Study on Prevalence and Economic Significance of Bovine Hydatidosis in Bako Municipal Abattoir, West Shoa Zone, Oromiya Regional State

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Abstract

A cross-sectional study aimed at determining the prevalence and cyst characteristics and estimating the financial loss due to cystic echinococcosis (hydatidosis) in cattle slaughtered at Bako municipal abattoir was conducted from November 2011 to April 2012. Out of 246 cattle examined, 29 (11.88%) were found to harbor visible hydatid cysts. Significantly higher infection was detected in cattle’s with poor body conditions (P<0.05) than animals with medium and good body condition score. No significant variation was observed with regard to sex of animals. Regarding organ distribution, infections of the lung, liver, kidney, and spleen were 47.2%, 38.88%, 8,33%, and 2.77% respectively. Of the total 36 hydatid cysts counted, 17(47%), 14 (38.88%), and 5 (13.88%) were found to be small-sized, medium-sized, and large-sized, respectively. Likewise, out of 36 cysts assessed, 18 (50%) were fertile, 4 (11.11%) sterile, and 14 (38.88%) calcified. Of the 29 fertile cysts subjected for viability test, 12 (27.77%) were viable while 8 (22.22%) were nonviable. Moreover, assessment of annual economic loss due to bovine hydatidosis at Bako municipal abattoir from offal condemnation and carcass weight loss was estimated at 180,792 ETB (Ethiopian Birr). 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 Bako district. Hence, establishment of well-equipped standardized abattoirs, creation of public awareness, and control of stray dogs are of paramount importance.

Keywords: Hydatidosis; Prevalence; Economic significance; Ethiopia

Introduction

Echinococcosis (Hydatidosis) is a chronic cyst-forming parasitic helminthic disease of domestic and wild ungulates as well as human beings caused by infection with the larval (metacestode) stages of dog tapeworms belonging to the genus Echinococcus and family Taeniidae. Three broad morphological forms of echinococcosis are recognized clinically: cystic echinococcosis caused by E granulosus, alveolar echinococcosis caused by E multilocularis, and polycystic echinococcosis caused by Echinococcus vogeli or Echinococcus shiquicus [1]. The life cycle of Echinococcus species is complex, involving two hosts (definitive hosts and intermediate hosts) and a free-living egg stages. Dogs are the usual definitive hosts whilst a large number of mammalian species can be intermediate hosts, including domestic ungulates and man.

The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries including Ethiopia [2]. The public health and economic significances of hydatidosis lies on the cost of hospitalization, medical and surgical fees, loss of income and productivity, permanent or temporary incapacity to work social consequence hydatidosis of disability and mortality [3]. In food animal hydatidosis has an adverse effect on production causing decreased production of meat, milk, wool, reduction in growth rate and predisposition to other diseases. The distribution of the disease varies depending on the cause; E. granulosus has a global distribution; E. multilocularis occurs in wide areas of the Northern Hemisphere, E. shiquicus is found in the People's Republic of China and E. oligarthrus and E. vogeli are confined to Central and South America [4]. Cystic Echinococcosis is still endemic in cattle herding areas of the world and is a public health problem in Mediterranean, Middle East, Asia, South America and Africa, including Ethiopia [5].

Diagnosis of the disease relies on epidemiologic and clinical findings; on detection of the hydatid cyst by imaging techniques, and serology. There are several major options for treatment of Cystic echinococcosis (CE), including surgery, puncture aspiration injection reaspiration (PAIR), and chemotherapy [6].

In Ethiopia, the presence and prevalence of Hydatidosis (Echinococcosis) is well established. The information existing from different authors confirms that the disease is prevalent in various parts of the country; kebede et al. [7] 22.1%, and Berhe [8] 32.1% are some of the researches conducted in different parts of the country to determine the prevalence and economic impact of the disease. And from these data’s it can be deduced that it is most commonly observed in bovine species.

Despite the above studies, in Ethiopia, the disease has not been investigated sufficiently, and information related to its prevalence and economic impact is still limited especially in and around the study area (Western Shoa, Bako). Bako is the smallest town, where a large population of cattle is reared with different husbandry system in and around the area. It is assumed that the problem (Hydatidosis) is a challenge in the study area like the other parts of the country and with this hypothesis the main objective of this study were:

- To assess the overall prevalence of the diseases and
- To investigate the effects of risk factors on prevalence of the disease

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Received September 08, 2014; Accepted November 17, 2014; Published November 20, 2014

Citation: Haftu B, Kebede T (2014) Study on Prevalence and Economic Significance of Bovine Hydatidosis in Bako Municipal Abattoir, West Shoa Zone, Oromiya Regional State. J Veterinar Sci Technol 5: 197. doi:10.4172/2157-7579.1000197

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To know the prevalence of the diseases at organ level and
to overview the economic significance of hydatidosis.

Material and Methods
Description of the study area
The study was conducted in Bako municipality abattoir, from
November 2011 to April 2012 Which is situated in Western Shoa zone,
Oromia regional state, around 281 km away West of Addis Ababa.
The area is found at a longitude of 9 08N and latitude of 37 03 E and
the altitude range is from 1600 to 2000 meters above sea level. It has
an annual rainfall of 1200mm, 89% of which falls between May and
September and temperature ranging from and 22-31°C with average
temperature of 27°C. The rainfall is bi-modal with the short rain
coming in March and April, there is district dry season extending
usually November to February. Agriculture is the main occupation of
the population of the area. The agricultural activities are mainly mixed
type with cattle rearing and crop production under taken side by side.
Extensive system of livestock management predominate the area and
dogs are rarely used for control and guarding of herds of cattle and
flocks of sheep and goats, which is related to religious taboos and social
norm [2].

Study design and study animals
A cross sectional observational study method were carried out
to assess the prevalence and economic significance of hydatid cyst
in slaughtered cattle in Bako municipality abattoir and a total of 246
indigenous zebu cattle slaughtered during the study period were
included in the study. During ante-mortem examination each study
animal was given an identification number; and age was determined.

During this study the age of the animals brought for slaughter
was determined by examination of the teeth eruption according to.
All cattle slaughtered during the study were adult. 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 (Shoboka,
Jere, and Bako markets). Both sex group of the cattle were presented
for slaughtering, but males were higher in number, so, infection rate
regarding sex variation was included.

Sample Size and Sampling Method
The sample size was calculated according to Thrusfield [9] by
considering 20% expected prevalence and 5% accepted error at 95%
confidence interval using this formula: N=1.962 *Pexp (1 - Pexp)/
d2; where, N=required sample; Pexp=expected prevalence; d=desired
absolute precision. A total of 246 bovine were selected by simple
random sampling method.

Study methodology
Regular visits were made to conduct ante mortem examination of
animals brought for slaughter and during this time, individual animals
were identified with regard to sex and body condition score and the
results were recorded accordingly. Animals, depending on their body
condition, were ranked as good, medium, and poor based on Nicholson
et al. [10]. 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
examinations were thoroughly carried out by visual inspection,
palpation, and systematic incision of each visceral organ particularly the
lung, liver, spleen, kidney, and heart carried out according to procedures
recommended by WHO [4]. The size (diameter in centimeters) of
each and individual cysts randomly selected was measured, and
the number of cysts per organ was counted and recorded. The cysts
randomly selected and collected from different organs were taken to the
laboratory to conduct fertility and viability tests. All organs harboring
hydatid cysts were partially or totally condemned and judged according
to guidelines on meat inspection for developing countries [11].

According to their size, hydatid cysts were then classified as small (<4
cm), medium (4-8 cm), and large (above 8 cm) in diameter; according
to Oosburg et al. [12] classification system. After each representative,
hydatid cyst was randomly collected from different organs and taken
to the laboratory, the cyst wall was carefully opened with scalpel blade
and the content were poured into a clean glass Petri dish and examined
under a microscope (×40) for the presence of hydatid protoscolices.
If the protoscolices were present, seen as white dots on the germinal
epithelium or brood capsule or hydatid sands within the hydatid cyst,
the cyst was categorized as fertile. Then the fertile cysts were further
subjected for viability test. A drop of the sediment consisting of the
protoscolices was placed on microscope glass slide and a drop of 0.1%
aqueous eosin solution was added and then covered with 22 × 22 mm
cover slip and observed under microscope (×40), with the principle
that viable protoscolices should completely or partially exclude the dye
while the dead ones take it up [13]. Moreover, the infertile cysts were also
classified as sterile or calcified according to Macpherson et al. [3].

Economic analysis
To determine 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. In calculating cost of condemned
edible organs and carcass weight loss, six Different meat sellers were
interrogated randomly to establish the price per unit organ and the
intermediate price of lung, liver, heart, spleen, and kidney. Average
carcass weight of an Ethiopian zebu was estimated based on retrospective analysis of data recorded from three
years. A 5% estimated carcass weight loss due to bovine hydatidosis
was determined by examination of the teeth eruption according to.

According to their size, hydatid cysts were then classified as small (<4
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 spleen out of the total examined
PI4=Percent involvement of heart out of the total examined
C1=Average market price of liver
C2=Average market price of lung
C3=Average market price of heart

Annual economic loss=(PI1x TkxC1) + (PI2xTkxC2) +
(PI3xTkxC3) + (PI4xTkxC4).

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 spleen out of the total examined
PI4=Percent involvement of heart out of the total examined
C1=Average market price of liver
C2=Average market price of lung
C3=Average market price of heart

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J Veterinar Sci Technolo
 ISSN: 2157-7579 JVST, an open access journal
Volume 5 • Issue 5 • 1000197

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C4=Average market price of spleen
TK=Average annual kill of bovines

**Indirect loss from carcass weight loss**

Annual economic losses due to carcass weight loss=Ns × Ci × Pa

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 Bako; Annual economic losses were calculated by adding both direct and in direct losses

**Data analysis**

Data obtained from the study were analyzed using SPSS version 20 software and the magnitude of the difference of comparable variables was tested using chi-square.

**Results**

**Antemortem examination result**

Up on regular visit done on animals brought for slaughter, individual animals were assessed with regard to their place of origin, age, sex, breed and body condition and all animals were found adult, local zebu brought from the local markets of the district. Both, male and female animals were identified and recorded with their body condition score as good, medium and lean.

**Clinical examination results**

Out of the total 246 cattle slaughtered and examined during the study duration, 29(11.8%) were found infected with hydatid cysts, harboring one or more cysts in different visceral organs (liver, lung, kidney, spleen, and heart). Analysis of the occurrence of infection with regard to body condition, and sex was made by using proportions and chi-square test. Sex did not show significant difference with regard to cyst detection (p>0.05), but body condition shows significant difference (p<0.05)

In this study the proportion of hydatidosis in various organs was also determined. Lungs were found to be the commonly affected organ. The total number of organs with one or more hydatid cysts was 36 and relative proportion of each organ is as follows: Lungs 17 (47.2%), liver 14 (38.88%), spleen 3 (8.33%), and heart 1 (2.77%) (Table 1).

**Proportion of hydatidosis in different organs**

Out of 36 cysts detected from different organs, 17(47.2%), 14(38.88%), 1(2.77%), 3(8.33%) and 1(2.77%) Were found from the lung, liver, spleen, kidney, and heart respectively (Table 2).

**Size distribution of cysts in relation to different organs of cattle**

Out of the total hydatid cysts recorded (36), 17(47%) were small, 14 (38.88%) medium, and 3(13.88) large cysts (Table 3).

**Cyst Status characterization**

Of the 36 hydatid cysts collected and examined for the status of fertility, sterility, or calcification, 18 (50%) were fertile, 4 (11.11%) sterile, and 14 (38.88%) calcified (Table 3). And out of 18 fertile cysts tested for viability, 10 (27.77%) were viable and 8(22.22%) were nonviable (Table 4).

**Economic loss estimation (financial loss evaluation)**

Direct loss from organ condemnation: in the current study a total of 17 lungs (47.2%), 14 livers (38.88%), 1 spleen (2.77%), 1 Heart (2.77%) and 3 kidneys (9.33%), were condemned due to detection of hydatid cysts. The mean current unit prices of these organs in Bako are 4.0, 65.0, 2.0, 3.0, and 8.0 ETB, respectively, while the mean current price of 1 kg beef is 90 ETB. Mean number of animals slaughtered annually at bako municipal abattoir was determined from the records of the last 1 year as1988. Then, the annual economic loss due to organ condemnation is estimated as follows:

Annual economic loss due to organ condemnation=(PI1x TkxC1)+ (PI2xTkxC2)+(PI3xTkxC3)+(PI4xTkxC4); (0.472 × 1988 × 65)+(0.388 × 1988 × 4)+(0.0277 × 1988 × 3)+(0.0277 × 1988X2)=64,349.8ETB

**Table 1:** Analysis of risk factors with regard to detection of hydatid cysts in cattle slaughtered at Bako municipal abattoirs.

| Variables   | No. examined | No. infected | Relative prevalence |
|-------------|--------------|--------------|---------------------|
| Sex         |              |              |                     |
| Male        | 221          | 27           | 10.975              |
| Female      | 25           | 2            | 0.813               |
| Total       | 246          | 29           | 11.788              |
| Body condition |         |              |                     |
| Fat         | 137          | 6            | 2.43                |
| Medium      | 87           | 12           | 4.87                |
| Lean        | 22           | 11           | 4.71                |
| Total       | 246          | 29           | 12.02               |

**Table 2:** Shows the relative distribution of the cysts in different organs of the cattle’s.

| Organ | No. of cysts | Relative prevalence (%) |
|-------|--------------|-------------------------|
| Lung  | 17           | 47.2                    |
| Liver | 14           | 38.88                   |
| Spleen| 1            | 2.77                    |
| Kidney| 3            | 8.33                    |
| Heart | 1            | 2.77                    |
| Total | 36           | 100                     |

**Table 3:** Size and organ distribution of hydatid cyst at bako municipal abattoir during the study period.

| Examined organs | No. of cysts examined | Fertile (%) | Nonviable (%) | Sterile (%) |
|-----------------|-----------------------|-------------|--------------|-------------|
| Lung            | 17                    | 8(47.05%)   | 6(35.2%)     | 2(11.76%)   |
| Liver           | 14                    | 1(7.14%)    | ---          | 13(92.86%)  |
| Kidney          | 3                     | 1(33.33%)   | 1(33.33%)    | 1(33.33%)   |
| Spleen          | 1                     | ---         | 1(100%)      | ---         |
| Heart           | 1                     | ---         | 1(100%)      | ---         |
| Total           | 36                    | 10(80%)     | 8(60%)       | 4(20%)      |

**Table 4:** Status of cysts in different organs of cattle slaughtered at Bako municipal abattoir.

| Cyst type | Organs inspected | Lungs | Liver | Spleen | Kidney | Heart |
|-----------|------------------|-------|-------|--------|--------|-------|
| Small     | 4(23.5%)         | 12(70.5%) | ---   | 1(5.88%) | ---   |
| Medium (7.14%) | 9 (64.28%) | 2(14.28%) | 1(7.14%) | 1(7.14%) | ---   |
| Large     | 4 (80%)          | ---   | 1(20%) | ---    | ---    | ---   |
Meat production loss: Annual economic losses due to carcass weight loss = \( N_s \times C_i \times P_a \) (Polydorou, 1981).

\[
= 29 \times 5\% \times 126 \times 90 \\
= 29 \times 0.05 \times 126 \times 90 \\
= 16,443 \text{ETB}
\]

Annual economic loss = Annual economic losses due to organ condemnation + Annual economic losses due to carcass weight loss.

Annual economic loss = 64,349 ETB + 116,443 ETB = 180,792 ETB.

Hence, the total loss from organ condemnation and meat production loss in cattle slaughtered at bako municipal abattoir is estimated to be 180,792 ETB.

Discussion

This study revealed that the prevalence of hydatidosis in cattle slaughtered at bako municipal abattoir was 11.8%. This finding is closer to that reported as 15.4% by Regassa et al. [15] and 16% by Kebede et al. [16]. However, it is lower than the findings from different places in Ethiopia like 61% in Assela [17], 52.69% in Hawassa [15], 48.9% in Debre Markos [16], 46.5% in Debre Zeit [18], 34.05% in Bahir Dar [19], 32.1% in Mekelle [8], and 22% in Tigray [20].

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 the country [21,22].

In this study, an assessment was made to establish relationship between body condition scores and hydatid cyst count. Animals with poor body condition were found to have higher hydatid cyst count and the poor condition among animals is probably a reflection of the effect of relatively high cyst burden. Polydorou [14] explained that in moderate to severe infection, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss.

No significant variation was noticed with regard to sex of animals. This may be explained by indiscriminate exposure to risk irrespective of sex in the management system of the area.

In this study, it has been shown that hydatid cysts occurred most commonly in the lung (47.2%) followed by the liver (38.88%), kidney (8.33%), and (2.77%) in spleen and heart. This is in agreement with the findings of Njoroge et al. [23] and Eckert and Deplazes [6], 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 possess 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 [6].

A greater frequency of medium-sized and large-sized cysts was found in the lung than in the liver, while the liver harbored a large number of small-sized and calcified cysts. The reason for the higher percentage of medium and large cysts in the lungs is the softer consistency of the lung, while the higher number of calcified cysts in liver could be attributed to relatively higher reticuloendothelial cells and abundant connective tissue reaction of the organ. The higher proportion of small cysts may be due to immunological response of the host which might preclude expansion of cyst size [24,25]. In examining the condition of cyst fertility and viability, the overall percentage of fertile cysts in this study was (50%). This is in line with the findings of Kebede et al. [20] but higher than the finding of Kebede et al. [16]. In the comparison of the fertility rate among the organs, it was higher in the lungs than in the liver. It has been stated that the relatively softer consistency of lung tissue allows the easier development of the cyst, and the fertility rate of hydatid cysts may show a tendency to increase with advancing age of the hosts [26]. This may be attributed probably due to reduced immuno-logical compatibility of animals at their older age of infection. The variation between tissue resistances of the infected organs may also influence the fertility rate of hydatid cysts.

The fertility rates observed in this study in all infected animals highlight the hazard that these animals perpetuate the cycle of hydatidosis when slaughtered and when raw offal are fed to dogs and also leftovers during backyard slaughter are eaten by wild carnivores. It was observed that majority of households had livestock including cattle, sheep, goat, and donkeys, which are the intermediate host of the parasite. Similarly, many households had dogs and cats, which were not dewormed regularly and were managed under free-range system. This study also revealed that a higher proportion of the cysts were fertile (50%) and calcified (38.88%). In the current study, it was emphasized to carry out an assessment on annual economic loss due to bovine hydatidosis at bako municipal abattoir. Losses from organ condemnation and carcass weight loss (meat production loss) in infected cattle were assessed and estimated at 180,792 ETB. The current estimate is approximately greater than (25,608ETB) that estimated by Kebede et al. [20] in Tigray region. However, it is lower than 1,791,625.89 ETB that estimated by Regassa et al. [15] 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 bako 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.

Acknowledgements

Special thanks to Wollega University, Nekemte, Ethiopia fully financial funded for this research.

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