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Assessment of prevalence, fertility, viability and economic loss of Bovine Hydatidosis at Addis Ababa Abattoirs Enterprise, Ethiopia.

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Abstract

A cross sectional study was conducted from November 2013 to April 2014 to determine the prevalence, cyst fertility, viability and economic importance of hydatid cyst in cattle slaughtered at Addis Ababa Abattoirs Enterprise. Individual animals were selected using systematic random sampling methods. Out of the total 486 cattle slaughtered and examined at Addis Ababa Abattoirs Enterprise, 98 (20.164%) cattle were infected with hydatidosis. Out of the total 98 infected cattle, 57 (58.16%) were infected their lung, 24 (24.5%) their liver, 2 (2.04%) their kidney, 1 (1.02%) their heart and 14 (14.28%) were infected both their lung and liver. Out of the total 361 collected cyst, the highest number 210 (58.17%) were found from their lung followed by liver 148 (40.99%), kidney 2 (0.55%), heart 1 (0.27%). Out of the total 361 cyst collected, 63 (17.45%) were fertile, 210 (58.17%) were sterile and 88 (24.38%) were calcified. Cyst from lung origin was highly fertile. The higher prevalence was found in cattles having poor body condition which was 44 (50%) followed by medium body condition 35 (26.12%) and good body condition 19 (7.196%). The total annual economic loss due to organ condemned and carcass weight loss at Addis Ababa Abattoirs Enterprise was estimated to be 38, 577, 974.8 ETB (1, 95, 0352.6188 USD). It can be concluded that hydatidosis is endemic and prevalent in cattle in the study area. Age and body condition of the animals are the major associated risk factors for hydatidosis infection. Therefore, effort should be made to control the transmission of hydatidosis from slaughterhouse by the safe disposal of infected organs.

Keywords: Abattoir, Addis Ababa, cyst fertility and viability. Economical loss, Hydatid cyst,

Introduction

Agriculture mainly crop and livestock production is the mainstay of the Ethiopian economy employing approximately 85% of the total population. Livestock production accounts for approximately 30% of the total agricultural GDP and 16% of national foreign currency earnings [1].

Ethiopia has the largest livestock population in Africa, with an estimated 49.3 million of cattle, 26.1 million of sheep and 21.7g million goats, 7.55 million of equines and 2.3 million of camels [2]. However, the contribution from these huge livestock resources to the national income is disproportional due to several factors. Diseases are among the factors responsible for poor production and productivity. Parasitic diseases are considers as a major obstacle in the health and

production performance of livestock. Studies conducted recently in abattoirs of various locations indicate that *Echinococcus granulosus* which is a causative agent of hydatidosis is wide spread in Ethiopia with great economic and public health significant [3].

The metacestodal larval stage of the dog tapeworm *Echinococcus granulosus* is the causative agent of hydatid cyst. *Echinococcus gronulosus* also called dog tapeworm or hydatid worm. Hydatid cyst is recognized as one of the main helminthic Zoonotic disease affecting both humans and animals in different parts of the world [4]. It is found throughout the world and causes considerable financial losses, in many countries of the world [5-7]. These parasites are endemic in North and East Africa, West and Central Asia, China, South America, North America and Australia [8]. The worldwide distribution of hydatid cyst is mainly due to its easy adaptability to different species of domestic and wild animals [9].

Factor governing the prevalence of hydatidosis in a given locality may be associated with prevailing specific social, cultural, environmental and epidemiological conditions. It has a considerable socio economic impact in countries where livestock industry is an important segment of agricultural sector and when livestock production is based mainly on extensive grazing system [10]. It's significance is higher in developing countries especially in rural communities where there is close contact between dogs which are a definitive host and various domestic animals which are intermediate host [6].

The different strains of *E. granulosus* infect various species of domestic and wild animals that play different roles in the life cycle and epidemiology of the parasite. In human diseases consequence include poor quality of life, cost for medical treatment, loss of opportunity for income generation and mortality. The adult *Echinococcus gronulosus* in the definitive host causes severe enteritis the infected definitive hosts are carriers of the parasite where as in intermediate hosts the animals are asymptomatic which causes chronic heavy sheep infection [9].

Despite the large efforts that have been put into the research and control of echinococcosis, it still remains a disease of worldwide significance. Fragmentary works have been done on the prevalence and economic importance of hydatidosis in Ethiopia; however there are few studies that have been conducted on fertility and viablity of hydatid cysts in Addis Ababa Abattoirs. This study is designed to assess the current prevalence and economical loss due to hydatidosis in the study abattoir. Therefore, the objectives of this study were to estimate the prevalence, fertility and economic loss of hydatidosis and to assess important associated factors of bovine hydatidosis in cattle slaughtered at Addis Ababa Abattoirs Enterprise.

Materials and Methods

Study area

The study was conducted at Addis Ababa Abattoirs Enterprise from November 2013 to April 2014. Addis Ababa is a capital city of Ethiopia, which is located at 9°1'48' North latitude and 38°44'24' East longitude. It is located in central highlands with an average altitude of ranging from 2000-3000 m above sea level. The annual rainfall of the area is about 1089 with mean annual temperature of 15.9°c. The maximum and minimum temperature during winter is 23°c and 6° and during summer 24°c and 10°c respectively. It has 60.1% annual relative humidity, which ranges from 49% in Februarys to 82% in July [11].

Study animals

The study animals were cattle brought to the Abattoirs to be slaughtered. On average about 800 cattles were slaughtered per day. It was difficult to precisely indicate the geographical origin of all animals slaughtered at the abattoir and relate the findings on hydatidosis to a particular locality. Nevertheless, the attempts made in this regards have disclosed that the majority of them were drawn from market oriented areas. It was difficult to know the exact origin of the animals. However, during the study period the slaughtered animals were mainly brought from highland areas of (Wollega, Wolaita, Jimma, Wollo, Debrebirhan, , Hararghe, and around Addis Ababa) and from lowland areas of (Borena, Awash, Afar, Nathrate and Shewarobit). However, all the slaughtered animals were male and local Zebu cattles.

Sampling and sample size determination

The sample size of the required species of animals was determined using the formula given by Thrusfield [12] and 95% confidence interval with required precision

of 5%. The expected prevalence of hydatidosis was taken from previous work of Zelalem e*t al.* [13] at Addis Ababa abattoir which was 19.7%. Individual animals were selected using systematic random sampling methods.

$$N=\frac{1.96^2(Pexp(1-Pexp)}{d^2}$$

Where n=required sample size
d=standard value
p=expected prevalence

The required minimum sample size was 243. However, in order to increase accurate precision, it was increased to 486 and they were selected using systematic random sampling methods.

Study Design

A cross sectional study was conducted from November, 2013 to April, 2014 to determine prevalence and economic loss with associated risk factors of bovine hydatidosis on cattles slaughtered at Addis Ababa Abattoirs Enterprise.

Study Methodology

Regular visit of the abattoirs twice a week was performed to carry out both ante mortem and post mortem inspection of cattle slaughtered at Addis Ababa Abattoirs Enterprise.

Ante mortem examination

Pre-slaughter animals were inspected to determine their origin, body condition, age, sex and breeds. Each studied animals were given an identification number (with a paint mark on their body). Age, sex, and body condition scoring of the study animals were also recorded. Estimation of age was done by the examination of the teeth eruption [14, 15]: two age groups were considered; above 5 years and below 5 years. Body condition scoring was estimated as described by Nicolson and Butterowrth, [16] classified in to three; good, medium and poor.

Post mortem examination

During post mortem examination, visceral organs which are Liver, lung, kidney, heart and spleen were examined by visual inspection, palpation and incision when necessary. The presence of hydatid cyst and affected organs were recorded.

Each cyst is then collected in ice box and then transferred to Yeka Animal Health laboratory for examination to identify those cysts which were fertile, viable and non-viable. The pressure of the cyst fluid was reduced by using sterile needle. Then the cyst was incised with a sterile scalpel blade and the content was poured in to a petridish and examined microscopically (40X) for the presence of protoscolices. Cyst which contains protoscolices was considered as fertile. Fertile cysts were further subjected to viability test. The viability of protoscolices was assigned by the amoeboid like peristaltic movements with (40×) objective lenses. For clear vision a drop of 0.1% aqueous eosin solution was added in hydrated fluid on microscope slide with the principle that viable protocolices should completely or partially exclude the dye while the dead ones take it up. Sterile cysts characterized by fluid filled cysts where as calcified cyst produced a gritty sound feeling up on incision [17].

Economic Analysis

The Annual economic loss due to hydatidosis in cattle slaughtered at Addis Ababa Abattoirs Enterprise was estimated by considering condemned organs due to bovine hydatidosis and 5% estimated carcass weight loss due to bovine hydatidosis described by Polydorou [18]. Average carcass weight of an Ethiopian zebu cattle was taken as 126 kg, as estimated by International Livestock Center for Africa [19]. The direct economic losses of bovine hydatidosis was calculated according to the formula set by Ogunrinade and Ogunrinade [20]. 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). To calculate cost of condemned edible organs and carcass weight loss, twelve different meat sellers were interviewed randomly to establish the price per unit organ of lung, liver, kidney, heart and spleen was determined. Average price was drawn out from that data and this price index was later used to calculate the meat loss in terms of Ethiopian birr (ETB). Average annual slaughter rate of cattle in Addis Ababa Abattoirs Eterprise was estimated based on retrospective analysis of data recorded from five years.

DL= (NAS * PHLU * CPLU)+(NAS * PHLI * CPLI) + (NAS * PHHXCPH)+(NAS * PS * PHS * CPS)+(NAS * PHK * CPK)

DL = Direct economic Loss; NAS = Average number of cattle slaughtered annually; PH = Prevalence rate of hydatidosis; PHLU = Prevalence rate of lung hydatidosis; CPLU = Current average price of lung; PHLI = prevalence of liver hydatidosis; CPLI = current average price of liver; PHH = Prevalence of heart hydatidosis; CPH = current average price of heart; PHS = Prevalence of spleen hydatidosis; CPS = current average price of spleen; PHK = Prevalence of kidney hydatidosis; CPK = current average price of kidney.

Annual economic losses due to carcass weight loss = Ns x Ci x Pa [18]. Where Ns=Total number of animals slaughtered and positive for hydatidosis; Ci= Carcass weight lost in individual animals; Pa=Average market price of a kg of beef in Addis ababa.

Data Analysis

The data obtained from the study site were coded and stored into Microsoft excel soft ware program and analyzed using SPPS software version 16.0 and associated risk factors which were related to occurrence of hydatidosis were investigated using chi-square test.

Results

Prevalence

Prevalence of hydatid cyst in different visceral organs of affected animals.

Out of the total 486 cattle slaughtered at Addis Ababa Abattoirs Enterpries 98 (20.16%) cattle were infected with hydatid cyst, harboring one or more cyst in different visceral organs such as lung, liver, heart, spleen and kidney. Out of the total 98 cattle 57 (58.16%) were infected their lung, 24 (24.49%) infected their liver, 2 (2.04%) their kidney, 1 (1.02%) their heart and 14 (14.28%) infected both their lung and liver (Table 1).

Table 1: Distribution of hydatid cyst in different visceral organs of slaughtered castles.

Organ infected	No examined	No of infected (%)	Proportion from infected animals (%)
Lung only	486	57 (11.7)	58.16
Liver only	486	24 (4.9)	24.49
Kidney only	486	2 (0.4)	2.04
Heart only	486	1 (0.2)	1.02
Spleen only	486	0 (0)	0
Lung an liver	486	14 (2.8	14.29
Total	486	98 (20.16)	100

Table 2. Prevalence of hydatid cyst based on different factors

Factors		No examined	No infected (%)	X^2	P value
Body condition	Poor	88	44 (50)	61.925	0.000
	Medium	134	35 (26.12)		
	Good	264	19 (7.19)		
Origin	Highland	311	71 (22.8)	4.714	0.318
	Low land	175	27 (15.4)		
Age	<5 years	151	26 (17.2)	11.977	0.53
	>5 years	335	72 (21.49)		

Prevalence of Hydatid cyst based on Body conditions of slaughtered cantles.

Cattle having poor body condition had the highest prevalence 44 (50%) followed by cantle having medium body condition 35 (26.12%) and good body condition 19 (7.196%) (Table 2). Therefore, the above table shows that there was a statistically significant association between body condition and hydatidosis infection ($P < 0.05$) in that cattle with poor body conditions were highly infected.

Prevalence of hydatidosis based on origin of cattles slaughtered at AAAE

A prevalence of 14.6 % and 5.56% was recorded between animals originated from highland and lowland areas, respectively. There was no a statistically significant difference ($P > 0.05$) between animals origin.

Cyst characterization

Out of the total 361 collected cyst 210 (58.17%) were from lung, 148 (40.99%) were from liver, 2 (0.55%) from kidney and 1 (0.28%) were from their heart. Out of the total 361 cyst collected and examined 51 (14.1%) cyst from lung and 12 (3.3%) cyst from liver were fertile. Whereas 135 (37.39%) cyst from lung 72 (19.94%) cyst from liver, 2 (0.55%) cysts from kidney and 1(0.28%) cyst from heart were sterile whereas concerning calcification 24 (6.65%) cyst from lung and 64 (17.73%) cyst from liver were calcified (Table 3).

Table 3: Classification of hydatid cyst based on fertility or sterility of cyst.

Organ	Fertile cyst (%)	Sterile cyst (%)	Calcified cyst (%)
Lung	51 (24.29%)	135 (64.29%)	24 (11.43%)
Liver	12 (8.10%)	72 (48.65%)	64 (43.24%)
Kidney	0 (0.00)	2 (100.00%)	0 (0.00)
Heart	0 (0.00)	1 (100.00%)	0 (0.00)
Total	63 (17.45%)	210 (58.17%)	88 (24.38%)

Cyst viability

Out of the total 63 fertile cyst which were examined for viability test a total of 21 cyst were viable, 16 cysts from lung and 5 cysts from liver were shown a peristalitic like movement up on staining with 0.1% aqueous eosin solution. The viable protoscolices exclude the dye while the dead ones take it up (Table 4).

Table 4: Viability and non-viability test of cysts

Organ	viable cyst	Non -viable	Total
Lung	16 (31.37%)	35 (68.63%)	51
Liver	5 (41.67%)	7 (58.33%)	12
Total	21 (33.33%)	42 (66.67%)	63

Table 5: Amount of cyst collected from different visceral organs of 98 infected cattles.

Organ	No cyst collected	Prevalence (%)
Lung	210	58.17
Liver	148	40.9
Kidney	2	0.5
Heart	1	0.28
Spleen	0	0.00
Total	361	100%

Economic loss

Loss due to organ condemnations was estimated to be 810875.899997 ETB annually and due to carcass weight loss it was 37767098.88ETB. This was calculated from average market price of cattle liver (40 birr), cattle lung (10 birr), cattle heart (30 birr) and cattle kidney (15 birr), annual slaughter rate of cattle and prevalence of hydatidosis per lung, liver, kidney and heart as well as 5% estimated carcass weight loss. Therefore, the total annual economic loss due to hydatidosis in cattle slaughtered at AAAE was estimated by adding both direct and indirect financial loss. Therefore, the total annual economic loss was estimated to be 38577974.8 ETB (1950352.6188 USD).

Discussion

The current overall prevalence of hydatidosis in cattle slaughtered at AAAE during the study period was found to be 20.164%. This prevalence was comparable with previous reported prevalence of hydatidosis in different region of Ethiopia. In the same study abattoir it was 19.7% by Zelalem *et al*., [13], in Dere Dewa 20.05% by Miheret *et al*., [21], in Adigrat Abattoir 18.61% by Alembirhan [22]. However, it was lower than the reported prevalence of bovine hydatidsis in Ambo 29.69% by Endrias *et al.*, [23] and in Gonder 28% by Endalew and Nuradis [24], However it was higher than the studies conducted, in Dessie 13.61% by Melaku and Lukas [25], in Mekele 17.5% by Gebre meskel and Kalayous, [26].

The variation in prevalence of hydatidosis from place to place may be due to difference in strains of *E.granulosus* that exist in different geographical location [17]. Other factors may be due to difference in culture, social activity and attitude to day in difference region [27]. In most rural communities dogs which are the principal factor for the disease transmission are used as a source.

There was a variation of prevalence between ages. The prevalence was higher in cattles of above 5 years old which 14.81% from the total examined cattles. Whereas the prevalence in below 5 years old was 5.35%. This finding was in agreement with the report of Zelalem [13] and Endrias *et al*, [23]. This could be mainly due to that old aged animals spend longer time to the eggs of *E. granulosus* and to lower immunity against the infection [13] where as the reason for lower prevalence in young cattle may be due to early culling of infected young cattle through slaughtering before they reach old aged [22].

The prevalence of hydatidosis was higher in cattle having poor body conditions which was 9.05% from the total examined cattle followed by medium body condition 7.20% and good body condition 3.9%. This finding was in agreement with the report of Zelalem, [13], Yechale, [28] and Endrias *et al*., [23]. This study indicates that the prevalence of hydatidosis was higher in lung (58.16%). Followed by liver which was (24.49%) from total infected cattles. Similar findings were reported from different regions of Ethiopia by Endalew and Nuradis [29] and from other counties such as from Iran by Radfar *et al.*, [30] and in Morocco by Azlaf and Dakar [27]. This may be due to the fact that cattle are slaughtered at older age during which period the liver capillaries are dilated and most cyst directly pass to the lung, additionally, it is possible for the hexacanth embryo to enter the systemic circulation and be carried via the lung may be infected before or instead of liver [30].

The study revealed that out of the total cyst collected (17.45%) were fertile, (58.17%) were sterile and (24.38%) were calcified. This finding was comparable with the work of Zelalem, [13] who reported from the same study abattoir of 19.3% fertile, (55.4%) sterile and (25.3%) calcified. However, the fertility rate was lower than the fertility rate which was reported (31.39%) by Yechale [28] in Ambo. However, the fertility percentage was higher than the fertility rate which was reported (16.9%) by Endalew and Nuradis, [24] in Gondor.

The variation in fertility rate in different might be due to difference in strain of *Echinococcus granulose*. A lung origin hydatid cyst was highly fertile which was (80.95%) than liver origin hydatid cyst which was (19.05%) from the total fertile cyst. This may be due to the softer consistency of the lung tissue allows the easier development of the cyst and the fertility rate of hydatid cyst may show tendency to increase with advancing age of the host [17]. Viable protoscolies were higher in lung origin hydrated cyst followed by liver origin. The viable protoscolices were (25.396%) in lung whereas (7.94%) in liver from the total fertile cyst. The overall prevalence of viable cyst was (33.33%). This indicates that cattle are an important intermediate host for the life cycle of the parasite.

The current study have shown that, the annual economic loss due to bovine hydatidosis at Addis Ababa Abattoir Enterprise from direct and indirect economic losses was estimated to be 38577974.7799 ETB ((1950352.6188 USD). which was higher than

previous report by Eckert [29] in Gonder 674,093.03ETB and 160,032.23 ETB economic loss in Ambo municipal abattoir by Endrias *et al.*, [23]. The difference in economic loss analysis in various abattoirs may be due to the variations in the prevalence of the disease, mean annual number of cattle slaughtered in different abattoirs and variations in the retail market price of organs [27].

Conclusion

It can be concluded that hydatidosis is endemic and prevalent in cattles in Ethiopia and age and body condition of the animals are the major associated risk factors for hydatidosis infection. The worldwide distribution of *Echinococcus gronulosus* is mainly due to its easy adaptability to different species of domestic and wild animals. It is found causing considerable economic losses in where there is a close contact between dogs and domestic animals. Based on the above conclusive points the following recommendations are forwarded:

- Further detailed epidemiological studies involving different species of livestock, and dogs, in different region of Ethiopia should be done and attempts to identify the species and strains of *Echinococcus granulosus* shoud be done.
- Effort should be made to control the transmission of hydatidosis from slaughterhouses by the safe disposal of infected offal.
- Public awareness should be created about the transmission and the life cycle of hydatid cysts.
- Regular deworming of pet dogs and control of stray dogs, proper food hygiene and personal hygiene, proper disposal of carcass either by burning or burring and avoiding the habit of giving raw offal to dogs must be encouraged.

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