Study on Prevalence of Bovine Fasciolosis and Its Economic Impact at Sheno Municipal Abattoir, North Shewa, Ethiopia

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ABSTRACT
A cross sectional study was carried out with the objectives to determining the prevalence, risk factor and economic importance of bovine Fasciolosis in Sheno town. A total of 327 cattle from four different areas were selected randomly at Sheno municipal and coprological and post-mortem examination was conducted. Economic loss was calculated on the totally or partially condemned organs. The prevalence of bovine fasciolosis by coprological and post mortem examination was 72.8% and 74.0%, respectively. Based on origins of animals, prevalence rates of 31.1%, 97.4%, 83.1% and 77.8% were recorded from animals came from Addis Ababa, Kottu, Hamus Gebeya and Mutte, respectively. Prevalence of 94.6%, 73.5% and 53.4% were observed in animals of poor, medium and good body condition, respectively. Statistically significant difference (P<0.05) of bovine fasciolosis was observed among different origin and different body condition. No significant effect on prevalence was observed due to age and sex. Among 242 infected livers, 225 (68.8%) and 17 (5.2%) of them were harboured with Fasciola hepatica and Fasciola gigantica, respectively. There was significant difference (P<0.05) between the Fasciola species among the animals from different origin. Highest prevalence of F. hepatica (96.8%) and F. gigantica (16.2%) was found in animals originated from Kottu and Addis Ababa, respectively. The high prevalence of bovine fasciolosis causes great economic losses as a result of condemnation of infected livers and carcass weight loss. The direct and indirect losses incurred due to fasciolosis in Sheno municipal abattoir were estimated about 1,751,432 Ethiopian Birr (80673.98 US Dollar).

Key words: Abattoir, Fasciolosis, Prevalence, Sheno.

INTRODUCTION
Ethiopia owns huge number of ruminants having high contribution for meat consumption and generates cash income from export of live animals, meat, edible organs and skin. In spite of the presence of huge ruminant population, Ethiopia fails to optimally exploit these resources due to a number of factors (ILRI, 2009). Livestock sector is affected by different problems, among these parasitism represents a major obstacle to the development of one countries animal production (Malone et al., 1998).

Fasciolosis is an important parasitic disease of domestic ruminants caused by two liver fluke species: F. hepatica and F. gigantica (Mas-Coma et al., 2005). Fasciolosis has an indirect life cycle with snails as intermediate hosts, typically from the genus Lymnaea. The geographic distribution of Fasciola species is dependent on the distribution of suitable species of snails such as Lymnae natalensis and Lymnae truncatula, the most common intermediate hosts and usually associated with herds and flocks grazing wet marshy land area (Brown, 2005).
In Ethiopia, the highlands contain pockets of water logged marshy areas. These provide suitable habitats year round for the snail intermediate hosts (Solomon and Abebe, 2007). The disease is responsible for considerable economic losses to cattle industry, mainly through mortality, liver condemnation, reduced meat, milk and wool production as well as from treatment cost (Ramajo et al., 2001). The damage caused by liver flukes to the animal host includes the destruction of tissues during their migrations in the body, especially in the liver and, in the case of *F. hepatica*, thickening of bile ducts. Such livers, when they are seriously damaged, are subject to condemnation at meat inspection. They are responsible for widespread mortality and morbidity in cattle characterized by weight loss, reduced carcass quality, anemia and hypoproteinemia (Urquahurt et al., 2007). There are scarce report on bovine fasciolosis prevalence and economic significance in the study area. Therefore the study was done to determine the prevalence of bovine fasciolosis, to access risk factors of fasciola infection in bovine and to estimate the economic loss due to the disease in the study area.

**MATERIALS AND METHODS**

**Study Area**

This study was conducted on the kembibit district, Sheno town, North Shewa zone of Oromia regional state, which is 78km from Addis Ababa. The area is characterized by bi-modal rainfall pattern with the main rainy season extending from June to September and short rainy season that stretches from February to March. Kembibit district extends from 9°12′-9°32′N latitude and 33°-39°04′E longitudes. The altitude of area ranges from 2400-3500 metre above sea level and predominantly has semi-arid types of climate. The average annual rainfall was 1056mm; annual minimum and maximum temperature are 12°C and 22°C, respectively (CSA, 2012).

**Study Animal**

The study animals were 327 local cattle breeds brought from different markets of Kembebit district and Addis Ababa at Shenno municipality abattoir. During sampling, sex, age, origin of animals (place) and body conditions of all the sampled cattle were recorded to estimate the prevalence of fasciolosis and assess the associated potential risk factors. Five female animals were slaughtered during the study period because of problems related with infertility, mechanical injury and age (older animal).

**Study Design and Sampling Size Determination**

A cross-sectional study was carried out to determine the prevalence and the economic importance of fasciolosis among randomly sampled cattle using coprological (sedimentation techniques) and post-mortem examination of liver. The sample size required for this study was determined by using the formula given by Thrusfield (2005) using simple random sampling technique, with 5% absolute precision and at 21.6%expected prevalence were done by (Alemayehu et al., 2012).

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

Where: \( n \) = total number of sample size; \( d \) = absolute precision; \( P_{exp} \) = expected prevalence
Using the formula given above, the minimum sample size was calculated to be 260. However, to correct the design effect and increase the precision of the results, the sample size was increased to 327.

**Study Methodology**

**Ante-mortem inspection:** Data collected during ante-mortem examination included age, sex, body condition score and origin of animals. Animals were categorized into two age groups as young (<6 years) and adult (> 6 years) based on their dentition (Johnson, 1997). In addition animals also classified in to three groups based on their body condition score (BCS) as poor, medium and good (Nicholson and Butterworth, 1986).

**Coprological examination:** Prior to sampling; an identification number was given to each cattle presented to the abattoir. Faecal samples were collected directly from the rectum of each cattle, using disposable plastic gloves and placed in clean universal bottle and each sample was labelled with cattle identification number, age, sex, BCS, date and origin. Then the samples were preserved with 10% formalin solution. The samples were taken to kembibit veterinary mini laboratory and examined for *Fasciola* eggs by using sedimentation technique. Morphological identification of eggs of *Fasciola* was conducted according to (Urquhart et al., 2007). To differentiate between eggs of *Paramphistomum* species and *Fasciola* species, a drop of methylene blue solution was added to the sediment where eggs of *Fasciola* species showed yellowish colour while eggs of *Paramphistomum* species stained by methylene blue as described by Hanson and Perry (1994).

**Post mortem examination:** Animals examined during the ante mortem examination further supervised and their livers and associated bile duct was carefully examined by visualization and palpation of the entire organ followed by incision along the bile ducts of the lobes (FAO, 2003). Matured flukes were collected into the universal bottles containing 5% formalin and examined to identify the involved species. The liver fluke collected was classified into two species (*F. hepatica* and *F. gigantica*) based on morphological features described by Urquhart et al. (2007).

**Economic loss assessment:** Direct economic loss was resulted from condemnation of liver affected by fasciolosis. Generally, all infected livers with fasciolosis were considered to be unfit for human consumption. The average number of cattle slaughtered at the abattoir was 1525 per year based on two consecutive year recorded data in the abattoir. A 10% estimated carcass weight loss due to fasciolosis was the parameter used for calculating carcass weight loss. 126 kg is estimated as average carcass weight of Ethiopian zebu (ILCA, 1993). After through interview made with local butcher men in Shenno town, the mean retail price of one liver and one kilogram of meat was taken as 40 and 120 birr respectively. The economic loss due to liver condemnation was estimated by the formula set by Ogunrinade and Ogunrinade (1980) as follows:

\[
\text{Direct annual cost loss of condemned liver} = NAL \times \%\text{COND} \times CL.
\]

Where, NAL = Average number of cattle slaughtered in Shenno Municipal Abattoir per year; \%\text{COND} = Percentage of liver condemned due to fasciolosis and \text{CL} = \text{Mean cost of one liver in Shenno town.}

\[
\text{Indirect Annual economic loss due to loss in meat production} = NAL \times CL \times P_A \times P_{rev}.
\]
Where, NAL = Average number of cattle slaughtered in Shenno municipal abattoir; CL = Carcass weight loss in individual animal due to fasciolosis; \( P_A \) = Average market price of one kilogram meat in Shenno town and \( P_{rev.} \) = Prevalence rate of fasciolosis in Shenno municipal abattoir.

**Data Management and Analysis**

The raw data generated from the study were entered into Microsoft Excel database organized and arranged using Microsoft Excel spreadsheet computer program and was imported to be analyzed by STATA 11. Chi-square \( (\chi^2) \) was used to determine the statistical association between infection rates, age, sex, origin, and body condition score. A statistically significant association between variables was considered to exist if the calculated p-value is less than 0.05 with 95% confidence level.

**RESULTS AND DISCUSSION**

**Prevalence of Bovine Fasciolosis**

Totally 327 cattle were examined for fasciolosis at Shenno municipal abattoir. Out of 327 faecal samples and liver examined, 72.8% \( (n = 238) \) and 74.0% \( (n = 242) \) were found positive for coprological and post-mortem examination, respectively (fig 1).

The prevalence of bovine fasciolosis found in the present study was higher by post mortem finding than the coprological examination. This finding was in agreement with that of Nega et al. (2012) and Negesse and Mohammed (2014), who reported the proportion of positive samples obtained by post-mortem examination was significantly higher than coprological examination. This is due to longer pre-patent period from 8-15 weeks after infection from the egg to appear in the faeces and it could be due the fact that the fasciola species found during the post-mortem examination could be immature (Radostits et al., 2007).

The prevalence indicated by faecal examination in the present study was higher than reported from 4.9% in Soddo (Fufa Abunna et al., 2010); 19.09% in Mekelle (Tesfay et al., 2012) and 36.72% in Bahir Dar (Fikirtemariam et al., 2013). This great variability shown could be probably due to the ecological and climatic differences between different locations throughout the country. Moreover one of the most important factors that influence the occurrence of fasciolosis in an area is availability of the suitable snail habitat (Urquhart et al., 2007).

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**Coprological Finding**

From a total of 327 faecal samples examined, 238 (72.8%) samples were found positive for bovine fasciolosis. Statistically significant difference \( (P<0.05) \) of bovine fasciolosis was observed among different origin and various body condition. However, the prevalence of bovine fasciolosis in age and sex groups was not statistically significant \( (P>0.05) \) (Table 1).

The prevalence of bovine fasciolosis was varied among origins. Higher prevalence was recorded in cattle purchased from Kottu followed by Hamusgebeya, Mutte, and Addis Ababa. This could be explained by the difference in the presence of intermediate hosts in the marshy grazing area and variation in the climatic such as altitude, rainfall, temperature and management systems of bovine.

Higher prevalence of bovine fasciolosis was observed in poor body conditioned animals. This finding is in line with study report of Demssie et al., (2012); Sisay and Nibret, (2013); Negesse and Mohammed, (2014) who reported high prevalence in cattle with poor body condition.
compared to cattle in medium and good body condition. This indicates the importance of bovine fasciolosis in causing weight loss and is the characteristic sign of the disease. Chronic fasciolosis is the common form of the disease in cattle and one of the characteristic signs is weight loss with emaciation (Urquhart et al., 2007).

The prevalence of bovine fasciolosis was varied among age group and higher prevalence was recorded in adult than young animal but they did not differ significantly. The present findings disagree with the findings of Nganga et al. (2004) from Kenya; Bekele et al., (2014), from Hossana. However, this result is in line with Atanfe and Melaku, (2012), who reported non-significant difference between age groups. This might be due to all age groups are grazing communally in the marshy area which allows both age groups for equal and continuous infective larvae exposure.

Non-significant difference among sex on prevalence of fasciolosis in the current study contradicts with the finding of Negesse and Mohammed, 2014 in Woliata Soddo. However, the result is in agreement with several previous reports in different parts of the countries (Keyyu et al., 2005; Phiri et al., 2005; Solomon and Abebe 2007; Khan et al., 2009; Kabir et al., 2010). This could be associated with similar management given to both male and females cattle. In communal grazing areas, both females and males graze on the same pasture and move in searching of food and water together, which expose to the same risk of infection.

Post Mortem Finding

From the total of 327 slaughtered cattle, 242 (74.0%) livers were found positive for liver fluke infection (Table 2). There was significant variation (P<0.05) in the prevalence of bovine fasciolosis among the four animal origins and body conditions but there was no statistically significant difference (P>0.05) in sex and age groups.

The prevalence indicated by post-mortem examination in the present study was lower than the findings by Yilma and Mesfin, (2000) in North Gonder (90.65%) which is due to difference in to ecology, climate and management system. However it is higher than 39.7%, 32.3%, 34.97% and 28.6% reported in in Wondogenet (Getachew et al., 2006); in Adwa (Mhreteab et al., 2010); in Assela (Shiferaw et al., 2011) and in Debre Zeit (Yemisrach and Mekonnen, 2012), respectively.

From the total of 327 slaughtered cattle, 242 livers were found positive for liver fluke infection and from these 225 livers (68.8%) harboured F. hepatica, 17 livers (5.2%) harbour F. gigantica as indicated in Table 3. F. hepatica prevalence was highest in cattle originated from Kottu (96.8%) and highest F. gigantica was encountered in cattle from Addis Ababa (16.2%). There was statistical significant difference origin related in the prevalence of Fasciola species (P<0.05).

Post-mortem examination of the infected livers revealed that F. hepatica was the most prevalent species compared to F. gigantica. Higher prevalence (89.70%) of F. hepatica was reported by Fikirtemariam (2013) at Bahir Dar. More or less similar findings were reported by Tolosa and Tigre, (2007) in Jimma; Gebretsadik et al., (2009) in Mekelle; Alula et al., (2013) in Wolita Soddo and Negesse and Mohammed, (2014) in Nekemt. However, Fufa et al. (2009) stated that F. gigantica was the most common liver fluke species affecting cattle at Welaita Soddo which is due to the fact that the cattle slaughtered in the abattoir were originated from lowlands.
Economical Loss Assessment

In the study abattoir the average annual cattle slaughtered rate was estimated to be 1525 while mean retail price of Bovine liver in Sheno town was 40 ETB. A total of 45140 ETB (2079.23 USD) annual direct losses were calculated from organ condemnation using the current abattoir prevalence of 74.0%. In the study area the average price of 1kg beef was 120 ETB. The average carcass weight of adult cattle was 126kg. The annual indirect economic loss from carcass weight reduction due to Bovine fasciolosis was calculated 1706292 ETB (78594.75 USD). Finally the total annual economic loss (direct and indirect economic loss) was calculated to be 1,751,432.ETB (80673.98 USD).

The total economic loss incurred during this study due to condemnation of infected liver was higher than the finding in Ziway 154,888 ETB (Adem, 1994); in Dire Dawa 251,000 ETB (Daneil, 1995) and in Assela 698,700.6 ETB (Alula, 2013). However the loss in the current study was lowers than 3,003,488.1 ETB (138,345.84 USD) in Jimma (Terefe et al., 2012) and 3,711,246 ETB (170,946.40 USD) in Woliata Soddo (Negesse and Mohammed, 2014) per annum in cattle due to fasciolosis. The estimated economic losses could be attributed to the increase in the price of liver and meat.

The current finding showed that bovine fasciolosis is the most common and economically important parasitic disease affecting the health and productivity of animals in the study area. It causes great economic losses as a result of condemnation of infected livers and carcass weight loss. The most prevalent Fasciola species obtained in condemned livers was Fasciola hepatica. Prevalence of bovine fasciolosis had significant association with origin and body condition of cattle but not with age and sex of the animal. Therefore, further epidemiological surveillance on the distribution and its economic impact should be conducted for the holistic implementation of bovine fasciolosis control. Strategic bovine fasciolosis control method with an integrated approach should be designed and implemented in the area.

ACKNOWLEDGEMENTS

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REFERENCES


Figure 1: Comparisons between coprological and post-mortem examination

Table 1: Coprological prevalence of bovine fasciolosis by origin, sex, age, and BCS of cattle

<table>
<thead>
<tr>
<th>Category</th>
<th>Variable</th>
<th>Number of animal examined</th>
<th>Number of positive</th>
<th>Prevalence (%)</th>
<th>$\chi^2$</th>
<th>P-value</th>
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<td>7</td>
<td>77.8</td>
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Table 2: PME of Bovine Fasciolosis based on their age, sex, BCS and origin

<table>
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<tr>
<th>Category</th>
<th>Variable</th>
<th>Number of animal examined</th>
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<th>Prevalence</th>
<th>$\chi^2$</th>
<th>P-value</th>
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Table 3: Origin wise prevalence of *Fasciola hepatica* and *Fasciola gigantica*

<table>
<thead>
<tr>
<th>Origin</th>
<th>Number of animal examined</th>
<th>$F.\ hepatica$ (%)</th>
<th>$F.\ gigantica$ (%)</th>
<th>$\chi^2$</th>
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<tr>
<td>Total</td>
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