Prevalence and economic importance of bovine fasciolosis in Dembi Dolo municipal abattoir, south-western Ethiopia

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Abstract: Fasciolosis is an economically important parasitic disease, which is caused by trematodes of the genus Fasciola that migrate in the hepatic parenchyma and establish in the bile ducts. A cross-sectional study was carried out from November 2014 to April 2015 to estimate the prevalence of bovine fasciolosis and assess the magnitude of the direct financial losses attributed to the condemned liver of cattle slaughtered at Dembi Dolo municipal abattoir. Active abattoir survey was conducted by using routine ante mortem and post mortem inspection. Descriptive statistics was used to compute prevalence and Pearson’s Chi-square (X²) was used to determine differences in prevalence. The overall prevalence rate of fasciolosis was 81.21% (81/384) and the prevalence rate of Fasciola hepatica, Fasciola gigantia and mixed Fasciola infection were 13.54% (52/384), 4.94% (19/384), and 2.6% (10/384), respectively. Statistically significant difference (P<0.05) was observed between the infection rates of Fasciola species. The prevalence of bovine fasciolosis was found to be significant (P<0.05) in relation to age of animals, in which young animals were more affected than adult animals. There was a significant difference (P<0.05) in the prevalence of bovine fasciolosis within different body conditions. The highest prevalence (50%) was found in animals with poor body condition and the lowest prevalence (12.64%) was found in good body conditioned animals. Sex of the animals was not found as a significant factor (P > 0.05) in causing bovine fasciolosis. Based on retail value of bovine liver, the direct economic loss from fasciolosis during the study time was estimated to be 63,504 ETB annually. Further research should be conducted on indirect economic loss of bovine fasciolosis and effective control measures should be implemented in the study area.

Key words: Bovine fasciolosis, economic importance, Fasciola hepatica, Fasciola gigantica, Dembi Dolo.

1. Introduction

Developing countries have nearly two third of the world’s livestock production but produces less than a third of the world’s meat and a fifth of its milk (WHO, 1995)[1]. Similarly, Ethiopia is one of the countries endowed with large and diverse livestock resources of which cattle accounts 53,990,061(CSA, 2013)[2]. However, many factors affect the maximum benefit to be obtained from livestock production and parasitic diseases are the major factors (ILRI, 2009)[3].

Parasitic infections have great economic impact, especially in developing countries. Parasitic worms (helminths) are a great success in an evolutionary sense, but are equally successful at causing a massive burden of human and animal disease. It has been said by one renowned parasitologist, “There are more different species of parasitic worms in the world than there are people in the world” [4]. Plant-borne trematodes have recently been included in the list considered by the Institute of Food Technologists Expert Panel on Food Safety and Nutrition [5]. More recently fasciolosis and other food-borne trematodiases were added to the list of important helminthiases with a great impact on human development at the Third Global Meeting of the Partners for Parasite Control held in WHO Headquarters Geneva in November 2004 [6]. Fasciolosis is an economically important parasitic disease, which is caused by trematodes of the genus Fasciola that migrate in the hepatic parenchyma and establish in the bile ducts. The two most important species are Fasciola hepatica found in temperate area and in cooler areas of high altitude above 1800 m.a.s.l in the tropics and subtropics and Fasciola gigantica, predominates in tropical area of altitude less than 1200 m.a.s.l. Mixed infection of fasciolosis occurs in tropical and subtropical areas between altitude of 1200-1800 meter above sea level (m.a.s.l) [7]. Fasciolosis caused by Fasciola hepatica and Fasciola gigantica, is one of the most prevalent helminth infections of ruminants in different parts of the world including Ethiopia [1-8]. The life cycle of these trematodes involves snail as an intermediate host [9]. Lymnaea truncatula is the most important intermediate host for Fasciola hepatica while Lymnaea natalensis and Lymnaea rubiginosa are among the main intermediate host species for Fasciola gigantica. However, some Lymnaea species (Radix peragra, Lymnaea natalensis, Lymnaea truncatula) are suitable intermediate hosts for both Fasciola gigantica and Fasciola hepatica [10].

The definitive host range of these parasites is very broad. Although herbivorous animals are the most susceptible hosts, other animal species and humans may also be infected (WHO, 1995) [1]. The adult parasites
reside in the liver of the definite hosts causing associated pathologies, and use lymnaeid snail intermediate hosts to complete their life cycles. The adult fluke can produce up to 20,000 eggs per day that are passed with the faeces to contaminate the environment. In a moist environment, miracidia hatched from these eggs may penetrate the intermediate snail host. After development and multiplication inside the snail, cercariae are released and attach to submerged blades of grass or other vegetation to become metacercariae. Humans and animals get infected by eating aquatic plants and by grazing, respectively, and by drinking water contaminated with metacercariae.\cite{10}

Fasciolosis imposes direct and indirect economic impact on livestock production, particularly of cattle and sheep \cite{11-12}. Economic losses due to fasciolososis includes death, loss in carcass weight, reduction in milk yield, condemnation of affected liver, decline production and productive performances, exposure of animals to other diseases due to secondary complications and cost of treatment expenses. Both Fasciola hepatica (high land) and Fasciola gigantica (low land) type of liver flukes cause severe losses in Ethiopia where suitable ecological conditions for the growth and multiplication of intermediate host snails are available\cite{13}.

The presence of fasciolosis due to Fasciola hepatica and Fasciola gigantica in Ethiopia has long been known and its prevalence and economic significance has been reported by several workers\cite{14-16}. Dembi Dolo is one of the areas where the environmental conditions and altitude conducive for the occurrence and transmission of fasciolosis. However no information is available about its prevalence and economic significance in the study area. Therefore the current study aims to estimate the prevalence of bovine fasciolosis and to assess the direct economic loss due to liver condemnation in Dembi Dolo municipal abattoir.

2. Materials and Methods

2.1. Description of the study area

The study was conducted at Dembi Dolo municipal abattoir which is found in Dembi Dolo town. Dembi Dolo town is found in Kellem Wollega Zone of Oromia Regional State of Ethiopia. Dembi Dolo is located at 652 km away from the capital city, Addis Ababa, towards the south west of Ethiopia. It’s the capital of Kellem Wollega Zone of Oromia region. The town has latitude and longitude of 8°32’N and 34°48’E respectively. The climate alternates with long summer rain fall (June to September) and winter dry season (October to May) with mean annual rain fall of 700mm-1100mm. The agro-climate condition fall within tropical sub- humid climate and the altitude range from 1701- 1827m above sea level with an average daily temperature 25°C \cite{17}.The livestock populations in the district include cattle, sheep, goat, horses, donkey and poultry. The vegetation type of the area is characterized by common cash crops. The district covers an area of 79,849 hectares and it is bordered by Hawegalen district at east, Anfillo district at west, Gidami district at north and Illubabor zone at south. The cattle population in Kellem Wollega zone of Seyo woreda is estimated to be about 859,614. The animals were maintained under traditional management system \cite{18}.

2.2. Study Design

A cross-sectional study was conducted during routine ante mortem and post mortem inspection on randomly selected cattle slaughtered at Dembi Dolo municipal abattoir from November, 2014 to April, 2015 to estimate prevalence and to assess direct losses due to liver condemnation.

Ante mortem inspection: Ante mortem inspection recommended by Gracey (1986)\cite{19} was used. The active abattoir survey was conducted during meat inspection on randomly selected cattle slaughtered at Dembi Dolo municipal abattoir. In the survey, study animal was selected by systematic random sampling on the basis of the entrance of animals into lairage. The age, sex and body condition of individual animal was identified and recorded. Body condition for each cattle was estimated based on Nicholson and Butterworth (1986) ranging from score 1 (emaciated) to score 5 (obese). In this case, three classes of scoring were used, poor (Score 2), medium (Score 3 and 4) and good (score 5). There was no any animal slaughtered at score 1. The age of the animal was estimated on the basis of dentitions (Delahunta and Habel, 1986) and all animals slaughtered were local zebu breed of cattle and grouped into young (< 5 years) and adult (> 5 years) based on their age\cite{20}.

Post mortem examination: The liver of each study animal was carefully examined for presence of lesions suggestive of Fasciola infection externally and incised for confirmation. Liver flukes were detected by cutting the infected liver into fine, approximately 1 cm slices with a sharp knife. Each mature fluke was identified to species level according to its shape and size. Investigation and identification of Fasciola was done according to their distinct morphological characteristics following the standard guidelines given by Urquhart et al. (1996)\cite{20}.

Sample Size and Sampling Method

The sample size was determined by simple random sampling method using 95% confidence interval and calculated by using the formula given by Thrusfield (2005) with 5% absolute precision and at 50% expected prevalence. According to the formula a total of 384 animals were included in the study. The animals were selected at the entrance to the abattoir identified by their owner’s name and recorded accordingly on a format prepared for this purpose. Systematic random sampling technique was used to select animals slaughtered in the abattoir.
\[ N = 1.96^2 \times P_{\exp}(1 - P_{\exp})/d^2 \]

Where, \( N \) = sample size

\( P_{\exp} \) = expected prevalence,

\( d \) = desired level of precision.

**Economic loss assessments**

Generally, all infected livers with fasciolosis were considered to be unfit for human consumption and if any liver was infected by *Fasciola* at the Dembi Dolo municipal abattoir, it was totally condemned. Economic losses were calculated based on condemned livers due to fasciolosis. In the study abattoir, the average annual cattle slaughtered rate was estimated to be 6048, while mean retail price of bovine liver in Dembi Dolo town was 50 ETB. The estimated annual loss from condemned liver was calculated according to mathematical computation using the formula set by Ogunrinade and Adegoke (21)

\[ ALC = CSR \times LC \times P \]

Where: \( ALC \) = Annual loss from liver condemnation,

\( CSR \) = mean annual cattle slaughtered at Dembi Dolo municipal abattoir,

\( LC \) = mean cost of one liver in Dembi Dolo town and

\( P \) = prevalence of bovine fasciolasis at Dembi Dolo abattoir.

**Data Analysis**

The data which were recorded during the study period were entered into Microsoft Excel sheet. Data were summarized and analyzed using statistical package for social sciences (SPSS) version 16 computer program. The Pearson’s Chi-square \( (X^2) \) test at a significance level of 5 % and 95% CI was used to determine the differences in the prevalence of fasciolosis infection among different sexes, between ages and among body conditions of cattle. A 5% significant level was used to determine the differences in the prevalence of fasciolosis infection between different sexes, ages and among body conditions. The difference was considered as statistically significant if the \( P\)-value was less than 0.05.

3. Results

**Prevalence of different species of *Fasciola***

A total of 384 indigenous cattle breeds that were slaughtered at Dembi Dolo municipal abattoir were examined for the presence of fasciolosis. Among the examined animals, 21.1% (81/384) were positive for fasciolosis. There was statistically significant difference \( (P<0.05) \) in between species of *Fasciola*. Among the examined animals, 13.54% (52 livers) harbored *Fasciola hepatica*, 4.94% (19 livers) harbored *Fasciola gigantica* and the remaining 10 (2.6%) livers harbored mixed infection of *Fasciola* species. Out of 81 livers positive for fasciolosis, 52 livers (64.19%) harbored *Fasciola hepatica*, 23.45% (19 livers) harbored *Fasciola gigantica* and the remaining 10 (12.34%) livers harbored mixed infection of *Fasciola* (Table 1).

**Prevalence in relation to age, sex and body condition**

A total of 384 indigenous cattle breeds that were slaughtered at Dembi Dolo municipal abattoir were examined for the presence of fasciolosis. There was a statistically significant difference \( (P<0.05) \) in the prevalence of bovine fasciolosis in different age groups considered. Among the examined animals, 239 were adult animals from which 41 (17.15%) were found positive and 145 were young animals from which 40 (27.5) of them found positive (Table 2). There was a significant difference \( (P<0.05) \) in the prevalence of bovine fasciolosis within different body conditions. Among the examined animals, 174 were animals with good body condition from which 22 (12.64%) animals were found positive, 170 were animals with medium body condition from which 39 (22.94%) animals were found positive and 40 animals had poor body condition from which 20 (50%) animals were found positive for fasciolosis. There was no significant difference \( (P>0.05) \) in the prevalence of bovine fasciolosis in relation to sex. Among 384 indigenous cattle breeds that were slaughtered at Dembi Dolo municipal abattoir, 350 animals were male from which 75 (21.42%) animals found positive and 34 animals were female from which 6 (17.65%) animals were found positive for fasciolosis (Table 2).

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<th>Table 1. Prevalence of different species of <em>Fasciola</em>**</th>
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<td>Species of <em>Fasciola</em></td>
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Economic loss assessments

The estimated annual loss from organ condemnation was calculated according to mathematical computation using the formula:

\[ ALC = CSR \times LC \times P \]
\[ = 6048 \times 50 \text{ETB} \times 0.21 \]
\[ = 63,504 \text{ETB} \]

Where \( ALC \) = Annual loss from liver condemnation, \( CSR \) = mean annual cattle slaughtered at Dembi Dolo municipal abattoir, \( LC \) = mean cost of one liver in Dembi Dolo town and \( P \) = prevalence of bovine fasciolosis at Dembi Dolo abattoir, \( CSR = 6048 \text{ head, LC} = 50 \text{ETB} \) and \( P = 0.21 \). So, the annual loss from liver condemnation in Dembi Dolo town was estimated to be 63,504 ETB.

**DISCUSSION**

The overall prevalence of bovine fasciolosis (21.1%) observed in this study was in a very close agreement with the report of Petros et al. [16] from Eastern Wollega of Ethiopia, who reported a 21.9% prevalence of fasciolosis in cattle slaughtered at Nekemte municipal abattoir. This result is also in close agreement with the report of Berhe et al.[23] from northern Ethiopia, who reported 24.3% prevalence in Bahir Dar. However, it is much lower than that of many other studies from different abattoirs in the country and elsewhere in Africa. Yilma and Mesfin (2000)[14] reported a 90.7% prevalence of fasciolosis in cattle slaughtered at Gondar abattoir, while Tolosa and Tigre [24] recorded a prevalence of 46.2% at Jimma abattoir. Phiri et al.[25] from Zambia and Pfukenyi and Mukaratirwa (2004) from Zimbabwe reported 53.9 and 31.7% prevalence, respectively. However, the prevalence of fasciolosis recorded in this study is higher than that of Dire Dawa municipal abattoir (14.4%) [26]. A lower prevalence of fasciolosis (14.0%) has also been observed in cattle slaughtered at Wolaita Soddo abattoir[27]. Difference in prevalence among geographical locations is attributed mainly to the variation in the climatic and ecological conditions such as altitude, amount and pattern of rainfall and temperature. Fasciola species prevalence has been reported to vary over the years mainly due to variation in amount and pattern of rainfall.

The result of present study revealed that the sex of animals did not have significant effect (\( P > 0.05 \)) on the occurrence of bovine fasciolosis. This agrees with the report of Petros et al. [16] and with Rahamato et al. (2009) who reported that sex has no impact on the infection rate and hence both male and female are equally susceptible and exposed to fasciolosis. On the contrary, Block and Arthur[28] revealed a higher prevalence in the male than female. The result of present study showed that age has significant effect (\( P < 0.05 \)) on the prevalence of bovine fasciolosis, being higher in young animals than the adult. There was a decrease in infection rate as age increased. This may be due to the result of acquired immunity with age which is manifested by humoral immune response and tissue reaction in bovine liver due to previous challenge. There are some additional reports confirming that the increased resistance against fasciolosis (low prevalence) with age is most likely related to liver fibrosis which impedes the passage of immature flukes, stenosis and calcification of bile ducts, assumed unfavorable site for adult parasites and consequently fasten their expulsion. These are in agreement with experimental study conducted by Radostitis et al.[29] and Petros et al. (2013)[16] which confirmed the occurrence of higher infection rate in younger animals.

The results of the present study indicated that body condition of the animal has significant association (\( P<0.05 \)) with the occurrence of fasciolosis. The prevalence was higher in poor body conditioned animals than that of medium and good body conditioned animals. This may be attributed to poor body condition is manifested in cattle when fasciolosis reaches at its chronic stage. Post mortem examination on the 81 Fasciola infected livers of current results indicated that 52 livers harbored Fasciola hepatica, 19 livers harbored Fasciola gigantica and only 10 livers harbored mixed infection of Fasciola species. This indicated the prevalence of Fasciola hepatica (13.54%) was higher than that of Fasciola gigantica (4.94%) which was higher than prevalence of mixed infection of Fasciola species (2.6%). The high prevalence of Fasciola hepatica may be associated with the presence of favorable ecological biotypes for its snail vector Lymnaea truncatula and also the ability of the snail to easily adapt to new environment.

The total annual economic losses encountered due to condemnation of infected liver in Dembi Dolo town were calculated as 63504 ETB. This result is very similar with the result by Petros et al. (2013)[16] who reported total loss of 63072 ETB from condemned liver due to fasciolosis in Nekemte town. This may be due to equivalent number of animals slaughtered in both town (Demi Dolo and Nekemte). However it is much lower than the results reported by Abdul (1992) and Daniel [26] who reported a total economic loss of 154,188 and 215,000 ETB, respectively annually in cattle due to fasciolosis at Ziway and Dire Dawa municipal abattoirs, respectively. These higher values may be due to higher number of animals slaughtered at Dire Dawa and Ziway abattoirs. In addition ecological conditions and the number of intermediate host found around the area may also be another factor contributing to the decrement of the economic loss.

4. **Conclusions**

Bovine fasciolosis is one of the major setbacks to livestock productivity, incurring huge direct and indirect economic losses in the country. The current study identified bovine fasciolosis as a cause of high liver condemnation which results in financial loss of about 63,504 ETB per annum. Hence, this study may be valuable for the municipality and the country by providing data about prevalence of bovine fasciolosis in the area and consequently of economic significance as
all of the observed conditions leading to condemnation of liver. Therefore, in order to control bovine fasciolosis and reduce its economic loss, strategic use of effective anthelmintics against *Fasciola* parasite and fencing of an environment harboring *Fasciola* vectors should be instituted.

5. References

17. SDARDO (Seyo District Agricultural and Rural Development Office) (2014). Annual report