Prevalence of Bovine Fasciolosis and its Associated Risk Factors in Mekelle Municipal Abattoir.

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Fasciolosis is disease causing mortality and production losses mainly in ruminants. The prevalence and risk factors of fasciolosis were determined in cattle at Mekelle municipality abattoir using liver inspection and faecal examination techniques. Out of the 703 bovine species, 22.76% (160) and 19.06% (134) were positive for fasciolosis infection through postmortem and faecal examinations respectively. The percentage agreement between the two diagnostic methods was found 83.75%. However, postmortem examination of infected livers was better for diagnosis of fasciolosis in slaughtered animals as early infection can also be diagnosed. In the study, significant variation in monthly prevalence of fasciolosis was not observed ($\chi^2 = 5.075, p = 0.166$). Among the possible risk factors associated with fasciolosis, only body condition of the animals was important ($\chi^2 = 82.435, p = 0.00$). However age, sex and breed of the cattle did not show significant impact ($p > 0.05$). From the finding, the dominant species in the study area was $F. hepatica$ (53.75%), while $F. gigantica$, mixed infection and unidentified immature flukes were recorded in 22.5%, 14.38% and 9.38% respectively. The financial loss due to liver condemnation in the abattoir was estimated about 52,591.30 Ethiopian birr per annual.

**Keywords:** Coproscopic examination; Fasciolosis; Prevalence; Postmortem Examination; Mekelle abattoir

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Received (January 2012), accepted (May 2012)
**Introduction**

Topical fasciolosis caused by *F. hepatica* and *F. gigantica* is regarded as one of the most important helminth infection in ruminants (Keyyu et al., 2005). Cattle, sheep and buffalo are the most important species of farm livestock affected by Fasciola species. *F. gigantica* is geographically restricted to South America and Africa. While, *F. hepatica* shows broader geographical distribution in the cooler areas of the world (Urquhart et al., 1996). The distribution of *F. hepatica* increased in the last decades mainly due to water resource developments to meet the agricultural need of the growing population associated with livestock management practice (Keiser and Utzinger, 2005).

In the Ethiopian highlands, fasciolosis is also major health problem and causes production losses in domestic ruminants. Highland regions of the country contain pockets of waterlogged marshy areas that provide suitable habitats year round for the snail intermediate hosts (Brook et al., 1985).

Several studies have been conducted on the epidemiological distribution of fasciolosis in different parts of Ethiopia (Yilma and Mesfin, 2000; Tilahun et al., 2006; Tolosa and Tigre, 2007; Fufa et al., 2009; Rahmeto et al., 2010). The prevalence of fasciolosis in Ethiopia ranges from 11.5% in low lands to 87% in central high lands (Malone et al., 1998). The low-lying areas in the highlands have poor drainage and the soil is acidic, which favors development of the parasites (Brook et al., 1985). Apart from the environmental factors and ethological agents, host related factors are also major risk causes for animal health and production losses (Dohoo et al., 1996).

In Tigray, several studies have been conducted on prevalence and economic losses associated with fasciolosis based on abattoir surveys (Gebretsadik et al., 2009; Bekele et al., 2010). However, studies on risk factors of bovine fasciolosis in cattle were lacking. This present study was conducted to determine the prevalence of fasciolosis by faecal and postmortem examination and to assess the risk factors associated with the presence of infestation.

**Methodology**

**Description of study area**

The study was conducted from November 2010 to February 2011 at Mekelle municipality abattoir. Mekelle is the capital of Tigray region located in Northern part of Ethiopia, 783 Km North of Addis Ababa. Mekelle has latitude of about 13° 30'593"N and longitude of about 39°28'849 E and an elevation ranging from 2008 to 2228 M.a.s.l. The mean annual rainfall of the study area is 628.8 mm and the rain is bimodal with short rainy season occurring from March to May and long rainy season from June to August, followed by the dry season from middle of September to February. The annual minimum and maximum temperature is 11.8 °C and 29.94 °C, respectively.

**Study methodology**

Three days visit was made for ante-mortem examination and postmortem examination of slaughtered cattle. Information was collected about the animals’ origin from butchers. In particular, age, sex, breed, origin, and body condition of each individual cattle was recorded. Body scoring of the cattle was made based on the method described by Nicholson and Butterworth (1986). Each scoring were given number from 1(L-, very lean) to 9 (F+, very fat) and these scores finally included under three body condition scores, good, medium and poor (Table 1). The age of the animals was estimated by means of their dentition as described by Kelly (1975).
Table 1 A table summarizing body scores scales and determination parameters.

<table>
<thead>
<tr>
<th>Score</th>
<th>Condition</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L-</td>
<td>Marked emaciation (animal would be condemned at ante mortem examination)</td>
</tr>
<tr>
<td>2</td>
<td>L</td>
<td>Transverse processes project prominently, neural spines appear sharply. Individual dorsal spines are pointed to the touch; hips, pins, tail-head and ribs are prominent.</td>
</tr>
<tr>
<td>3</td>
<td>L+</td>
<td>Transverse processes visible, usually individually Ribs, hips and pins clearly visible. Muscle mass between hooks and pins slightly concave. Slightly more flesh above the transverse processes than in L+.</td>
</tr>
<tr>
<td>4</td>
<td>M-</td>
<td>Ribs usually visible, little fat cover, dorsal spines barely visible Animal smooth and well covered; dorsal spines cannot be seen, but are easily felt</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>Animal smooth and well covered, but fat deposits are not marked. Dorsal spines can be felt with firm pressure, but feel rounded rather than sharp.</td>
</tr>
<tr>
<td>6</td>
<td>M+</td>
<td>Fat cover in critical areas can be easily seen and felt; transverse processes cannot be seen or felt. Heavy deposits of fat clearly visible on tail-head, brisket and cod; dorsal spines, ribs, hooks and pins fully covered and cannot be felt even with firm pressure.</td>
</tr>
</tbody>
</table>

Sample size and sampling technique

The sample size was calculated according to Daniel (1995). The expected prevalence in the study area was 24.32 % (Gebretsadik et al., 2009). To correct the design effect and increase the precision of the result, two fold of the sample and 24 % of contingency were used hence, the sample size was 703.

Coprosopic and postmortem examination

Faecal sample collected from the cattle were placed in clean universal bottle preserved with 10% formalin labeled with the unique identification numbers. Faecal examination for Fasciola eggs was carried out using the sedimentation method described by Hansen and Perry (1996). Two gram of feces in a conical cup was mixed with 20ml of water and the mixture was sieved through a tea strainer into beaker and then to centrifuge tube. The mixture was centrifuged for three minutes at 1500 rpm and by removing the supernatant, the sediment was added a drop of methylene and well mixed. A drop of sediment was taken into slide and examined under microscope, eggs of Fasciola species were identified by their characteristics yellow color. The prevalence was calculated as the number of positive samples obtained divided the by number of cattle examined. After the cattle were slaughtered, livers were examined for Fasciola species. Identification of recovered fluke species was done using the identification measurement provided by Urquhart et al. (1996). The prevalence was calculated as the number of positive liver samples obtained divided by the number of cattle examined. The percent of agreement between the two methods was calculated according to Gordis (2000) as the number of positive samples by both methods divided by the number of samples that were positive for at least one method, multiplied by 100.

Assessment of economic Losses

Results from ante-mortem and postmortem examination were recorded in formats, including; the total number of cattle slaughtered, prevalence of fasciolosis, average weight of liver of mature cattle in kg and selling price of the cattle livers (expressed as birr/ kg of liver). Average selling price of cattle liver was obtained through asking in various meat shops in Mekelle municipality. In the abattoir, livers were randomly taken and weighed using weighing balance to get the average weight of the livers of cattle. The economic loss due to condemnation was estimated by the formula set by Oggunrinade and Oggunrinade (1980) as follows:

EL = Σsr X Coy X Roz.

Where:
EL = Annual loss estimated due to liver condemnation
Σsr = annual slaughter rates at the abattoir (estimated from retrospective abattoir record)
Coy = Average cost of each cattle liver
Roz = Condemnation rates of cattle liver due to fasciolosis

Data analysis

All raw data generated from this study were coded and entered in Micro Soft Excel spread sheet for data analysis; SPSS software version 16 was used. Descriptive statistics was used to determine the prevalence of the parasite and Chi-square (χ2) test was used to assess the association of the prevalence of fasciolosis and its associated risk factors such as sex, age, breed and body condition score of the animals. Statistical significance was set at P < 0.05 to
determine whether there are significant associations between the parameters measured and groups.

Results

Prevalence of fasciolosis

Totally 703 cattle were examined for fasciolosis at Mekelle municipal abattoir. Out of 703 faecal samples examined (N = 703), 19.09% (n = 134) were found positive for *Fasciola* species and out of 703 livers examined (N = 703), 22.76% (n = 160) were found to be positive (Table 2).

Table 2: Number of positive and negative cattle for *Fasciola* infection from coproscopic and postmortem examination in Mekelle municipal abattoir (November 2010 to February 2011)

<table>
<thead>
<tr>
<th>Type of examination</th>
<th>Examined</th>
<th>Positive</th>
<th>( \chi^2 )</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coproscopic</td>
<td>703</td>
<td>134</td>
<td>5.619</td>
<td>0.000</td>
</tr>
<tr>
<td>Postmortem</td>
<td>703</td>
<td>160</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The proportion of positive samples obtained by postmortem examination was significantly higher than coproscopic examination (P < 0.05). 134 samples were detected positive by both methods, while 26 positive samples detected by postmortem examination alone but not by coproscopic Examination. The percentage agreement between the two methods was 83.75% (134/160). Coproscopic examination failed to detect 16.25% (26/160) of positive samples.

In the prevalence of fasciolosis based on postmortem examination, statistically significant variation in monthly prevalence of fasciolosis was not observed (p > 0.05) (Table 2).

Table 3: Monthly prevalence of fasciolosis in Mekelle municipal abattoir (November 2010 to February 2011)

<table>
<thead>
<tr>
<th>Months</th>
<th>Examined</th>
<th>% of infection</th>
<th>( \chi^2 )</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td>237</td>
<td>27.43 % (65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>117</td>
<td>23.1 % (27)</td>
<td>5.075</td>
<td>0.166</td>
</tr>
<tr>
<td>January</td>
<td>232</td>
<td>19.4% (45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>117</td>
<td>19.66 % (23)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risk factors associated with fasciolosis

Prevalence fasciolosis in cattle depending upon age, sex, breed and body condition status of animals is presented in Table 3. The prevalence of fasciolosis has only significantly associated with body condition of the cattle (p < 0.05). However, no significance differences were found among cattle regarding sex, age and breed of the animals (p > 0.05).

From a total of 160 livers found positive for fluke infection during post mortem inspection of slaughtered animals, 86 livers (53.75%) harbored *F. hepatica*, 36 livers (22.5%) had *F. gigantica*, 23 livers (14.38%) with mixed infection and 15 livers (9.38%) were infected with unidentified immature flukes (Table 4).

Table 4. The effect of risk factors on the occurrence of fasciolosis in cattle slaughtered at Mekelle municipal abattoir (November 2010 to February 2011)

<table>
<thead>
<tr>
<th>Category</th>
<th>No of examined</th>
<th>Prevalence</th>
<th>( \chi^2 )</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5 years</td>
<td>289</td>
<td>23.18% (67)</td>
<td>0.50</td>
<td>0.823</td>
</tr>
<tr>
<td>&gt; 5 year</td>
<td>414</td>
<td>22.46 % (93)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>692</td>
<td>22.97 % (159)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>9.09 % (1)</td>
<td>1.188</td>
<td>0.276</td>
</tr>
<tr>
<td>Body condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>213</td>
<td>43.7 % (93)</td>
<td>82.435</td>
<td>0.000</td>
</tr>
<tr>
<td>Medium</td>
<td>250</td>
<td>18.4% (46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>240</td>
<td>8.75% (21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barka</td>
<td>48</td>
<td>22.92% (11)</td>
<td>0.940</td>
<td>0.816</td>
</tr>
<tr>
<td>Sanga</td>
<td>261</td>
<td>24.52% (65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holstein-Friesian</td>
<td>37</td>
<td>18.92% (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local zebu</td>
<td>357</td>
<td>21. 85% (78)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Economic losses

The abattoir data showed a total of 5924 cattle were slaughtered from September 2010 to May 2011. Primary data collected during the meat inspection in the abattoir showed that out of total 703 cattle examined, 79 livers were totally condemned because of fasciolosis. From the average measurement taken from 10 livers in the abattoir, the weight of mature bovine liver was found 3.5 Kg in average. According to the selling price of meat in different meat shops the average price of liver of bovine species (expressed as birr/Kg) was 25 Ethiopian birr. Accordingly the annual loss caused by fasciolosis in the abattoir due to liver condemnation was estimated 52,591.30 Ethiopian birr.
Discussion
The present study revealed that overall prevalence of fasciolosis in the study area is 22.76%. This less or more agrees with the previous report (24.32%) in the same study area (Gebretsadik et al., 2009). Different findings on prevalence of fasciolosis have been reported from different parts of Ethiopia. Out of the studies carried, much higher prevalence of fasciolosis was reported from Gonder, Wondogenet, Jimma, Adwa and Hawassa municipality abattoirs (Yilma and Mesfin, 2000; Tilahun et al., 2006; Tolosa and Tigre, 2007; Bekele et al., 2010 and Rahmeto et al., 2010).

Availability of moisture, optimal temperature and suitable snail habitat are among factors influence the occurrence of fasciolosis in a certain area (Urquhart et al., 1996). An optimal temperature of 10 °C and 16°C are necessary for snail vectors of F. hepatica and F. gigantica and for development of the Fasciola in the intermediate snail hosts. Moreover, such conditions are required for completion of the life cycle such as development of fluke eggs, miracidia searching for snails and dispersal of cercaria (Urquhart et al., 1996). Variation of these environmental and ecological factors on different agro ecological zones leads to variation of the prevalence of fasciolosis from one study area to other localities.

The seasonality survey of fasciolosis in this study period (November to February) did not show significant variation (P > 0.05). The absence of difference in monthly prevalence could be associated with the existence of permanent suitable ecological condition for breeding of snails such as lakes; slowly moving rivers as well as low lying marshy areas which contributes for infection of grazing animals in dry season.

In addition to environmental and ecological conditions necessary for transmission of fasciolosis, in Ethiopian highlands metacercaria of Fasciola species remain viable in hay from endemic areas up to 3 months after harvest, even conditions are not suitable for fluke development infection could occur when cattle supplemented to feed with hay (Njau and Scholtens, 1991). Moreover, in the long dry season infection could occur when grazing animals concentrate along snail infested banks of streams and ponds due to inadequate grazing pastures and drinking water. The seasonality infection of liver flukes is absent in the study area because the examined cattle were coming from various grazing areas.

Out of the cattle examined for Fasciola infection both by postmortem and faecal examination, more positive cases were detected by postmortem examination, while faecal examination failed to detect same positive samples. This indicates that postmortem examination is important than of faecal examination for diagnosis of liver fluke (fasciolosis) in slaughtered animals as early infection can be also detected. Eggs are found in feces when flukes are already matured (usually between 10 and 14 weeks of infection (Urquhart et al., 1996). Moreover, eggs are released sporadically from bile ducts, and consequent incorrect sampling can also lead to false negative result as described by Graber (1975). This supports the present result, the infection prevalence obtained by faecal examination is lower than the prevalence by postmortem examination. However, the percentage agreement between the two methods was (PA = 83.75%). From the percentage agreement value, faecal examination is still good to diagnose fasciolosis in live animals.

In the present study, the infection prevalence of fasciolosis in cattle was not affected by sex of the animals. This is in agreement with several previous reports in different parts of the countries (Keyyu et al., 2005; Phiri et al., 2005; Khan et al., 2009; Kabir et al., 2010; Kanyar 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. Moreover, it might also be that fasciolosis is not a disease directly related to animal reproductive system. However, in the study, the number of male cattle examined was higher than the female cattle. These female cattle may not have been adequately represented in the study.

In the present study, the risk of infection to all age groups was the same. The adult and older cattle have the same risk of infection. Similar risk of infection could be due to the fact that both adult and older cattle were forced to graze on the same pasture, exposed to risk of infection by metacercaria of Fasciola species. This corroborates with other previous findings (Phiri et al., 2005; Khan et al., 2009; Elkannah, 2010).

In the present study, the relation between breed and prevalence of fasciolosis is in agreement with many earlier research findings (Sanchez-Andrade et al., 2002; Yildirim et al., 2007; Kanyar et al., 2010). The risk infections for cattle in all breeds were equal in the study area. This is related with the management of the cattle in this area. All these cattle breeds graze on cultivated and natural pastures. On contrary, in Bangladesh higher prevalence of fasciolosis was reported in Hariana breed (Kabir et al., 2010). Similarly Kato et al. (2005) found higher prevalence of fasciolosis in Japanese native cattle breed than Friesian or Jersey breeds and this was related with the
management of cattle breeds. Friesians have limited access to cultivated pastures; while, Japanese native cattle breed graze both in natural pastures and cultivated rice field, which indicated that rice straw feeding is suggested to be related with high rates of cattle fasciolosis in Japanese native cattle (Kato et al., 2005).

In the present study, animals with lean body condition were associated with higher infection than animals with medium and fat body condition. Similar finding was also reported by Bekele et al. (2010). This implies that fasciolosis causes emaciation of the animals. Low body score was associated with liver fluke infection. However, other than fluke infection, inadequate nutrition and concurrent infection of the animals with other bovine pathogens could enhance the effects of the flukes for the emaciation of the animals.

It was difficult to trace the exact geographical origin of the animals slaughtered in the municipal abattoir as most of the cattle were brought from markets. Based on information requested from the traders and farmers, most of the animals are local indigenous zebu cattle originated from various grazing areas of Mekelle and neighboring woredas. Significant numbers of cattle were originated from low land areas of Raya, Amhara Regions and low land areas of Western Regions of Tigray. The presence of small irrigation practice in the low land areas might support suitable snail breeding habitats that results in the existence of Fasciola species which causes infection of animals originated from these areas. However, the finding is difficult to relate to particular locality.

Postmortem examination of the infected livers revealed that the dominant species that causes fasciolosis in the study area was F. hepatica. In support of the present study, similar study in Gonder, Jimma, Mekelle and Adwa, F. hepatica was identified as the dominant species that causes fasciolosis (Yilma and Mesfin, 2000; Tolosa & Tigre, 2007; Gebretsadik et al., 2009; Bekele et al., 2010). This was associated with the existence of favorable ecological condition for L. truncatula (intermediate host of F. hepatica in the study area) such as swampy areas, small irrigation and marshy areas in the low lying plain area and temporary shallow ponds. However, Fufa et al. (2009) stated that F. gigantica was the most common liver fluke species affecting cattle at Welalya Soddo. The infection of cattle with F. gigantica and mixed infection with both species in the present study could be due to the reason that the cattle slaughtered in the abattoir were originated from lowlands and middle altitude zone flood prone areas, drainage ditches which are favorable habitat to L. natalensis (Urquhart et al., 1996). At altitudinal range of 1200-1800 M.a.s.l., mixed infection was also reported (Graber, 1975).

Liver condemnation in the abattoir as result of fluke infection was significant in terms of the economic status of the country. In the present study, an annual loss about 52,591.30 Ethiopian birr was estimated in the abattoir. This indicates that losses resulted from total condemnation of livers. However, livers with partial infection were passed as fit for human consumption after avoiding the affected parts; as a result they are not included in loss estimation. The financial loss observed in the study was comparable with previous report of financial loss of (57,960 Ethiopian birr) from Adwa abattoir (Bekele et al., 2010). This could be due to similar ecological and climatic condition between these two localities.

Conclusion and recommendations

The study indicates that fasciolosis affects the health productivity of animals. In the study although the prevalence is low, the financial loss associated with condemnation of infected livers at the abattoir is substantial. The infection prevalence of fasciolosis has an association with body condition of the animals, but not with age, sex and breed of the animals. Abattoir based postmortem survey appeared superior to faecal examination to determine prevalence, economic importance of livestock disease, but have limitations as many organs remain undiagnosed because of meat inspectors’ personal errors, use of gross pathology in diagnosis of infection and poor record keeping. As it is generally conducive in terms of labor and financial cost-wise, faecal method of examination is important for application in field investigations and monitoring programs.

From the present study, following recommendations are suggested. Animal should be treated twice a year, in the rainy season and in long dry season as animals could get infection when they graze in marshy areas during dry periods. Strict ante mortem and post mortem inspection procedures are to be made mandatory. Snail control methods such as drainage of swampy areas which are favorable for snail multiplication are important. Other control options should be also considered such as preventing susceptible animals such as calves and sheep to infection prone areas, feeding herbagas which have been harvested from areas free of the parasite. Supplementary feeding of animals is recommended to improve the body condition of the animals to adapt the damage caused by the flukes. Moreover further epidemiological surveillance of the distribution and its economic impact should be studied in relation with the liver and carcass condemnation.
Acknowledgements
This study was financially supported by Mekelle University. The authors specially thank to all workers of Mekelle Municipality Abattoir.

References


