24.7%).

The prevalence of bovine hydatidosis according to the origin of the study animals slaughtered at Dodola municipal abattoir were 213 (47.9%), 18 (40.9%), 12 (36.4%) and 66 (26.8%) in Dodola, Gedeb Asasa, Adaba and Nensebo districts, respectively. The difference in the prevalence of bovine hydatidosis among animals of different origin was statistically significant ($p<0.05$) (Table 1).

The prevalence of bovine hydatidosis in line with body condition score were, 178 (63.8%), 76 (28.4%) and 55 (24.9%) in poor, medium and good body condition scores, respectively. The rate of infection within the body condition score were proportionally higher in cattle of poor body condition and the prevalence among them were statistically significant ($p<0.05$) (Table 1).

Organ Involvement and Distribution of Cysts: From the total 234 cattle harboring hydatid cysts in their organs, single and multiple infections of organs were recorded during post-mortem examination. The total number of animals harboring hydatid cyst only in one of their visceral organ was found to be 223 (72.2%) and the total number of animals harboring hydatid cyst in their two or three visceral organs was 86 (27.8%) (Table 2). In this study, lungs were found to be the most commonly affected organ than other visceral organs. Out of the total 309 cattle found positive, 176 (22.9%) had cysts merely in lungs, 17 (2.2%) in liver, 15 (2.0%) in spleen, 10 (1.3%) in heart and 5 (0.7%) in kidney, whereas, the rest of 86 (27.8%) infections involved multiple organs (Table 2).

Cyst Characterization

Size of Cysts: A total of 424 cysts of lung, 210 cysts of liver, 12 cysts of spleen, 39 cysts of heart and 7 cysts of kidney origins were taken and subjected to cyst characterization. Out of the total hydatid cysts recovered from infected animals, 284 (41.04%) were small, 229 (33.09%) were medium and 179 (25.9%) were large cysts (Table 3). Systematic measurement of the cysts based on size in different organs showed that majority of medium-sized (35.6%) and large (32.5%) cysts were found in lungs, while a large number of small sized cysts (53.8%) were found in the liver.

Fertility Status: During Laboratory examination, Out of the collected 692 hydatid cysts, 285 (41.2%), 230 (33.2%) and 177 (25.6%) were fertile, sterile and calcified cysts, respectively and a total of 219 (51.6%) fertile , 132 (31.1%) sterile and 73 (17.2%) calcified cysts in the lung, 53 (25.2%) fertile, 60 (28.6%) sterile and 97 (46.2%) calcified cysts in the liver, 2 (16.7%) fertile, 6 (50%) sterile and 4 (33.3%) calcified cysts in the spleen, 10 (25.6%) fertile, 27 (69.2%) sterile and 2 (5.1%) calcified cysts in the heart and 1 (14.3%) fertile, 5 (71.4%) sterile and 1 (14.3%) calcified cysts of kidney were recorded during laboratory examination (Table 4).

Viability Status: The recorded fertile cysts were subjected to viability test. From the total 285 fertile cysts, 180 (63.1%) and 105 (36.8%) were viable and non-viable cysts, respectively (Table 5). The cyst condition in terms of organ involvement was also recorded. Out of fertile cysts obtained from the lung (219), 140 (63.9%) and 79 (36.07%) were viable and nonviable cysts, respectively. From the total 53(18.6%) fertile cysts recorded in the liver,

Table 1: Overall prevalence of bovine hydatidosis with potential risk factors in Dodola Municipal Abattoir, West Arsi Zone, Oromia Regional State, Ethiopia

Variables	Examined	Infected	Prevalence (%)	Chi-square (χ^2)	p-value
Age Groups					
Group 1 (≤5 Years)	200	19	19.0	21.6	0.002
Group 2 (>5 Years)	568	290	43.4		
Breed type					
Local	614	271	44.1	19.4	0.001
Cross	154	38	24.7		
Sex					
Male	740	292	39.5	5.07	0.024
Female	28	17	60.7		
Body Condition					
Poor	279	178	63.8		
Medium	268	76	28.4	101.8	0.001
Good	221	55	24.9		
Origin of Animals					
Dodola	445	213	47.9		
Gedeb Asasa	44	18	40.9	29.4	0.001
Adaba	33	12	36.4		
Nensebo	246	66	26.8		
Total	768	309	40.2%		

Table 2: Number of animals harboring hydatid cysts in one or more of their organs

	Total Number of Animals		
Organ	Examined	No. of Cases	Percentage
Lung Only	768	176	22.9
Liver Only	768	17	2.2
Spleen Only	768	15	2.0
Heart Only	768	10	1.3
Kidney Only	768	5	0.7
Liver and Lung	768	45	5.9
Liver and Spleen	768	4	0.5
Liver and Kidney	768	9	1.2
Lung, Liver and Spleen	768	8	1.0
Liver, Spleen and Kidney	768	6	0.8
Lung, Liver, Spleen and Heart	768	4	0.5
Lung, Liver, Spleen and Kidney	768	10	1.3
Total	768	309	40.2%

Table 3: Size of hydatid cysts collected from infected organs of positive animals

	Number and Percentage of Cysts			
Infected Organ	Small	Medium	Large	Total
Lung	135(31.8)	151(35.6)	138(32.5)	424(61.3)
Liver	113(53.8)	59(28.09)	38(18.09)	210(30.3)
Spleen	3(25)	7(58.3)	2(16.7)	12(1.7)
Heart	26(66.7)	10(25.6)	3(7.7)	39(5.6)
Kidney	4(57.1)	2(28.6)	1(14.3)	7(1.01)
Total	284(41.04)	229(33.09)	179(25.9)	692

Table 4: Fertility status of cysts collected from infected animals

Infected Organ	Fertile Cyst (%)	Sterile Cyst (%)	Calcified (%)	Total (%)
Lung	219(51.6)	132(31.1)	73(17.2)	424(61.3)
Liver	53(25.2)	60(28.6)	97(46.2)	210(30.3)
Spleen	2(16.7)	6(50)	4(33.3)	12(1.7)
Heart	10(25.6)	27(69.2)	2(5.1)	39(5.6)
Kidney	1(14.3)	5(71.4)	1(14.3)	7(1.01)
Total	285(41.2)	230(33.2)	177(25.6)	692

Table 5: Viability status of fertile cysts collected from organs of infected cattle

Infected Organ	Viable Cyst	Non-viable cyst	Total
Lung	140(63.9)	79(36.07)	219(76.8)
Liver	13(24.5)	40(75.5)	53(18.6)
Spleen	0(0.00)	2(100)	2(0.7)
Heart	0(0.00)	10(100)	10(3.5)
Kidney	0(0.00)	1(100)	1(0.4)
Total	180(63.1)	105(36.8)	285

13 (24.5%) were viable and 40 (75.5%) were non-viable cysts. Of the total 2 (0.7%) fertile cysts in the spleen, all of them were non-viable cysts. Of the total 10 (3.5%) fertile cysts in the heart, all of them were non-viable cysts. A fertile cyst which was obtained from kidney (1) was non-viable cyst.

Analysis of Financial Loss: Due to the aesthetic value, zoonotic importance and to break the life cycle of the *Echinococcosus granulosus* parasites, all infected organs were condemned. Thus, a total of 243 lungs, 103 livers, 47 spleens, 14 hearts and 30 kidneys of sampled cattle were condemned totally. The determined average market price of cattle lung (15 Birr), liver (30 Birr), spleen (5 Birr), heart (10 Birr) and kidney (15 Birr) in Dodola town during the study period, annual slaughter rate of cattle at Dodola Municipal abattoir (1322 cattle's), overall prevalence of hydatidosis (40.2%) and percentage involvement of organs (liver, lung, heart, spleen and kidney), average local price of 1 kg of beef in Dodola town (250 Birr), a 5% estimated carcass weight loss due to bovine hydatidosis and average carcass weight of an Ethiopian zebu (126 kg) were used to calculate the economic loss occurred due to bovine hydatidosis. Accordingly, direct loss and indirect loss were calculated as;

LOC = (NAS x Plu x Cplu) + (NAS x Pli x Cpli) + (NAS x Psp x Cpsp) + (NAS x Phr x Cphr) + (NAS x Pk x Cpk)

= (1322 x 0.6 x 15) + (1322 x 0.23 x 30) + (1322 x 0.1 x 5) + (1322 x 0.03 x 10) + (1322 x 0.07 x 15)

= 11, 898+9, 121.8+661+396.6+1, 388.1

= 23, 465.5 Ethiopian Birr/annum of direct loss

LCWL = NAS × Ph × CPB × 5% x 126 kg = 1, 322 × 0.402 × 250 x 0.05 × 126

= 837, 024.3 ETB/annum of indirect loss

Total economic loss= 23, 465.5 + 837, 024.3= 860, 489.8 Ethiopian Birr (ETB). This result shows that bovine hydatidosis causes higher financial losses through carcass weight reduction and organ condemnation in the study area.

DISCUSSION

Hydatidosis is known to be important in livestock and public health in different parts of the world. There had been different magnitude records of hydatidosis in cattle with low, medium and high rates of occurrences. The current study revealed that the overall prevalence of bovine hydatidosis at Dodola Municipal abattoir was found to be 40.2%. This prevalence was higher than the reports of Kebede *et al*. [31], Tsegaye [32], Mersie [13], Njoroga *et al*. [33], Bizuwork *et al*. [34] and Ulutas *et al*. [35] which are 15.2% in Northwestern Ethiopia, 7.2% in Debre Brhan, 20.5 in Eastern Ethiopia, 19.4% in Turkana Kenya, 17% in South wollo and 16.6 in Turkey, respectively. However, our finding was lower than the prevalence of 63% in Bale Robe by Sinshaw [36], 59.9% in Bahir Dar by Gesese [37], 50.78% in Dodola by Tolossa *et al*. [23], 48.7% in Ngorongoro, Tanzania by Ernest *et al*. [38] and 82% in Argentina by Larrieu *et al*. [39]. This may be described to difference in environmental conditions, livestock intensity and livestock movement. On the other hand this might also be due to the difference in availability and repetition in contact among the infected intermediate and final hosts and vice- versa that contributes to the differences in prevalence rates.

In this study, an assessment was made to establish relationship between two age groups (≤5 years and >5 years) of the study animals and hydatid cyst count. Significant difference ($p<0.05$) was obtained between prevalence of hydatidosis and age groups of study animals. Animals with greater than five years were found to have higher hydatid cyst count and increased age of the animals was probably a reason of the effect of relatively high cyst burden. This could be mainly due to the fact that aged animals have longer exposure time to eggs of *Echinococcus granulosus* in addition to weaker immunity to combat against the infection and as Soulsby [27] explained, the hydatid cyst develops slowly over several months, forming an outer laminated membrane and an inner membrane called the germinal layer.

The prevalence of bovine hydatidosis by the origin of slaughtered cattle was assessed and statistically significant difference ($p<0.05$) was found which indicate that geographical regions play an important role in distribution of the cysts. In this study, animals brought from Dodola area have high prevalence rates followed by Nensebo area. This could be due to the difference in the socio-economic status and animal husbandry practices of the community and agro ecology of the areas from where the animals brought for slaughter. This finding was similar with the report of Mekuria *et al*. [40] and Nasr and Pal [41].

Statistically significant association ($p<0.05$) was recorded between body condition and occurrence of hydatidosis. Higher infection of hydatidosis was registered in animals that had poor body condition 178 (63.8%) followed by medium 76 (28.4%). This may be due to hydatidosis causes reduction in weight gain and growth. Symptoms can occur a long time after infection, sometimes months or years later and may not be symptoms at all [42]. This asymptomatic and chronic nature of the disease causes unexplained weight losses.

From the examined internal organs for the presence of hydatid cyst, the highest proportions were observed in lungs 176 (22.9%) and followed by liver 17 (2.2%). In the study area, majority of slaughtered cattle were older/aged (>5years). As a result, the liver capillaries are dilated which allows the passing of most oncospheres to the lung and also due to entrance of hexacanth embryo to the lymphatic circulation and then carried to organs (via thoracic duct) such as heart and lung. For this reason, lung can be affected before liver [43]. Nevertheless, there were also development of hydatid cysts in other organs such as liver, heart, spleen and kidney. This can be happened when oncospheres escapes directly into the general circulation. Therefore, the present study is in agreement with report of Alemu *et al*. [44] and also other studies conducted in different abattoirs of Ethiopia and other countries.

Through measuring the size of cysts systematically, higher numbers of medium sized (151(35.6%)) and large sized hydatid cysts (138(32.5%)) were found in lungs. This might be due to the softer consistency of the lung tissue that enabled the oncosphere to grow into larger hydatid cyst as well as the oncospheres reach the lung via thoracic duct and enter into lymphatic system. Although a higher number of calcified (46.2%) and small sized (53.8%) cysts were found in liver from the total recovered hydatid cysts. This might be due to the liver property which comprises presence of higher reticuloendothelial cells and abundant CT (connective tissue) together with prohibition of cyst expansion due to immunological response of the host [45].

In the current study, 284 (41.04%) small, 229 (33.09%) medium and 179 (25.9%) large hydatid cysts were obtained through measuring in an ordinary ruler out of the total hydatid cysts taken from infected animals (Table 3). The obtained higher number of small cysts than others might indicate infection of cattle as a result of heavy rainfall and continuous grazing in the past rainy seasons or it might be due to prohibition of cyst expansion due to immunological response of the hosts [44].

Out of the total 692 hydatid cysts recovered from hydatid positive animals for characterization purpose, 285 (41.2%), 230 (33.2%) and 177 (25.6%) were fertile, sterile and calcified cysts, respectively (Table 4). Around 219 (51.6%) fertile, 132 (31.1%) sterile and 73 (17.2%) calcified cysts in the lung and 53 (25.2%) fertile, 60 (28.6%) sterile and 97 (46.2%) calcified cysts were obtained in the liver. This finding agrees with the reports of Abdiselam [46] in Dire Dawa who obtained 92 (58.88%) fertile and 33 (21.15%) sterile cysts and Buzuayehu *et al*. [47] in Harar town, who obtained and reported higher proportion of fertile cysts.

The current study revealed the occurrence of fertile cysts to be 41.2%. This finding is lower than the percentage reported in Great Britain (70%), South Africa (96.9%) and Belgium (94%) [43]. However, it is slightly related with the report of 22% by Elmahdi *et al*. [15] in central Sudan. This variation might be due to strain difference of the causative agent, *E. granulosus*.

From fertile cysts (285) obtained from the lung, 180 (63.1%) and 105 (36.8%) were viable and nonviable cysts, respectively. Out of fertile cysts 53 (18.6%) obtained from the liver, 13 (24.5%) and 40 (75.5%) were viable and nonviable cysts, respectively. This finding showed the occurrence of viable cysts from the examined fertile cysts of the lung and liver. The difference in fertility and viability status of the cysts in the organs might be due to the action of anthelmintic drugs on the organs and also due to the tissue resistance difference among organs in the growth of hydatid cysts [43].

The total economic loss due to bovine hydatidosis in Dodola municipal abattoir was found to be 860, 489.8 Ethiopian Birr. The present finding was lower than the report of total economic loss of 1, 791, 625.89 ETB by

Regassa *et al*. [48] in Hawassa municipal abattoir, loss of 160, 032.23 ETB by Zewdu *et al*. [49] in Gondar municipal abattoir and financial loss of 410, 755.90 ETB by Torgerson *et al*. [50] in Wolaita Sodo municipality abattoir. The variation might occurred due to the difference in the prevalence of bovine hydatidosis, average number of slaughtered cattle and variation in mean retail market price of organs in different places of Ethiopia.

CONCLUSION AND RECOMMENDATIONS

Hydatidosis is an important public health burden and causes substantial economic loss through decreasing livestock production and condemnation of offal's in slaughter houses of Ethiopia. Prevalence of bovine hydatidosis in the present study was found to be 40.2%. Lung and liver were the main organs condemned due to hydatid cyst. The highest numbers of cysts obtained were fertile cysts. Lung had higher proportion of fertile and viable cysts whereas liver had higher proportion of calcified and non-viable cysts. The annual financial loss due to organ condemnation and carcass weight loss in the study abattoir was high. Therefore, the problem warrants well organized control interventions. Based on the above conclusion the following recommendations were forwarded: The government should give attention towards building standard abattoirs with good facilities and control backyard slaughtering houses. Keeping dogs in close association with animals and humans should be supported with regular treatment. Public awareness and education programs should be created on the transmission cycle of hydatidosis. Feeding of infected offal's to dogs and other canine species should be avoided and all infected visceral organs should be either burnt or buried properly. Reduction of stray dog's population should be undertaken to reduce the risk of hydatidosis to animals and humans.

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