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Prevalence of Gastrointenstinal 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 eggs were found to be 14%, 20%, 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 *Schstosoma* 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 planing of any helmith 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 speices of veterinary importance are *S. mattheei*, *S. curassoni, S. indicum, S. spindale* and *S. nasale* (Rollinson and Southgate, 1987). Similarly, Fasciolosis is another important parasite 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 endemicity 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 subclinical 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^{o}, 36$^{'}$N latitude and 37^{o}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 ^{o}C and 27^{o}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 flotation 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 (χ^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

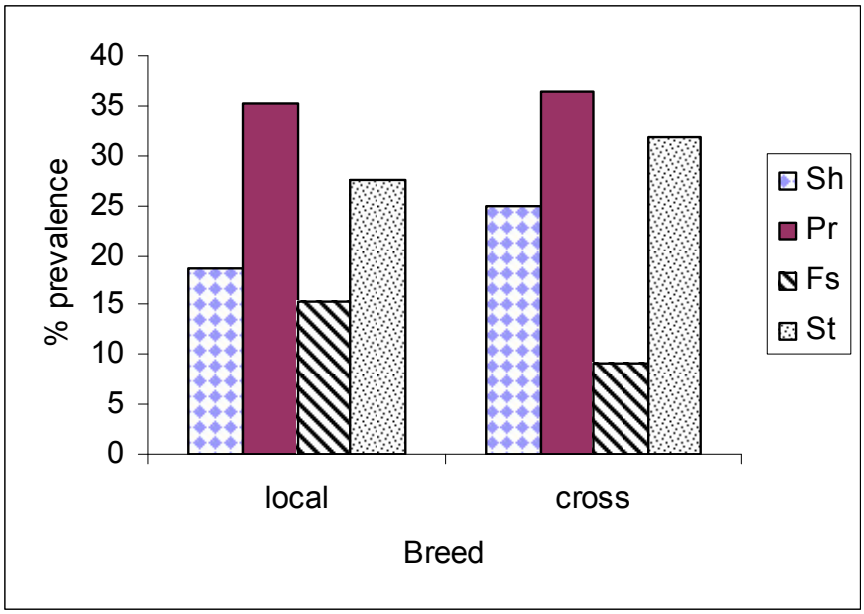
Among the 200 faecal samples examined, the overall prevalence of helminth eggs irrespective of parasite species was 59.5%. Mainly, *Fasciola, Schisasoma, Paramphistomum* and strongyle eggs were found with faecal examination. *Paramphistomum* and strongyle eggs were more prevalent than those of *Fasciola*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

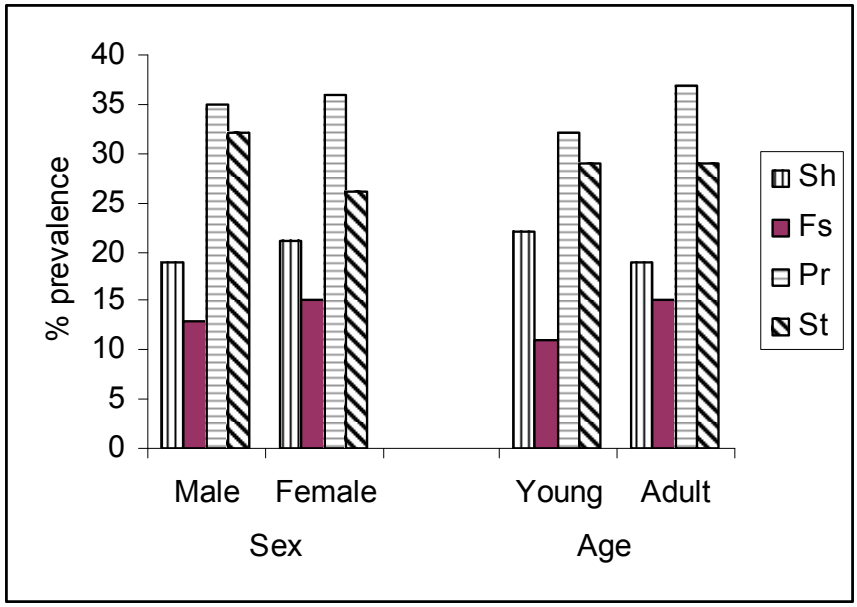
Table1. Prevalence of *Fasciola*, *Schistosoma*, *Paramphistomum* and strongyle eggs in faeces of cattle

Parasite genera	*No of samples*	*% positive animals*
Fasciola	200	14[a]
Schistosoma	200	20[a]
Paramphistomum	200	35.5[b]
Strongyles	200	28.5[b]

Values with different letters are statistically different



Sh: *Schistosoma*, Pr: *Paramphistomum*, Fs: *Fasciola*, St: Strongyle
Figure 1. Comparison of the prevalence of different parasite genera between local zebu and cross breed cattle



Sh: *Schistosoma*, Pr: *Paramphistomum*, Fs: *Fasciola*, St: Strongyle
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 *Schstosoma* 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 animas. Such association with Schistosomes was not demonstrated for other parasite eggs (*Paraphistomum*, 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.

Status	*% Fasciola (+)*	*% Strongyle (+)*
Schitsosoma (+)	25^{a}	28
Schitsosoma (-)	11^{b}	29
Fasciola (+)		39^{c}
Fasciola (-)		27^{d}

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 hyporesponsiveness, 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 Rhön 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. Intact male 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 gestation 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 *Schostosoma* eggs in their faeces were found to concurrently harbour *Fasciola* eggs than those without *Schostosoma* 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 the pathology associated to fasciolosis. The first phase occurs during migration in the liver parenchyma (6-8 weeks) and is associated with liver damage and haemorrhage. The second phase occurs when the parasite reaches the bile ducts, and results from the haematophagic activity of the adult flukes and from the damage to the mucosa, by their cutical spines (Urquhart, *et al.,* 1987). Schistosoma larvae (cercaria) are carried in the lymph to the lungs. The parasite remain in the lungs for a few days before moving down the pulmonary veins to the left side of the heart and pumped around the body to their next destination in the hepatic portal system along the gut wall or reach the liver via the hepatic artery. In the liver, the parasites take 3-4 weeks to reach maturity. Enough matured parasites are migrating through the portal vein against the blood stream until they reach their egg laying site in the small venules (Urquhart, *et al*., 1987).

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:

- 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
- Further studies are recommended to elaborate the immunological mechanisms governing mixed infections such as with schistosomes and *Fasciola* species
- 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

Aban, J.L., Ramajo, V., Arellano, J.L.P., Oleaga, A., Hillyer, G.V. and Muro, A. (1999): Afatty acid binding protein from *Fasciola hepatica* induced protection in C57/BL mice from challenge infection with *Schistosoma bovis*. *Veterinary Parasitology*, 83: 107-121.

Central Statistical Authority (2003): Ethiopian Agricultural Sample enumeration results for NNPR, statistical report on livestock and farm implements, *part IV*. Pp. 29-304.

Clark, G.M. (1992): Statistics and experimental design. A series of student text in contemporary biology 2nd ed. Lon. Edward Arnold, Pp. 124-142.

Clark, I.A. (2001): Heterologous immunity revisited. *Parasitology*, 122, 851-859.

Colditz, I.G., Watson, D.L., Gray, G.D. and Eady, S.J. (1996): Some relationships between age, immune responsiveness and resistance to parasites in ruminants. *International Journal for Parasitology,* 26, 869-877.

Cox, F.E.G. (2001): Concomitant infections, parasites and immune responses.*parasitology*, 122, 823-838.

Dobson, R.J., Barnes, E.H. and Windon, R.G. (1992): Population dynamics of *Trichostrongylus colubriformis* and *Ostertagia circumcincta* in single and concurrent infections. *International Journal Parasitology,* 22(7), 997-1004.

Ferreras, M.C., Garcia-Iglesias, M.J.,Manga-Gonzalez, M.Y., Perez-Martinez, C., Mizinsk, Y.,Ramajo, V., Gonzalez-Lanza, M.C., Escudero, A. and Garcia-Marin, J.F. (2000): Histopatological and immunohistochemical study of lambs experimentally infected with *Fasciola hepatica* and *Schistosoma bovis*. *J. Vet. Men. B. Infect Dis. Vet. Public Health,* 47(10), 763-773.

Gauly, M., Kraus, M., Vervelde, L., Van Leeuwen, M.A. and Erhardt, G. (2002): Estimating genetic differences in natural resistance in Rhon and Merinoland sheep following experimental *Haemonchus contortus* infection. *Veterinary Parasitology,* 106, 55-67.

Gauly, M., Schackert, M., Hoffmann, B. and Erhardt, G. (2006): Influence of sex on the resistance of sheep lambs to an experimental *Haemonchus contortus* infection. *Deutsche Tierärztliche Wochenschrift,* 113, 178-181.

Goossens, B., Osaer, S., Kora, S., Jaitner, J., Ndao, M. and Geerts, S. (1998): The interaction of *Trypanosoma congolense* and *Haemonchus contortus* in Djallonké sheep. *International Journal of Parasitology*, 27,1579-84.

Gracey, J.F. (1986): Parasitic diseases: Meat Hygiene. 8th ed. Bailliere Tindall, London, pp. 371-372.

Hall, H.T.B. (1985): Endoparasites trematodes. Disease parasites of livestock in the tropics, 2nd ed. Longman Group Ltd. London, pp. 213-214.

Lacroux, C., Nguyen, T.H.C., Andreoletti, O., Prévot, F., Grisez, C., Bergeaud, J.P., Gruner, L., Brunel, J.C., Francois, D., Dorchies, P. and Jacquiet, P. (2006): *Haemonchus contortus* (Nematoda: Trichostrongylidae) infection in lambs elicits an unequivocal Th2 immune response. *Veternary Research,* 37, 607-622.

Lo, C.T. and Lemma, A. (1975): Studies on *Schistosoma bovis* in Ethiopia. *Annals of Tropical Medicine and Parasitology*, 69, 375-382.

Manton, V.J.A., Peacock, R., Ponter, D., Silverman, P.H and Terry, R. J. (1962): The influence age on naturally acquired resistance to *Haemonchus contortus* in lambs. *Research Veterinary Science,* 3, 308.

Monrad, J., Christensen, N.O., Nansen, P. and Frandsen, F. (1981): Resistance to *Fasciola hepatica* in sheep

harbouring primary *Schistosoma bovis* infections. *Journal Helmithology*, 55(4), 261-271.

Mulcahy, G., O'Neill, S., Donnelly, S. and Dalton, J.P. (2004): Helminths at mucosal barriers-interaction with the immune system. *Advanced Drug Delivery Reviews,* 56, 853-868.

Onah, D.N. and Nawa, Y., (2000): Mucosal immunity against parasitic gastrointestinal nematodes. *Korean Journal of Parasitology,* 38, 209-236.

Onah, D.N. and Wakelin, D. (1999): Trypanosome-induced suppression of responses to *Trichinella spiralis* in vaccinated mice. *International Journal Parasitology,* 29, 1017-1026.

Rollinson, D. and Southgate, V.R. (1987): The genus *schistosoma*: A taxonomic Appraisal. In: D. Rollinson and A.J.G. Simpson (eds), the biology of Schistosomes: From genus to Latrines. London Academic Press, pp. 1-49.

Shaw, K.L., Nolan, J.V., Lynch, J.J., Coverdale, O.R. and Gill, H.S. (1995): Effect of Weaning, supplementation and gender on acquired immunity to *Haemonchus contortus* in lambs. *International Journal for Parasitology,* 25, 381-387.

Solomon, H. (1985): Schistosomiasis in domestic ruminants in Bahir Dar. DVM Thesis, Faculty Veterinary Medicine, Addis Ababa University. Debre Zeit, Ethiopia.

Solomon, W. (2005): Effects of a strategic anthelmintic treatment intervention ruminant Fascioloisis in upper Blue Nile Basin, North Western Ethiopia. MSc Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Southgate, V.R., Jourdane, J.and Tchuem Tchuente, L.A. (1998): Recent studies on the reproductive biology of schistosomes and their relevance to speciation in the Digenea. *International Journal for Parasitology*, 28, 1159-1172.

Tembely, S., Lahlou-Kassi, A., Rege, J.E.O., Mukasa-Mugerwa, E., Anindo, D., Sovani, S. and Baker R.L. (1998): Breed and season effects on the peri-parturient rise in nematode egg output in indigenous ewes in a cool tropical environment, *Veterinary Parasitology,* 77, 123-132.

Terefe, G., Lacroux, C., Andreoletti, O., Grisez, C., Prévot,F., Bergeaud, J.P., Penicaud, J., Rouillon, V., Gruner, L., Brunel, J.C., François, D., Bouix, J., Dorchies, P. and Jacquiet, P. (2007): Immune response to *Haemonchus contortus* infection in susceptible (INRA-401) and resistant (Barbados Black Belly) breeds of lambs. *Parasite immunology*, 29, 415-427.

Terefe, G., Yaco, H.T., Grizer, C., Prenot, F., Dumas, E., Bergeaurd, J.P., Dorchies, Ph.,Host, H. and Jacquiet, P.(2005): *Haemonchus contortus* egg excretion and female length reduction in sheep previously infected with *Oestrus ovis*. Veterinary Parasitology, 128: pp. 278-283.

Terefe, G., Yacob, H.T., Grisez, C., Prevot, F., Dumas, E., Bergeaud, J.P., Dorchies, Ph., Hoste, H. and Jacquiet, P. (2005): *Haemonchus contortus* egg excretion and female length reduction in sheep previously infected with *O. ovis* larvae. *Veterinary Parasitology*, 128: 271-283.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W. (1987): Veterinary Parasitology. Churchil Livingstone Inc., New York, pp. 114-116.

Utzinger, J. and Tanner, M. (2000): Microhabitat preferences of Biomphalaria pfeifferi and Lymnea natalensis in natural and a man made habitat in southeaster. *Mem. Inst. Oswaldo Cruz*, 95(3), 287-294.

Watson, D.L. and Gill, H.S. (1991): Effect of weaning on antibody responses and nematode parasitism in Merino lambs. *Research in Veterinary Science,* 51, 128-132.

Yacob, H.T., Duranton-Grisez, C., Prevot, F., Bergeaud, J.P., Bleuart, C., Jacquiet, Ph., Dorchies, Ph. and Hoste, H. (2002): Experimental concurrent infection of sheep with *Oestrus ovis* and T*richostrongylus colubriformis*: negative interactions between parasite populations and related changes in the cellular responses of nasal and digestive mucosa. *Veterinary Parasitology,* 104, 307-317.

Yalelet, W. (2004): Survey on Bovine Schistosomiasis in and around Bahir-Dar, North western Ethiopia. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University. Debre Zeit, Ethiopia.