African Journal of Basic & Applied Sciences 8 (5): 293-298, 2016
ISSN 2079-2034

DOI: 10.5829/idosi.ajbas.2016.293.298

Study on Prevalence and Economic Significance of Bovine Hydatidosis in Woliso Municipal Abattoir, West Shoa, Ethiopia

Kibruyesfa Bayou and Worku Tolera

Wollega University, College of Medical and Health Science,
School of Veterinary Medicine, P.O. Box: 395, Nekemet, Ethiopia

Abstract: A cross-sectional study was conducted on male cattle from June, 2015 to December, 2015 at Woliso Municipal Abattoir to determine the prevalence of hydatidosis and the financial losses attributed to it. Out of 390 cattle examined, 107 (27.4%) were found to harbor visible hydatid cysts. Significantly higher detection of the cysts ($p<0.05$) was seen in cattle with the age of greater than five years than less than or equal to five years old. From the 107 positive animals 50 (12.8%) had cysts only in their lungs, 15 (3.8%) only in their liver, 4 (1.0%) only in their heart, 5 (1.3%) in their lung and heart, 28 (7.2%) in their lung and liver and 5 (1.3%) in their lung, liver and heart. Regarding cummulative cyst distribution in individual organs, infections of the lung, liver and heart were 58.7%, 32% and 9.3% respectively. Moreover, assessment of annual economic loss due to bovine hydatidosis at Woliso Municipal Abattoir from offal condemnation and carcass weight loss was estimated at approximately 5,704.20 USD. Despite the moderate magnitude of infection detected currently, there seems to be an existing socioeconomic situation favorable for hydatidosis and hence, it remains one of the most important diseases warranting serious attention for prevention and control actions in Woliso district. Hence, promoting the establishment of intensive farms should be encouraged, creation of public awareness and control of stray dogs have paramount importance.

Key words: Cattle · Economic significance · Hydatidosis · Organ condemination · Prevalence

INTRODUCTION

Slaughterhouses are valuable sources for information about food borne and zoonotic diseases epidemiology, actual losses in meat production and the economical impacts for condemnations [1]. However, zoonotic threats prevention and control remains one of the major aspects in the developing countries [2].

Cystic echinococcosis, caused by the metacestode of *Echinococcus granulosus*, is one of the most common zoonotic diseases associated with huge economic losses and great public health significance worldwide [3]. Dog and other carnivores that harbor the adult cestode in their small intestine are the definitive hosts for the parasite, while a wide range of mammalian species including domestic ungulates and man act as intermediate hosts [4]. Consumption of offal containing viable hydatid cysts results in infection of definitive host carnivores including dogs that void eggs with their feces to contaminate the environment. The adult tapeworm in the definitive host is harmless unlike the hydatid cyst in the intermediate host that is responsible for immense economic and medical importance in infected hosts [5,6].

Factors governing the prevalence of hydatidosis are given locally being associated with prevailing specific social, cultural, environmental and epidemiological situations. Human behaviour plays a significant role in the epidemiology of the disease [7, 8]. Its high prevalence is closely connected to the following factions: continued widespread use of traditional techniques when raising ruminants (extensive or semi-extensive grazing), illegal slaughtering of animals and the presence of high number of dogs [9].

In Ethiopia, certain deeply rooted traditional activities could be commonly described as factors substantiating the spread of the disease in some areas of the country. These may include the widespread backyard animal slaughtering practice, the corresponding absence of rigorous meat inspection procedures and long standing habit of the most Ethiopian people to feed their dogs with

Corresponding Author: Kibruyesfa Bayou, Wollega University, College of Medical and Health Science, School of Veterinary Medicine, P.O. Box: 395, Nekemet, Ethiopia.

condemned offal which facilitate the maintenance of the perfect life cycle of *Echinococcus granulosus* and consequently high rate of infection of susceptible hosts [10].

As hydatidosis is the major cause of organ condemnation in most Ethiopian abattoirs and slaughter houses causing huge economic losses [11], information regarding the status of bovine hydatidosis in the study area was limited. Therefore, this study aimed to investigate the prevalence, organ distribution and estimation of the financial losses of hydatidosis in cattle slaughtered at Woliso Municipal Abattoir, Ethiopia.

MATERIALS AND METHODS

The Study Area: The study was carried out from June, 2015 to December, 2015 in Woliso Municipal Abattoir. Woliso town is located in the Oromia regional state, 114 km away from Addis Ababa, the capital city of Ethiopia. The district is covered by different vegetation and has an altitude, ranging from 1800-2200 metres above sea level. It receives an annual rain fall of 1400mm and 1600mm minimum and maximum respectively and has a minimum 10°C and a maximum 30°C daily temperature. The people in and around the area practice mixed farming system, that is crop production and livestock rearing. The livestock population in the area includes 212,261 bovine, 37,202 ovine, 49,220 caprine, 27,789 equine and 120,007 poulty [12].

Study Design and Study Animals: A cross-sectional study was carried out to assess the prevalence and economic significance of hydatidosis in cattle slaughtered at Woliso Municipality Abattoir and a total of 390 indigenous zebu cattle slaughtered during the study period were included in the study.

Sampling Method and Sample Size Determination: By using simple random sampling method and by considering 50% expected prevalence and 5% accepted error at 95% confidence interval, the sample size was calculated according to Thrusfield [13], using the formula: $N=1.96^2 *Pexp (1-Pexp)/d^2$; where, N=required sample size; Pexp=expected prevalence; d=desired absolute precision. $N=1.96^2 * Pexp (1-Pexp)/d^2$ $N=1.96^2 * 0.5(1-0.5)/ (0.05)^2 = 384 + 6 = 390$

Accordingly, the minimum sample size was 384 but in order to increase precision, 390 samples were taken for the study.

Data Collection Procedure: In the abattoir, regular visits were made to conduct antemortem examination of animals brought for slaughter and during this time, individually animals were identified with regard to sex and age and the results were recorded accordingly. Estimation of age was carried out by examination of the teeth eruption using the approach forwarded by De Lahunta and Habel [14]. Two age groups were considered; less than or equal to 5 years and above 5 years old. Since almost all the cattle presented to slaughtering in the study area were male and indigenous zebu, infection rate regarding sex and breed variation was not included.

All the animals were identified on the basis of enumerated marks on their body surface using ink and this marking was transferred to all visceral organs during postmortem inspection. Postmortem examination was made by routine visual, palpation and systematic incision methods of each visceral organ particularly the lung, liver, spleen, kidney and heart [15]. The presence of any hydatid cyst in the organs was recorded. All organs harboring hydatid cysts were totally condemned and judged according to guidelines on meat inspection for developing countries [16, 17].

Economic Loss Evaluation: The economic losses due to hydatidosis in cattle slaughtered at Woliso Municipal Abattoir were estimated by considering both; the direct and the indirect economic losses. The direct loss was estimated based on the condemned organs (lung, liver and heart) and the indirect loss was assessed on the basis of live weight reduction due to hydatidosis using the formulas described below. In calculating cost of condemned edible organs and carcass weight loss, eight different meat sellers were interrogated randomly to establish the price per unit organ and the collective price of lung, liver and heart 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 Woliso municipality abattoir was estimated based on retrospective analysis of data recorded from three years. A 5% estimated carcass weight loss due to bovine hydatidosis described by Endrias *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 [19].

Direct Loss from Organ Condemnation:

Annual economic loss = (PI1x TkxC1) + (PI2xTkxC2) + (PI3xTkxC3) [20].

Where:
PI1=Percent involvement of lung out of the total examined
PI2=Percent involvement of liver out of the total examined
PI3=Percent involvement of heart out of the total examined

C1=Average market price of lung
C2=Averagemarket price of liver
C3=Average market price of heart
TK=Average annual kill of bovines

Indirect Loss from Carcass Weight Loss: Annual economic losses due to carcass weight loss = Ns × Ci × Pa [21].

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 Woliso

Annual economic losses were calculated by adding both direct and indirect losses.

Data Analysis: Data obtained from antemortem and postmortem findings were entered into Microsoft Excel 2007 spreadsheet computer program and analyzed using SPSS version 20 software and hydatidosis prevalence was calculated as percentage by dividing the number of infected animals to the total number of animal samples. Pearson chi-square (X^2) test was employed to assess the existence of association between the result and different age groups of the study animals. The significance level was set at 95%.

RESULTS

Abattoir Survey: Out of the total 390 male cattle slaughtered and examined during the study period, 107 (27.4%) were found harboring hydatid cysts in one or more of their organs (liver, lung and heart). Analysis of the occurrence of infection with regard to different age groups was made by using proportions and chi-square test. The Age catagory showed significant difference ($p<0.05$) as regard to the abattoir based prevalence of bovine hydatidosis (Table 1).

Table 1: The proportions of the hydatid cysts in different age groups of animals

Age groups	Number of examined animals	Number of positive animals	Prevalence (%)	X^2(P-value)
≤5 years	91	24	6.1	6.9 (0.03)
>5 years	299	83	21.3	
Total	390	107	27.4	

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

Organs affected	Number of animals	Percent (%)
Lung only	50	12.8
Liver only	15	3.8
Heart only	4	1.0
Lung and heart	5	1.3
Lung and liver	28	7.2
Lung, liver and heart	5	1.3
Total	107	100

Table 3: Distribution of the hydatid cysts in different organs of the examined animals

Organs	Number of animals	Percent (%)
Lung	88	58.7
Liver	48	32
Heart	14	9.3
Total	150	100

The total number of animals harboring hydatid cyst only in one of their visceral organ was found to be 69 (64.5%) and the total number of animals harboring hydatid cyst in their two or three visceral organs was 38 (35.5%) (Table 2). In this study, lungs were found to be the most commonly affected organ. The relative proportion of hydatid cysts in each organ were recorded as 88 (58.7%) in lungs, 48 (32%) in liver and 14 (9.3%) in heart (Table 3).

Economic Loss Estimation (Financial Loss Evaluation)
Direct Economic Loss from Organ Condemnation: In the current study, a total of 88 lungs (58.7%), 48 livers (32%) and 14 Heart (9.3%) were condemned due to detection of hydatid cysts. The mean current unit prices of these organs in Woliso are 6.0, 70.0 and 6.0 ETB, respectively, while the mean current price of 1 kg beef is 120 ETB. Mean number of animals slaughtered annually at Woliso municipal abattoir was determined from the records of the last 3 year as 1680. Then, the annual economic loss due to organ condemnation is estimated as follows:

Annual economic loss due to organ condemination = (PI1x TkxC1) + (PI2xTkxC2) + (PI3xTkxC3) [20] = (0.587 x 1680 x 6) + (0.32 x 1680 x 70) + (0.093 x 1680 x 6) = 44,486.40 ETB.

Indirect Economic Loss from Carcass Weight Loss: Annual economic loss due to carcass weight loss = Ns × Ci × Pa [21] = 107×5%×126×120 = 107 × 0.05 × 126 x 120 = 80,892 ETB.

Annual Economic Loss: It was estimated as annual economic losses due to organ condemnation + annual economic losses due to carcass weight loss. Annual economic loss = 80,892 ETB + 44,486.40 ETB = 125,378.40 ETB.

Hence, the total loss from organ condemnation and carcass weight loss in cattle slaughtered at Woliso municipal abattoir is estimated at 125,378.40 ETB which is equivalent to 5,704.20 USD (1USD = 21.98 ETB).

DISCUSSION

This study revealed that the prevalence of hydatidosis in cattle slaughtered at Woliso municipal abattoir was 27.4%. This finding is higher than the findings that reported as 15.4% by Regassa *et al*. [22] and 16% by Kebede *et al*. [23]. However, it is lower than the findings from different places in Ethiopia like 61% in Assela [24], 52.69% in Hawassa [22], 48.9% in Debre Markos [23], 46.5% in Debre Zeit [10], 34.05% in Bahir Dar [23] and 32.1% in Mekelle [25]. Factors like 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 [26, 27].

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. 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 [28] explained, the hydatid cyst develops slowly over several months, forming an outer laminated membrane and an inner memberane called the germinal layer.

In this study, it has been shown that hydatid cysts occurred most commonly in the lung (58.7%) followed by the liver (32%) and (9.3%) in heart. This is in agreement with the findings of Njoroge *et al*. [29] and Eckert and Deplazes [30], which show that the lung and liver are the most common sites of hydatid cyst in domestic animals. It is due to the fact that the lung and liver posses first great capillaries encountered by the migrating echinococcus oncosphere (hexacanth embryo), which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved. Likewise, due to older age of slaughtered cattle, during which time the liver capillaries are dilated and most oncosphere pass directly; additionally, it is possible for the hexacanth embryo to enter the lymphatic circulation and be carried through the thoracic duct to the lungs in such a way the lung may be infected before or instead of the liver [30].

In the current study, it was emphasized to carry out an assessment on annual economic loss due to bovine hydatidosis at Woliso municipal abattoir. Losses from organ condemnation and carcass weight loss (meat production loss) in infected cattle were assessed and estimated at 125,378.40 ETB. The current estimate is greater than 25,608 ETB, that was estimated by Kebede *et al*. [31] in Tigray region. However, it is lower than 1,791,625.89 ETB that was estimated by Regassa *et al*. [22] in Hawassa municipal abattoir. The difference in economic loss estimates in various abattoir/regions may be due to the variations in the prevalence of disease, mean annual number of cattle slaughtered in different abattoirs and variation in the retail market price of organs. Considering the current result, hydatidosis is an important disease of cattle in Woliso and its surroundings, causing substantial visible and invisible losses. It causes considerable economic loss in livestock due to condemnation of organs and denied weight gain of infected stocks.

CONCLUSION

The prevalence of cattle hydatidosis observed in Woliso is significant and this undoubtedly reflects the potential hazards to public health in the area. The disease was found to cause substantial visible economic losses through caracass weight loss and condemnation of important organs like lungs, liver and heart. In terms of frequency of the infection in different organs, the lungs were found to be the most preferred predilection sites of hydatid cyst in cattle. Hence, promoting the establishment of intensive farms should be encouraged, creation of public awareness and control of stray dogs have paramount importance.

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