Prevalence of Gastrointestinal Helminths in Cattle with and Without Patent Natural Schistosoma Infection in and Around Bahir Dar

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Abstract
A cross sectional study was conducted from November 2014 to April 2015 in and around Bahir Dar, North Western Ethiopia to assess the concurrent gastrointestinal helminths in cattle with and without patent natural Schistosoma infection. A total of 200 faecal samples were examined using flotation and sedimentation techniques. The results show the prevalence of Fasciola, Schistosoma, Paramphistomum and Strongyle genera were found to be 14%, 20%, and 35.5% and 28% respectively. The overall prevalence irrespective of helminth genera was 59.5%. No statistical difference between male and females, young and adults or local and cross breeds in the prevalence of the infections. Mixed infections with two or more parasites were not uncommon. Fasciola eggs were more prevalent in the faeces of Schistosoma positive than in Schistosoma negative cattle (P<0.01). On the other hand, strongyle eggs were more prevalent in cattle harbouring Fasciola eggs than in those without Fasciola (P< 0.05). We conclude that there are associations between different parasite species that deserve attention in the planning of any helminth control program.

Keywords: Cattle, Fasciola, Mixed infection, Prevalence, Schistosoma

INTRODUCTION
Ethiopia is said to have 38 million heads of cattle (Central Statistical Authority, 2004). They serve as sources of food and hides and provide important draught power for crop production. However, the productivity of these animals is severely reduced by malnutrition, low management system, low genetic potential and health problems. Among the livestock health problems, diseases caused by helminth parasites are highly prevalent and economically important in many parts of Ethiopia. Helminth infections are responsible for a number of deaths of animals and in many cases their deleterious effects are more insidious and lead to debility and digestive or respiratory disturbance with retardation of growth and losses of body conditions, meat, milk, hides and draught power (Gracey, 1986). A number of helminth species are known to infect cattle worldwide. The most important ones include: nematodes like Haemonchus species, Osteragia spp., Trichostrongylus spp. Trematodes of economic importance are Fasciola spp. and Schistosoma spp. while cestodes like Moniezia spp. could also be important constraints in animal production, (Lo and Lemma, 1975; Onah and Nawa, 2000).

In most cases of natural infections, animals harbour more than one parasitic species (Clark, 2001; Cox, 2001). The existence of one species is often reported to have synergistic or antagonistic effects on the development and survival of other species or genera (Dobson, et al., 1992; Onah and Wakelin, 1999; Terefe, et al., 2005). The coexistence of more than one parasitic species or the presence of concurrent infections in a given host may or may not be associated with common predilection sites in the host (Terefe, et al., 2005; Cox, 2001), common parasitic genera (Dobson, et al., 1992; Goosens, et al., 1998; Southgate, et al., 1998) or common habitat (ecological niche) of the parasite or its intermediate host (Urquhart, et al., 1987).

The most important strongyle parasites inhabit organs of the digestive and respiratory tract. Trematodes like Fasciola reside in the liver as their final predilection site while Schistosomes prefer the blood vascular system (mesenteric and portal veins) (Urquhart, et al., 1987). Schistosomosis caused by the genus Schistosoma is an infection of man and its domestic animals. Schistosoma bovis, the common cause of the disease in cattle in Africa is transmitted by snails of the genus Bulinus (Hall, et al., 1985; Urquhart, et al., 1987; Southgate, et al., 1998). Other species of veterinary importance are S. mattheei, S. curassoni, S. indicum, S. spindale and S. nasale (Rullinson and Southgate, 1987). Similarly, Fasciolosis is another important parasitic of cattle, which is caused by Fasciola spp., including F. gigantica and F. hepatica. Its intermediate hosts are snail species of the genus Lymnaea (Urquhart, et al., 1987). Both genera of snails often depend for their continuous endemics on permanent water masses, such as lakes, rivers, swampy areas and ponds as suitable environments (Urquhart, et al., 1987). It has been established that high prevalence of subclinicial infections caused by such parasitic species incurs significant economic losses because of the long-term effects on animal growth and productivity. Parasitic infections are also responsible for the increase in susceptibility of animals to microbial diseases (Mulcahy, et al., 2004), other parasitic infections (Goosens, et al., 1998) or increase in the resistance of other infections (Monard, et al., 1981). This could be attributed to changes in the immunocompetence status of the animals. There are numerous mechanisms documented for helminth immunomodulation including downregulation of Th1 responses, enhancement of Th2 responses and changes in the microenvironment at the predilection sites (Mulcahy, et al.,...
2004; Terefe, et al., 2005).

Therefore, understanding the epidemiology and immunological mechanisms underlying multiple parasitic infections could have paramount importance in the designing of control strategies. For example, a fatty acid binding protein from *Fasciola hepatica* has been reported to induce protection in C57/BL mice from challenge infection with *S. bovis* (Abán, et al., 1999).

The objective of the present study was therefore:

- To assess the prevalence of gastrointestinal helminth infections in cattle with and without natural patent schistosomosis in Bahir Dar and its environs.

**MATERIALS AND METHODS**

**Study Area**

The study was carried out from November 20014 to April 2015 in Bahir Dar town and its surroundings (west Gojam, North western Ethiopia). Bahir Dar is located 564 kms from Addis Ababa at 11°, 36 N latitude and 37°25' E longitude. It has an altitude of 1800 meter above sea level. The mean annual rain fall in the area extends from June to September and ranges between 845 and 2037mm. The average minimum and maximum monthly temperatures at Bahir Dar are 15.4°C and 27°C respectively. The topography of the area is characterized as plain with slight slopping, drained by Lake Tana and Abay (Blue Nile) River. The area is covered by various bushes, low weeds, evergreen plants of various types and some semi-humid and humid high land vegetation. The grass land management in the zone is of traditional type. The main livestock grazing land include swampy and water logged areas, forest margin, hill tops and mountain sides, stony infertile lands and road sides. Agriculture is the livelihood for major section of the population in the surrounding areas. Bahir Dar and its surroundings (Bahir Dar Zuria Wereda) have an estimated cattle population of 158564 heads.

**Study Animals**

A total 200 heads of cattle were examined during the study period. Majority of them were local zebu while others were local zebu x Holstein crosses. During sampling, breed (local and cross), age (Based on history: - young: < 2 years, adult: > 2 years) and sex of the animals were recorded. Animals were sampled at grazing fields, market places, veterinary clinics and during field services.

**Study Method**

Faecal samples were collected directly from the rectum of each animal in universal bottles containing 10% formalin and examined using sedimentation and floatation techniques for the presence or absence of helminth eggs as described previously (Urquhart, et al., 1987). Briefly, for the sedimentation technique, faecal samples were homogenized in small quantity of water and filtered using a sieve. The filtrate was then allowed to sediment. The sediment was examined for the presence of trematode eggs under 10X objective using a binocular microscope. For the floatation technique, faecal samples were homogenized in a test tube using saturated Nacl solution. The tube was filled until slight convex or oval shape was formed at the top. A cover slip was then placed for 10 minutes on the surface of the solution after which it was removed and placed on a glass slide. The slide was examined under low magnification (X10).

**Data Analysis**

Percentage of helminth positive and negative animals according to presence or absence of *Schistosoma* eggs, sex and age categories were analysed using Chi-square ($\chi^2$) statistics. P-values less than 0.05 were considered significant when differences exist between groups (Clark, 1992).

**RESULTS**

**Prevalence of different genera of helminth eggs in faeces of cattle**

Among the 200 faecal samples examined, the overall prevalence of helminth eggs irrespective of parasite species was 59.5%. Mainly, *Fasciola*, *Schisasoma*, *Paramphistomum* and strongyle eggs were found with faecal examination. *Paramphistomum* and strongyle eggs were more prevalent than those of *Fasciola* and *Schistosoma* (P< 0.05).

(Table 1). Two animals were found harbouring eggs of all four genera, 4 animals had the first three, 2 animals had *Fasciola*, *Schisosoma* and strongyle and 11 animals had both *Fasciola* and Strongyle eggs in their faeces. There was no statistical difference between local and cross breeds (Figure 1), between male and females or young and adult groups (Figure 2) for the prevalence of helminth eggs irrespective of parasite species.

Table1. Prevalence of *Fasciola*, *Schisosoma*, *Paramphistomum* and strongyle eggs in faeces of cattle

<table>
<thead>
<tr>
<th>Parasite genera</th>
<th>No of samples</th>
<th>% positive animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasciola</td>
<td>200</td>
<td>14$^a$</td>
</tr>
<tr>
<td>Schistorasoma</td>
<td>200</td>
<td>20$^a$</td>
</tr>
<tr>
<td>Paramphistomum</td>
<td>200</td>
<td>35.5$^b$</td>
</tr>
<tr>
<td>Strongyles</td>
<td>200</td>
<td>28.5$^b$</td>
</tr>
</tbody>
</table>

Values with different letters are statistically different
Figure 1. Comparison of the prevalence of different parasite genera between local zebu and cross breed cattle

Figure 2. Comparison of the prevalence of different parasite genera based on sex and age groups

Helminth prevalence with and without Schistosoma

Fasciola eggs were more prevalent in the faeces of Schistosoma positive than in Schistosoma negative cattle (P<0.01). While this was true in general and in the local zebu breed in particular, it was not evident in cross breed animals. Such association with Schistosomes was not demonstrated for other parasite eggs (Paramphistomum, Strongyle) discovered (Table 2). On the other hand, strongyle eggs were more prevalent in cattle harbouring Fasciola eggs than in those without Fasciola (P< 0.05).

Table 2: Prevalence of Fasciola with and without Schistosoma, and that of strongyle with and without Fasciola in cattle.

<table>
<thead>
<tr>
<th>Status</th>
<th>% Fasciola (+)</th>
<th>% Strongyle (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schistosoma (+)</td>
<td>25\textsuperscript{a}</td>
<td>28</td>
</tr>
<tr>
<td>Schistosoma (-)</td>
<td>11\textsuperscript{b}</td>
<td>29</td>
</tr>
<tr>
<td>Fasciola (+)</td>
<td>11\textsuperscript{c}</td>
<td>39\textsuperscript{c}</td>
</tr>
<tr>
<td>Fasciola (-)</td>
<td>27\textsuperscript{d}</td>
<td></td>
</tr>
</tbody>
</table>

Values with different letters in each column are statistically different.
DISCUSSION

The results of the present study indicate that cattle around Bahir Dar town are affected by a number of parasitic infections. Previous studies in the area and elsewhere in the country also reported particularly Fasciola and strongyle infections in cattle are the most important parasitic problems (Solomon, 1985; Yalelet, 2004; Solomon, 2005). It has been suggested in previous studies that European breeds and their crosses are less adapted to tropical climates and hence are susceptible to variety of microbial and parasitic infections. In this study however, the prevalence of various genera of helminth parasites was not different between local zebu cattle and their crosses with Holstein breed. This may suggest that both breeds are equally exposed to the risk of parasitic infection and probably the latter have developed a degree of adaptation to the prevailing environmental conditions.

Similarly, helminth prevalence was not different between ages (young and adult) or between sexes. Young animals are said to be more susceptible to many parasitic and non parasitic infections (Watson and Gill, 1991; Colditz, et al., 1996). It is believed that lower resistance to disease in young ruminants is partly due to immunological hypo responsiveness, and is not simply a consequence of their not having been exposed sufficiently to pathogens to develop immunity (Manton, et al. 1962; Colditz, et al., 1996). On the other hand, previous exposure to H. contortus infection could result in enhanced resistance to subsequent infections. Improved resistance to H. contortus was reported in second infections in Rhôn and Merinoland (Gauly, et al., 2002) and in INRA 401 breeds (Lacroux, et al., 2006, Terefe, et al., 2007). The problem with the present study in this respect was that animals were not properly classified in to several age groups. Those classified as young had less than 2 years of age according to history obtained from the owners. As cattle at Bahir Dar area graze around the permanent water body (Lake Tana and Nile river) where pastures are relatively abundant, even those classified as young could have had more than one exposure in their 2 yours life and hence have developed some degree of acquired immunity. Immune animals are also frequently reported to have lower resistance to parasites than their nonpregnant, nonlactating female counterparts (Gauly, et al., 2006) whereas castration improves in males and castration and lactation lowers in females the resistance to various helminth infections (Shaw, et al., 1995; Tembely, et al., 1998). Throughout the period of this study, it was noticed that farmers brought their oxen to Bahir Dar veterinary clinic for castration once a week. Therefore, the absence of statistical difference in the prevalence of helminth infections between male and females may be attributed to this regular practice. However, the exact reason is yet to be studied.

Mixed infections were common although the extent varies with parasite species. It was observed in this study that more cattle having Schistosoma eggs in their faeces were found to concurrently harbour Fasciola eggs than those without Schistosoma eggs. This could be attributed to various factors. The intermediate hosts: Bulinus for Schistosomes and Lymnaea for Fasciola share common ecological niche (Utzinger and Tanner, 2000), particularly around the Lake Tana and Blue Nile River. Therefore, cattle grazing in this area could have similar opportunity to pick infective stages of the two parasites.

The other possibility is that the concurrent or prior presence of one of the two infections may predispose the animal to the other infection due to the close proximity of parasites’ predilection sites (liver and portal veins etc). Fasciola (metacercaria) are ingested and reaches the small intestine (duodenum). After some days, it penetrates the wall of the peritoneum and passes to the liver for development. There are two essential phases in practice. However, the exact reason is yet to be studied.

In light of this, Schistosoma bovis infection followed by challenge F. hepatica increased the severity of liver alterations (cholangiohepatitis etc) in lambs whereas primary patent infection with F. hepatica induced a lower number of schistosome eggs (Ferreras, et al., 2000). Similarly, acute haemonchosis developed in Djallonke sheep when animals were infected first by Trypanosoma congolense followed by challenge with Haemonchus contortus (Goosens, et al., 1998). On the contrary, infestation of sheep with larvae of the nasal bot fly Oestrus ovis has enhanced their immune response to challenge infection with H. contortus (Terefe, et al., 2005) and Trichostrongylus colubriformis (Yacob, et al., 2002) although their predilection sites are far apart.

Therefore, it is possible that both situations have contributed for the association between schistosomosis and fasciolosis. The latter or both mechanisms may also explain the association between fasciolosis and strongylosis observed in this study.
CONCLUSIONS AND RECOMMENDATIONS
This study revealed cattle around Bahir Dar area are exposed to a variety of helminth parasitic infections; some of them harbouring multiple genera. Prevalence was not different between sexes and between young and adult animals. Cross breed cattle are equally infected as their local zebu counterparts irrespective of parasite species. Schistosoma positive cattle had higher opportunity to develop fasciolosis due to communalities in snail habitats and close association of predilection sites in the infected host. As grazing areas are best places for the development of strongyle infective larvae, it is also possible that the latter could be concurrently present with the former parasite genera. Based on these findings, the following points could be suggested for future studies and designing of control strategies:
  o Any helminth control strategy to reduce losses from helminth parasitism must take into account the diverse genera of parasites and their intermediate hosts prevalent in the area
  o Further studies are recommended to elaborate the immunological mechanisms governing mixed infections such as with schistosomes and Fasciola species
  o This study did not consider different age categories (only young and adult). The physiological status (pregnancy, lactation, castration etc) of animals were not included. Therefore, future works should take into account these factors as they could have paramount importance in the implementation of control programmes.

REFERENCES


