Study on the Prevalence and Associated Risk Factors of Bovine Hydatidosis in Hawassa Municipal Abattoir, Hawassa, Ethiopia

Gebremedhin Yohannes* and Seyoum Masresha
Department of Veterinary Surgery, College of Veterinary Medicine, Hawassa University, Ethiopia

Abstract
A cross sectional study was conducted on both local and cross breeds of animals from November 2018 to April 2019 with the objective of determining the prevalence of bovine hydatidosis and its associated risk factors on the slaughtered cattle in Hawassa municipal abattoir. Regular visit of the abattoirs twice a week was performed and a simple random sampling method was employed to carry out both ante mortem and post mortem inspection of cattle slaughtered in the abattoir. Laboratory procedures for fertility and viability tests, to determine the status of the cysts, were also performed at Hawassa university veterinary parasitological laboratory. Out of the total 395 male and female cattle slaughtered in the abattoir and examined during the study period, 158 (40.2%) were found harboring hydatid cysts in one or more of their organs (liver, lung and spleen). All hydatid cyst positives were found to be male animals. Analysis of the occurrence of infection with regard to different age groups, breeds, sex, body condition score and origin was made by using proportions and chi-square test. The highest percentage of bovine hydatidosis was found from bovines with age group greater than five years (46.3%) and from bovines having poor body condition 10 (62.5%). So that animals greater than five years ($X^2=8.6, P=0.003$) and having poor body conditions ($X^2=23.2, P=0.000$) were statistically significant with the occurrence of bovine hydatidosis. The highest prevalence of bovine hydatidosis in Hawassa municipal abattoir was found to be (40.2%) revealed that the potential hazards to public health and significant economic loss in the area. Establishment of various control measures such as local education programs targeting at the dynamics of transmission, proper disposal of offal, strict meat inspection in abattoir, regular Deworming of dogs, stray dog control are recommended to reduce the incidence of the disease in animals and humans.

Keywords: Bovine hydatidosis; Hawassa; Abattoir; Prevalence; Risk factors

Introduction
Hydatidosis (Cystic Echinococcosis) caused by the larval stage (metacestode) of *Echinococcus granulosus* is the most important worldwide parasitic disease of livestock that has both economic and public health significance. Echinococcosis has a worldwide distribution; the reason is mainly due to the ability of this tape worm to adapt a wide variety of domestic and wild Intermediate Hosts (IH) [1]. Its distribution is usually more prevalent in developing countries especially in the rural communities where the dog lives in close quarters with man and domestic herbivores, feeding on scraps and offal of wild herbivores hunted by his master or domestic herbivores bred for butchering and the highest incidence is reported mainly from sheep and cattle rearing areas [2].

In Africa *E. granulosus* has been recognized from most countries including Ethiopia. In Ethiopia, hydatidosis has been known and documented as early as 1970’s. It is the major cause of organ condemnation in most Ethiopian abattoirs and slaughter houses causing huge economic losses [3]. The absence of proper meat inspection procedures, the presence of large stray dog population, lack of proper legislation on the control and unhygienic environment are thought to contribute significantly to the prevalence of the disease in Ethiopia [4].

Echinococcosis is a zoonotic disease caused by the larval stages of the tape worm *E. granulosus* for which domestic intermediate hosts (cattle, sheep, goats and camels) are major reservoirs for the disease occurrence in humans [5]. These intermediate host's contract hydatidosis by grazing on pastures contaminated with dog feces containing eggs of the cestode. The transmission of *Echinococcus* species from intermediate hosts to definitive host (Dog) is the result of predator-prey relationship existing between hosts, however it can be modified by human behavioral factors for synathropic cycles and man is usually a dead end intermediate host [6,7].

The disease has greater public health importance and economic impact in countries where livestock industry is an important segment of the agricultural sector and when livestock production is based on mainly extensive grazing system [8]. In addition, backyard slaughter of animals, the corresponding absence of rigorous meat inspection procedures, the long standing habit of feeding domesticated dogs and wild carnivores with condemned offal and the subsequent contamination of pasture and grazing fields contributes more than expected [9].

In Ethiopia, abattoir reports from different regions of the country indicated that hydatidosis is highly prevalent disease incurring economic loss and affecting public health [10]. However, the current status of the problem and its associated risk factors is not known in Hawassa municipal abattoir, in Hawassa city; so that the present study is going to fill this gap, and the findings obtained will help the policy
To determine the prevalence of bovine hydatidosis in cattle slaughtered at Hawassa municipal abattoir.

To identify the potential risk factors associated with the occurrence of bovine hydatidosis in cattle slaughtered at Hawassa municipal abattoir.

Materials and Methods

Study area

The study was conducted from November 2018 to April 2019 on selected cattle brought to Hawassa municipal abattoir for slaughtering purpose. Hawassa is the capital city of Southern, Nations, Nationalities and Peoples of Ethiopia and the region, located on the shore of the Rift valley lakes and found at 275 km south of Addis Ababa. It is geographically lies between 4°27’ and 8°30’ latitude North and 34°21’ and 39°1’ East longitude at an altitude of 1,790 m above sea level. The area receives average rain fall annually ranging from 800 mm to 1,000 mm of which 67% falls in the long rainy season, which extends from June to September. The mean minimum and maximum temperatures of the area were 20.1°C and 30°C, respectively and 51.8% mean relative humidity. The area is mainly covered by dry savannah and bush type of vegetation (CSA, 2008).

Study animals

The study animals were mainly males (393) and a few females (2) of cattle that were in different age groups (>5 and ≤ 5) and body condition (medium, good and poor) brought from various localities (from Hawassa, Tula, Shashemene, W. Sodo and N. Arsi) to Hawassa municipal abattoir for slaughtering purposes. The study was conducted on both local and cross breeds of cattle that brought to Hawassa city municipal abattoir.

Study design

A cross sectional study was conducted from November 2018 to April 2019 to determine the prevalence of bovine hydatidosis and its associated risk factors on the slaughtered cattle in Hawassa municipal abattoir. Two slaughtering days per week, visits were made to Hawassa municipal abattoir from November 2018 to April 2019 and both ante mortem and postmortem inspection procedures were carried out during the study periods.

Sampling technique and sample size determination

Simple random sampling technique was employed for determining the prevalence of bovine hydatidosis among cattle slaughtered at Hawassa municipal abattoir; to calculate the total sample size, the following parameters were used: 95% level of confidence (CL), 5% desired level of precision and 41% prevalence of bovine hydatidosis in Hawassa municipal abattoir; prevalence from previous study [11]. The sample size was calculated using the formula given in Thrusfield (2005).

\[ n = \frac{1.96^2 \cdot (P_{exp}) \cdot (1 - P_{exp})}{d^2} \]

Where, \( n \) = required sample; \( P_{exp} \) = expected prevalence; \( d \) = desired absolute precision

\[ n = \frac{1.96^2 \cdot (0.41) \cdot (1 - 0.41)}{0.05^2} = 3.8416 \cdot 0.59/0.0025 = 9.2928304/0.0025, n = 371 \]

However, to increase the accuracy, 24 samples were added during ante mortem inspection and based on the above formula; the total sample size of cattle was calculated to be 395.

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 Hawassa municipal abattoir. Laboratory procedures for fertility and viability tests were also performed at Hawassa university veterinary parasitological laboratory.

Ante mortem examination: For the ante-mortem examination the cattle were randomly selected and examined clinically both at rest and in motion. Each of the study animals was given an identification number (with a paint mark on their body). Age, sex, body condition scoring and origin of the study animals were also recorded. This was because of that high prevalence of bovine hydatidosis was more suspected in animals with poor body condition and in adults. Estimation of age was carried out by examination of the teeth eruption using the approach forwarded by [12]. The age of the animals was classified into two categories as less than or equal to five and greater than five. Cattle presented for slaughtering in the study area were mostly male with a few females. Interview with the owner of the animal or with the one who represents the owner was also made to obtain information on animal’s origin. The body condition scoring was classified into three categories as poor (lean), medium and good (fat) [13].

Postmortem examination: Postmortem examination was carried out through visual inspection, palpation and incision of internal organs (lung, liver, heart, spleen and kidney) for the presence of hydatid cyst. The presence of the cyst and organ distribution was recorded. Some organs (offal’s) having cysts were condemned and selected Hydatid cysts found in the infected organs were carefully removed and separately collected (in organ basis) in clean containers and transported to Hawassa university veterinary parasitological laboratory to conduct cyst fertility as well as viability test of protoscolices in the laboratory.

Hydatid cyst characterization: Fertility test: Eighty five selected positive samples were taken from lung, liver and spleen and transported to Hawassa university veterinary parasitological laboratory to conduct cyst characterization using fertility and viability tests and the status of the cysts were assessed. The pressure of the cysts fluid was reduced and individual cysts were carefully incised by using a sterile needle and sterile scalpel blade respectively. The content was poured into a glass petri dish and examined by using a light microscope for protoscolices to categorize them as fertile cysts (If they have similar appearance of white dots on the germinal epithelium) and then fertile cysts were subjected to viability test. On the other hand, infertile cyst were further classified as sterile (cysts those were heavily supplicative) or calcified cysts (cysts those produced gritty sound feeling on incision) [14].

Viability test: A drop of the sediment containing the protoscolices was placed on the microscope glass slide, equal volumes of 0.1% eosin solution was added into the microscope slide and covered with a cover slip and observed for amoeboid like peristaltic movements and color change (from white to pink) with X40 objective microscope. A drop of 0.1% aqueous eosin solution was added to equal volume of hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead (non viable) ones take it up (Figure 1) [15].
The prevalence of bovine hydatidosis in animals with different age groups, body conditions, sex, breeds and origin was assessed. Thus, the prevalence was assessed in terms of age groups and the findings were recorded as 46.3% and 32.4% prevalence in those male animals greater than five years and in those male animals less than or equal to five years respectively. Bovines with age greater than five years old were strongly associated with the occurrence of bovine hydatidosis. The prevalence was also assessed in terms of body condition scores and it was found to be 44.4%, 25.0% and 62.5% prevalence in those animals with medium, good and poor body condition respectively. Bovines with poor body condition were strongly associated with the occurrence of bovine hydatidosis. The highest percentage of bovine hydatidosis was found from bovines with age group greater than five years (46.3%) and from bovines having poor body condition 10 (62.5%). So that animals greater than five years ($X^2=8.6$, $P=0.000$) and having poor body conditions ($X^2=23.2$, $P=0.000$) were statistically significant with the occurrence of bovine hydatidosis.

On the other hand, the prevalence was also assessed in terms of sex and the result was found to be 40.2% prevalence in males and out of two female animals both of them was not infected by the disease. Sex prevalence has shown statistically insignificance variation ($P>0.05$, $X^2=3.02$). The prevalence was also assessed in terms of breed and the result was 40.9% and 35.7% prevalence in local and cross breeds of cattle respectively. The breed prevalence has shown statistically insignificance variation ($P>0.05$, $X^2=5.2$).

The prevalence was also assessed in terms of origin of animals and the prevalence was found to be 38.8%, 46.2%, 45.1%, 33.9% and 34.7% in Hawassa, Tula, Shashemene, Wolylatasodo and Negelle Arsi respectively and the origin prevalence has shown statistically insignificance variation ($P>0.05$, $X^2=0.07$).

**Organ involvement and distribution of cysts**

From the total of 395 cattle examined during post-mortem inspection, 158 different visceral organs were found to be affected by hydatid cyst. From these 86 (54.4%) of them were lungs only, 23 (14.6%) of them were livers only, 47 (29.38%) of them were lung and liver only, 10 (6.6%) of them were spleen only, 1 (0.6%) of them was lung, liver and spleen only and 1 (0.6%) of them was liver and spleen only. Among the inspected internal organs lungs harbored major part of the total cysts obtained during this study period and followed by the liver. During the study period both kidney and heart were also carefully inspected but they were found to be hydatid cyst negative. The distribution of hydatid cysts by organs affected was summarized in the Figure 2 below.

---

**Table 1:** Analysis of Risk factors with regard to detection of hydatid cysts in cattle slaughtered at Hawassa municipal abattoir.

<table>
<thead>
<tr>
<th>Risk Factors (variables)</th>
<th>Groups</th>
<th>No. of Cattle Examined</th>
<th>No. of Positive</th>
<th>No. of Negative</th>
<th>Prevalence In (%)</th>
<th>P-value CI at 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&gt;5 years</td>
<td>216</td>
<td>100</td>
<td>116</td>
<td>46.3</td>
<td>$X^2=8.6$, $P=0.000$</td>
</tr>
<tr>
<td></td>
<td>≤ 5 years</td>
<td>179</td>
<td>58</td>
<td>121</td>
<td>32.4</td>
<td>$P=0.083$</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>393</td>
<td>158</td>
<td>235</td>
<td>40.2</td>
<td>$X^2=3.02$</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>$P=0.003$</td>
</tr>
<tr>
<td>Breeds</td>
<td>Local</td>
<td>325</td>
<td>133</td>
<td>192</td>
<td>40.9</td>
<td>$X^2=0.07$</td>
</tr>
<tr>
<td></td>
<td>Cross</td>
<td>70</td>
<td>25</td>
<td>45</td>
<td>35.7</td>
<td>$P=0.789$</td>
</tr>
<tr>
<td>BCS</td>
<td>Medium</td>
<td>275</td>
<td>122</td>
<td>153</td>
<td>44.4</td>
<td>$X^2=23.2$</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>104</td>
<td>26</td>
<td>78</td>
<td>25</td>
<td>$P=0.000$</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>16</td>
<td>10</td>
<td>6</td>
<td>62.5</td>
<td>$P=0.27$</td>
</tr>
<tr>
<td>Origin</td>
<td>Hawassa</td>
<td>98</td>
<td>38</td>
<td>60</td>
<td>38.8</td>
<td>$X^2=5.2$</td>
</tr>
<tr>
<td></td>
<td>Tula</td>
<td>78</td>
<td>36</td>
<td>42</td>
<td>46.2</td>
<td>$X^2=5.2$</td>
</tr>
<tr>
<td></td>
<td>Shasheme</td>
<td>82</td>
<td>37</td>
<td>45</td>
<td>45.1</td>
<td>$P=0.000$</td>
</tr>
<tr>
<td></td>
<td>W. Sodo</td>
<td>82</td>
<td>21</td>
<td>41</td>
<td>33.9</td>
<td>$P=0.000$</td>
</tr>
<tr>
<td></td>
<td>N. Arsi</td>
<td>75</td>
<td>26</td>
<td>49</td>
<td>34.7</td>
<td>$P=0.000$</td>
</tr>
</tbody>
</table>
Cyst fertility, viability and infertility from different infected organs

Out of 85 cysts collected from infected organs and examined for fertility and viability test in the laboratory during the study period, 41 (48.2%) of them were found to be sterile cysts, 28 (32.9%) of them were found to be calcified cysts and 16 (18.8%) of them were found to be fertile cysts of which 11 (12.9%) of them were viable cysts. Out of 85 cysts collected from the abattoir during the study period, 64 (47.1%) of them were taken from lung and examined for fertility and viability tests and only 14 (21.9%) of them were fertile of which 10 (71.4%) of them were with viable protoscolices, 19 (26.4%) of them were taken from the liver and examined for fertility and viability tests and only 2 (10.5%) of them were fertile of which 1 (5.0%) was with viable protoscolices, 2 of them were taken from the spleen and examined for fertility and viability tests and both of them were found to be sterile cysts. The percentage of sterile cysts in the lung and liver was found to be 32 (50%) and 7 (36.8%) respectively. The percentage of calcified cysts in the lung and liver was found to be 18 (28.1%) and 10 (52.6%) respectively (Table 2).

Table 2: Distribution of fertile (with or without viable protoscolices) and infertile cysts in different infected organs from slaughtered cattle in Hawassa municipal abattoir.

<table>
<thead>
<tr>
<th>Organs</th>
<th>No. of Organ Examined</th>
<th>Fertile Cysts</th>
<th>Viable Protoscolices</th>
<th>Sterile Cysts</th>
<th>Calcified Cysts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In No.</td>
<td>In %</td>
<td>In No.</td>
<td>In %</td>
<td>In No.</td>
</tr>
<tr>
<td>Lung</td>
<td>84</td>
<td>14</td>
<td>21.9</td>
<td>10</td>
<td>71.4</td>
</tr>
<tr>
<td>Liver</td>
<td>19</td>
<td>2</td>
<td>10.5</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>Spleen</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Discussion

The current study revealed that the prevalence of bovine hydatidosis in cattle slaughtered at Hawassa Municipal Abattoir in Hawassa city was found to be 40.2%. This finding is in agreement, who reported (41%) from Hawassa Municipal Abattoir [11]. This implies that there was no modification on the environmental condition, meat inspection practice and stray dog control practice and offal disposal habits in the area. It might be also due to the owners were not aware of caring for the health and nutritional problems of their animals and it also might be due to the owners did not present their animals to the market at their younger ages.

However, the current finding is relatively higher than the findings that reported as 27.4% in Woliso [16], 11.21% in Wolaya [17], 20.50% in Arbaminch [18]. On the other hand, it is slightly lower than the findings reported from Debrezeit (42.86%) [19]. The variation of the prevalence of hydatidosis among different researchers could be associated with the differences in geographical location, climatic condition, seasonal variation, environmental condition, home slaughtering and offal disposal habits, contamination rate in the intermediate host and feeding status of animals, livestock stocking intensity and livestock movement that contribute to the differences in prevalence rates [20].

In this study age was considered as a risk factor of bovine hydatidosis and there was an association between the occurrences of the disease with respect to the risk factor. The highest percentage of bovine hydatidosis was found from bovines with age groups greater than five years 100 (46.3%). Age was statistically significant with the occurrence of bovine hydatidosis (X²=8.6, P=0.003). This variable was anticipated as some of the reason contributing to the high prevalence of the disease in the study area. In this study, the prevalence of hydatidosis seems to increase as the animal’s age advances. The finding is in agreement with the findings of other researchers where they reported a higher prevalence in older animals [21]. This could be mainly due to the fact that aged animals have longer exposure time to *E. granulosus* eggs and weaker immunity to resist the infection [22]. This may be due the fact that cattle are slaughtered at their medium or older age with which they have greater chance of being infected with *E. granulosus* [23].

The prevalence of bovine hydatidosis was also assessed in terms of sex and all hydatid cyst positives were found to be male animals. Sex was statistically insignificance (X²=3.02, P=0.083) with the occurrence of bovine hydatidosis. This implies that there is no association between sex and prevalence of the disease. This may be due to small number of female animals slaughtered at the abattoir during the study period. There was no significant difference in the prevalence of the disease among animals from the different regions. This could be due to the similarity in socio-economic status and animal’s husbandry practices of community in the study area [11].

Body condition score was also among the risk factors of bovine hydatidosis and it was found to be statistically significant (X²=23.2, P=0.000) with the occurrence of bovine hydatidosis. The prevalence of hydatidosis was higher in cattle having poor body condition (62.5%), followed by cattle having medium body condition (44.4%) and cattle having good body condition (25.0%). Animals with poor body condition scores had high risk of infection with hydatid cyst due to low immunity. It might be due to the animals under poor body condition had previously faced on nutritional and health problems. Moderate to severe infection of the parasite may cause retarded growth; reduce meat and milk production as well as live weight [24].

Regarding cyst distribution, the finding reveals that the occurrence of cysts higher in lungs than in the livers. The reason for this phenomenon probably the presence of greater capillary beds in the lung and the liver capillary is dilated as the animal age advances and most on co spheres pass directly to the lung. Additionally, it is possible for the hexacanth embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and lungs in such a way that the lung may be infected before or instead of liver [11].

The overall percentage of fertile cysts in present study is 18.8%. This finding is higher than the previous findings14 (17.5%) in Hawassa and significantly higher than fertility rate of (9.62%) reported from Wolaya Soddo [17]. The study reveals that out of 85 cysts collected and examined for fertility and viability tests during the study period, 16 (18.8%) of them were found to be fertile and cysts collected from the lungs showed a higher fertility proportion14 (21.9%) as compared to cysts collected from the liver 2 (10.5%) and other organs. The percentage of sterile cysts in the lung, 32 (50%) was higher than in the liver, 7 (36.8%). But the percentage of calcified cyst was found to be higher in the liver, 10 (52.6%) than in the lung, 18 (28.1%). This may be associated with the higher reticuloendothelial cell and abundant connective tissue reaction of the organ [25].

In comparison of the fertility rate of different organs, it was higher in lung than liver and other organs. This might be due to relatively softer consistency of lungs that allow earlier development of cyst; and fertility of hydatid cysts may show a tendency to increase in advanced age of the host [26]. The fertility of hydatid cysts in the intermediate hosts is genotype dependent. Cattle infected with G5 had more than 90% fertile cysts.
In contrast, cysts from cattle infected with G1, G3 genotypes of *E. granulosus* were all sterile [27]. The variation between tissue resistances might also influence the fertility rate of cysts with respect to organ type; for example, host reaction that limit fertility rate of hydatid cysts in liver is more than that of the lung [15]. Information about prevalence and fertility of hydatid cysts in various organs of cattle are important indicators of potential source of infection to perpetuate the disease to dogs [28].

**Conclusion**

The findings obtained in this study revealed that bovine hydatidosis was highly prevalent in Hawassa municipal abattoir. This finding suggests that the prevalence of bovine hydatidosis was not reduced and this undoubtedly reflects the potential hazards to public health and significant economic loss in the area. Among the risk factors of bovine hydatidosis age and body condition scores were found to be statistically significant. High percentage of hydatid cyst was observed in bovines with age groups greater than five years old and from bovines with poor body conditions.

Based on the above conclusion the following recommendations are forwarded:

- Various control measures such as local education programs targeting at the dynamics of transmission, proper disposal of offal, strict meat inspection, regular Deworming of dogs and stray dog control to reduce the incidence of the disease in animals and humans should be successfully implemented in the area.
- Awareness creation programs should be launched for the owners to care for their animals, to provide sufficient balanced nutrition for their animals, to avoid the hygienic problems encountered in their animal’ environment, to present their animals to the nearby veterinary clinics against any disease and to present their animals to the market before they become too aged.
- Further studies on the prevalence of hydatidosis in different zones of the region and in other areas where animals were originated from involving different hosts should be conducted.

**References**

3. Lobago F. Echinococcus in Conso (southern Ethiopia) and an assessment of the prevalence and economic and public health importance of hydatidosis. Faculty of Veterinary Medicine Addis Ababa University: 1994.61.