

Full Length Research Paper

Major trematodes of cattle slaughtered at Hirna municipal Abattoir: Prevalence, associated risk factors and test agreement of sedimentation technique in Ethiopia

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A cross-sectional study was conducted to estimate the prevalence of fasciolosis and paramphistomosis in Hirna town, assess the associated risk factors and evaluate the diagnostic efficiency of fecal sedimentation technique for both flukes. On coproscopy, out of the total of 387 cattle examined, 24 (6.2%) and 21(5.43%) cattle were positive for *Fasciola* and *Paramphistomum*, respectively. Postmortem examination of hepatobiliary organs and fore-stomachs of the slaughtered cattle (n=387) revealed adults of *Fasciola gigantica* (8.53%, n= 33) and *Paramphistomum* spp. (5.43%, n=21), respectively. There was statistically significant difference in prevalence of both *Fasciola* and *Paramphistomum* between medium and good body conditions. Cattle with medium body condition were more frequently affected by *Fasciola* (OR=13.64, 11.3%) and *Paramphistomum* (OR=8.26, 7.06%) than cattle with good body condition. Considering necropsy examination as gold standard, the sensitivity of fecal sedimentation technique compared and found to be 72.7% (kappa = 0.83) and 100% (kappa=1) in agreement for fasciolosis and paramphistomosis, respectively. Though the existing prevalence of fasciolosis and paramphistomosis is low, the presence of flukes pose enormous economic loss through liver condemnation, poor weight gain and productivity, treatment cost, predisposition to infectious diseases and death in severely affected young animals. Therefore, strategic deworming and further investigation on the ecology of the intermediate hosts and socioeconomic impact of the problem deemed necessary.

Key words: *Fasciola*, *paramphistomum*, cattle, coproscopy, necropsy, Hirna, Ethiopia.

INTRODUCTION

The huge livestock resource in Ethiopia is not efficiently and fully exploited due to several constraints including

malnutrition, traditional management practice, poor genetic makeup and prevailing disease (Bekele et al.,

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1992). Among the prevailing disease of the country, trematodes are one of the main parasitic problems of cattle and other ruminants with potential zoonotic effect and significant economic loss mainly through mortality, liver condemnation, reduced production of meat, milk and wool, and expenditures for anthelmintics (Hillyer and Apt, 1997; Yilma and Mesfin, 2000).

Trematodes are neglected in the international public health in comparison with other disease affecting domestic ruminants and humans (Haridy et al., 2002). According to WHO report (2007), the infection was limited in the past to specific and typical geographical area (endemiotores), but wide spread throughout the world, with an increasing report of human cases from Europe, American, Australia, Africa and Asia. As consequences, fasciolosis should be considered as potential zoonosis of major global and regional importance (WHO, 2007).

Fluke of ruminants, mainly *Fasciola* (liver fluke) and *Paramphistomum* (rumen fluke) are the most important flukes recorded from different parts of the world (Dreyfuss et al., 2006). The life cycles of flukes are always indirect, involving one or two intermediate hosts before invasion of definitive hosts. Snails such as genus *Lymnaea* for *Fasciola*, genus *Planorbis*, *Bulinus* or *Lymnaea* for *Paramphistomum* acts as an intermediate host (Kahn et al., 2005). They are narrowly dependent to their close environment (nature of the soil), and climatic conditions for survival and multiplication of the intermediate hosts and also for the survival and evolution of the intermediate stages (Dreyfuss et al., 2006).

Pathogenesis of fasciolosis varies according to the phase of parasitic development in the liver and species of the host involved, essentially the pathogenesis is two-told; the first phase occurs during migration in the liver parenchyma and is associated with liver damage and hemorrhage and the second phase occurs when the parasite reside in the bile ducts, and results from the haematophagic activity of the adult flukes and from the damage to the mucosa, by their cuticular spines (Bowman, 2014).

The adult paramphistomum in fore-stomach are essentially nonpathogenic even though large numbers may be present (Urquhart et al., 1996). At most there may be a localized loss of rumen papillae. The immature worms attach to the duodenal mucosa by means of posterior suckers causes severe enteritis, possibly necrosis and hemorrhage (Soulsby, 1986). In heavy infestation frank hemorrhage, duodenitis, hypoproteinemia and oedema may be produced with immature fluke deeply embedded in the mucosa. Severely affected animals exhibit anorexia and severe diarrhea (Brown et al., 2007).

Although there are numerous reports on the prevalence of cattle fasciolosis in different parts of the country (Solomon and Abebe, 2007; Gebretsadik et al., 2009; Fufa et al., 2009; Mihreteab et al., 2010, Abebe et al.,

2011) and still paucity information on the epidemiology of *Paramphistomum*.

Moreover, the above studies were conducted in areas widely known to have suitable environmental conditions for the intermediate hosts and hence information gap is clearly seen pertaining to *Paramphistomum* in the presumed study area. Therefore, the study was conducted to determine the prevalence of fasciolosis and paramphistomum infection in cattle slaughtered at Hirna municipal abattoir, to compare the diagnostic efficiency of fecal sedimentation and postmortem examination for both flukes and assess some of the potential risk factors that might contribute to fluke infection.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Hirina municipal abattoir which is found in Hirna town in western Hararghe zone. Hirna, the capital city of Tullo woreda, is located at 375 km east of Addis Ababa at 9°13'N latitude and 41°6'E longitude, and mean elevation of 1663 m above sea level.

The area has mean maximum and minimum temperature of 32 and 17°C, respectively, and receives an average 600 to 900 mm annual rainfall (Dawit et al., 2012).

Study design and study animal

Cross-sectional study design was used and fecal and parasitic samples were collected from a total of 387 cattle slaughtered at the abattoir. The study animals include adult male indigenous cattle breed presented to the abattoir for slaughter from various place of the eastern part of Ethiopia.

The cattle population in the area is composed of diversified local cattle breeds (locally called Harare Sanga) known for beef production, the '*Harerghe beef*'. The people in the area fatten their cattle with hand feeding/cut and carry system because of their small land holding plus the higher proportion of land being slop and hill top, usually left for cash crop production (Tadesse et al., 2014).

Study approach

Each animal selected for the study was further identified by, providing specific identification number that could be used for both ante-mortem and post mortem examinations. The sampled cattle were examined for the presence of the major trematodes of interest by coproscopic and post mortem examination. Identification of sampled animals, origin, age, sex, body condition score and general health condition of each study animal were recorded. The body condition score were classified into five categories using a technique recommended by Nicholson and Butterworth (1986).

Accordingly, body condition score were categorized as score 1(emaciated) to 5 (obese). For the purpose of this study, body condition score were categorized into three categories; namely: poor (Score 2), medium (Score 3 and 4) and good (score 5). Similarly, the animals' source was traced from the people who fetched them to slaughter. Generally the animals were hand-fed by the local farmers which had defined source.

Table 1. Logistic regression analysis of various risk factors against prevalence of trematode infection in cattle based on fecal examination.

Risk factors	Number examined	<i>Fasciola</i>		<i>Paramphistomum</i>	
		No (%)	Adjus. OR (95% CI)	No (%)	Adjus. OR (95% CI)
BCS					
Good	104	1 (0.96)	1	1 (0.96)	1
Medium	283	23 (8.12)*	9.17 (1.22-69.09)	20 (7.06)*	8.26 (1.11-62.54)
Origin					
Chafbanfe	77	7 (9)	1	4 (5.2)	1
Debaso	74	4 (5.4)	0.52 (0.14-1.87)	3 (4.1)	0.71 (0.15-3.31)
Doba	74	2 (2.7)	0.29 (0.06-1.48)	5 (6.8)	1.44 (0.37-5.65)
Hirna	162	11 (6.8)	0.77 (0.28-2.11)	9 (5.6)	1.15 (0.34-3.89)

BCS=body condition score; *= statistically significant ($P < 0.05$), OR=odds ratio.

Coprosopic examination

Animals selected for this study were given identification number before fecal sampling. Fecal samples were collected directly from the rectum of these cattle, placed in universal bottle and closed tightly.

Bottles containing sample were labeled with the corresponding animals' ID and transported to Hirna regional laboratory for examination. Fecal sedimentation technique was employed to examine for *Fasciola* and rumen fluke eggs using method described by Antonia et al. (2002) and Bowman (2014).

Post mortem examination

After evisceration, the liver particularly the bile ducts and the gall bladder, rumen, reticulum and duodenum of 387 cattle were thoroughly examined (visual, palpation and incision if necessary were made depending on inspected organs) for trematode identification as these organs are known to be predilection site for adult and young liver and rumen flukes. Liver and rumen fluke recovery was conducted for identification following the approach of Soulsby (1986).

Data management and analysis

The data obtained from fecal examination and organ necropsy were recorded on special designed forms entered into spread sheet of Microsoft Excel. The data was coded and analyzed using STATA software version 11 (STATA corp., College Station, TX). Pearson's chi-square (χ^2) and logistic regression were used to evaluate the association between the prevalence of fasciolosis and the considered risk factors that is body condition score and origin.

Statistical analysis is considered as significant when P-value is less than 0.05 at 95% confidence level. Moreover, Kappa statistic was used to determine the degree of agreement between the two diagnostic methods employed (fecal sedimentation technique and necropsy finding) in the study. The kappa value was interpreted as: slight agreement ($k < 0.2$); fair agreement ($k = 0.2$ to 0.4); moderate agreement ($k = 0.4$ to 0.6); substantial agreement ($k = 0.6$ to 0.8); and almost perfect agreement ($k > 0.8$) (Thrusfield, 2005).

RESULTS

Coprosopic examination

Out of 387 cattle examined for the presence of eggs of *Fasciola* and *Paramphistomum* with simple fecal sedimentation technique, 24 (6.2%) and 21(5.43%) were positive for *Fasciola* and *Paramphistomum* eggs, respectively. In this study there was no poor body condition score record.

However, there was a statistically significant difference in the prevalence of both *Fasciola* and *Paramphistomum* between medium and good body conditions score. Cattle with medium body condition were more likely to be affected by *Fasciola* (OR=9.17, 8.12%) and *Paramphistomum* (OR=8.26, 7.06%) than cattle with good body condition (Table 1).

Though, there was no statistically significant difference in the prevalence of fasciolosis and paramphistomosis among the cattle brought from different origins/sites. But, cattle brought from Chafebante were having the highest fasciolosis prevalence (9%) followed by those from Hirna (6.8%), Debeso (5.4%) and Doba (2.7%) (Table1).

Postmortem examination

Out of 387 cattle examined with postmortem to recover adult flukes in the liver and fore stomach, 33 (8.53%) were positive for fasciolosis and 21 (5.43%) were also positive for paramphistomiasis.

Fasciola gigantica was the only *Fasciola* species identified, similarly, *Paramphistomum cervi* and undifferentiated. There was a statistically significant ($p < 0.05$) difference in the prevalence of both in liver fluke (*Fasciola*) and fore-stomach (*Paramphistomum*), between

Table 2. Logistic regression analysis of various risk factors associated with the prevalence of trematode based on postmortem examination.

Risk factors	Number examined	<i>Fasciola</i>		<i>Paramphistomum</i>	
		№ (%)	Adjus. OR (95% CI)	№ (%)	Adjus. OR (95%CI)
BCS					
Good	104	1(0.96)	1	1 (0.96)	1
Medium	283	32 (11.31)*	13.64 (1.83-101.51)	20 (7.06)*	8.26 (1.11-62.54)
Origin					
Chafbanfe	77	8 (10.39)	1	4 (5.2)	1
Debaso	74	5 (6.76)	0.56 (0.17-1.84)	3 (4.1)	0.71 (0.15-3.31)
Doba	74	3 (4.05)	0.39 (0.097-1.55)	5 (6.8)	1.44 (0.37-5.65)
Hirna	162	17 (10.49)	1.09 (0.44-2.70)	9 (5.6)	1.15 (0.34-3.89)

BCS=body condition score, *Significant variation ($p < 0.05$).

Table 3. The presence or absence of *Fasciola* and *Paramphistomum* eggs in the feces of cattle (n=387) compared with adult fluke recovery in the liver and fore stomach.

Fecal examination	Adult <i>Fasciola</i> in liver		Total	<i>Paramphistomum</i> fore-rumen		Total
	Present	Absent		Present	Absent	
Eggs present (+)	24	0	24	21	0	21
Eggs absent (-)	9	354	363	0	366	366
Total	33	354	387	21	366	387

medium and good body conditions scores. Cattle with medium body condition score were more likely to be affected by *Fasciola* (OR=13.64, 11.3%) and *Paramphistomum* (OR=8.26, 7.06%) than cattle with good body condition (Table 2).

However, there was no statistically significant ($p > 0.05$) difference in the prevalence of fasciolosis and paramphistomosis among the cattle brought from different origins despite the presence of minor difference in the prevalence (Table 2).

Diagnostic efficiency of coproscopy as compared to postmortem finding (gold standard)

Sensitivity and specificity of direct sedimentation technique were calculated from the results in Table 3 which sets out, the numbers of positive and negative test results in animals with and without flukes in their livers (Smith, 2009). Out of 387 cattle subjected to both fecal and liver examination, 33 had flukes in their livers but only 24 showed *Fasciola* eggs in their feces.

Accordingly, the sensitivity of a single examination by sedimentation method was found to be 72.7% and the specificity was 100% with substantial agreement between the two tests ($\kappa = 0.83$). The sensitivity of single

sedimentation method in the detection of *Paramphistomum* eggs was found to be 100% and 100% specificity with complete agreement between coproscopy and necropsy (Table 3).

DISCUSSION

In this study, the prevalence of fasciolosis as indicated 6.2 and 8.53% by fecal and postmortem examination, respectively; is much lower than the previous reports made by several authors in different part of the country. Accordingly, 90.65% at Gondar abattoir (Yilma and Mesfin, 2000), 88.57% at Debre-Brehan abattoir (Tsegaye, 1995), 80% at Debre Berhan abattoir (Dagne, 1994), 56.6% at Ziway abattoir (Adem, 1994), 47% at Sodo abattoir (Abdul, 1992), 46.58% at Jimma abattoir (Tadele and Workue, 2007) and 28.63% at Hawassa abattoir (Rahmeto et al., 2010) were reported among others. Such big difference might be associated with community perception in treating animals on time and availability of veterinary service close to livestock producers. Early and mid nightees' veterinary service was not addressed to vast majority as, the result used (anthelmintics) was poor as compared to recent years. Probably this might be the reason for high prevalence of

parasitism as compared to the current finding; low prevalence has been reported by Fufa et al. (2009) at Wolaita Sodo (12.7%) and Daniel (1995) at Dire-Dawa abattoir (14.4%). Nature of the ecology of intermediate host where animals originated from also affects the prevalence of fasciolosis.

This significant difference in the prevalence of fasciolosis within the country is attributed mainly to variations in the ecological and climatic conditions such as altitude, rainfall, and temperature. However, differences in livestock management system and the ability of the inspector to detect the infection may also contribute. Water logged and poorly drained areas that support the survival and multiplication of snails are often conducive areas for fluke infection which contributes much (Soulsby, 1986; Urquhart et al., 1996; Bowman, 2014). In line with this, the animals bought to the abattoir for slaughter included in this study were mostly from ragged terrain with arid climate, where there are few suitable environments for multiplication of snails and cattle are feed with cut and carry system.

Though bovine fasciolosis exists in almost all regions of the country (Yilma and Mesfin, 2000), the species involved vary significantly with locality which is mainly due to difference in climatic and ecological condition such as temperature, attitude, rainfall and livestock management. In the current study, only *F. gigantica* was observed in the bile ducts of the affected livers, which was narrow shoulder elongated than *F. hepatica*. In line with this finding, Yilma and Malone (1998) indicated that *F. gigantica* is endemic in the entire western zone of the Ethiopia with localized foci in the south and east. This may thus be associated with the existence of favorable ecological biome for *Lymnaea natalensis*, the intermediate snail host (Urquhart et al., 1996).

The prevalence of rumen fluke in the present study (5.43%) is comparatively lower than the report of Abebe et al. (2011), who reported a prevalence of 57.52% in cattle in and around Jimma. Similarly, a study conducted by Menkir et al. (2007) at eastern Ethiopia (mainly in Haramaya, Harar, Dire Dawa and Jijiga) revealed prevalence of 21 and 25% for *Paramphistomum microbothrium* in goat and sheep, respectively. There was no clearly defined report on the prevalence of bovine paramphistomosis in Ethiopia especially at current study area. The major reason for such scanty information on the prevalence and geographic distribution of the fluke may be partly associated to the fact that, the adult *Paramphistomum* are considered as non-pathogenic and researchers' may not be interested to expand resources for such non-pathogenic types of cases.

The absence of statistical difference in the prevalence of *Fasciola* and *Paramphistomum* against the origins may be due to the similarity in elevation and ecology of the snail host observed in these sites (Chafebante, Debaso, Doba and Hirna). In line with the report of Abebe et al.

(2011), these flukes were more frequent in cattle with medium body condition (with odds of 9.17 and 8.26 for *Fasciola* and *Paramphistomum*, respectively) than in cattle with good body condition score. As a predisposing factor or sequel, as the body condition improves/increase, infection with *Paramphistomum* and *Fasciola* decrease. Both trematodes are known to proteinemia and feed on tissue plug and even damage the parenchyma of the liver (immature *Fasciola*) and the duodenum (immature *Paramphistomum*) which ultimately deplete protein from the host (Marquardt et al., 2000).

The lower prevalence of fasciolosis reported using fecal examination (8.12%) when compares to the necropsy (11.31%) and may be partly associated with hepatic fibrosis and hyperplastic cholangitis as a result of chronic infection (Urquhart et al., 1996), old age of parasites, host immunity of the animals, irregular egg discharge to the duodenum and certain group of animals that might have received drug treatment before sent to abattoir. On the other hand the prevalence of paramphistomosis was the same in both fecal and fore-stomach examination. The adult *Paramphistomum* in the fore stomachs are well tolerated, even when many thousands are present, feeding on the wall of the rumen or reticulum (Urquhart et al., 1996; Bowman, 2014). Moreover, adult *Paramphistomum* are very prolific and many eggs are expelled (Dreyfuss et al., 2006).

The study further indicated 72.7 and 100% sensitivity of the sedimentation diagnostic technique in relation to necropsy results of liver and fore-stomachs examination for fasciolosis and paramphistomosis, respectively. The two tests showed substantial ($\kappa = 0.83$) and perfect agreement ($\kappa = 1$) for fasciolosis and paramphistomosis, respectively. The present sensitivity result obtained for fasciolosis is comparable to the reports of 67.13% in Hawassa, Ethiopia (Rahmeto et al., 2010), 66.7% in Vietnam (Anderson et al., 1999) and 69% in Switzerland (Rapsch et al., 2006).

In this regard, the test suggests that about 27.3% (that is 9 out of 33) *Fasciola* infected animals may pass undetected with single examination of feces by sedimentation technique. This may be attributed partly to the fact that *Fasciola* eggs only appear in feces 8 to 15 weeks post infection, so most of pathological lesions had already occurred (Sanchez et al., 2002).

Furthermore, detection of *Fasciola* eggs can be unreliable during the patent period because the eggs are expelled intermittently depending on the evacuation of the gall bladder (Briskey, 1998). However, the sensitivity of the routine fecal sedimentation technique can be improved to approximately 92% through repeated sampling and testing (Rapsch et al., 2006).

CONCLUSION AND RECOMMENDATIONS

The present study revealed that flukes are less prevalent

in the study area than the other parts of the country especially when it is compared in areas having high rainfall and favorable climatic condition for the intermediate snail hosts. However, the existing prevalence of fasciolosis and paramphistomosis can pose enormous economic loss through liver condemnation, poor weight gain and productivity, treatment cost, predisposition to infectious necrotic hepatitis and death in severely affected young animals.

In the study area, *F. gigantica* was the only species of *Fasciola* affecting cattle and body condition, score was a potential risk factor determining its occurrence. Moreover, the current study reflected the limitation of single fecal sedimentation technique in the detection of *Fasciola*. Nearly one cattle out of four cattle having *Fasciola* species in their liver can be undetected by this technique.

Based on the above findings, the authors recommend further detailed studies in different geography and seasons with larger sample size, possible to generate a complete data set on the epidemiology of fluke infections, their economic loss and ecology of intermediate host snails. Moreover, if fecal sedimentation or direct smear is used for the diagnosis of fasciolosis repeated sample should be used to increase its sensitivity.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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