# PREVALENCE OF *FASCIOLA* SPP INFECTIONS OF SHEEP IN THE MIDDLE AWASH RIVER BASIN, ETHIOPIA

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**Abstract.** Ovine fascioliasis plays an important role of the major constraints to small ruminant production in Ethiopia. The objectives of this study were to assess the prevalence of *Fasciola* spp infections of sheep in Middle Awash River Basin, and to compare *Fasciola* spp. The fecal samples (3,697)) were collected and tested using the ethyl-acetate centrifugation technique to identify eggs of *Fasciola* spp. The overall prevalence of fascioliasis was 13.2%. The results demonstrated that *Fasciola* spp infection was higher among Afar (13.5%) than blackhead breed (9.1%). Infection rates for the different age groups were found to vary significantly ($p<0.001$). Infection rates for sheep with poor body condition (19.5%) were higher than sheep with good body condition (2.8%). With regard to the seasonal factors, the highest infection rate was observed during the cool season (6.9%), and lowest infection rate was recorded during the main rainy season (0.8%). To control the disease in this area, appropriate preventive control strategies have to be designed to reduce the impact of the disease on sheep production.

## INTRODUCTION

Production of sheep for meat, milk, wool, hair, skin, and manure is an attractive agricultural enterprise for Ethiopian farmers because of the relatively low cost of breeding stock, the high productive rate of sheep, and the source of cash income. Sheep require minimal inputs and maintenance costs to live in various conditions, from desert to humid rainforest (Gatenby, 1991). In Ethiopia, sheep are the dominant livestock, providing up to 63% of cash income and 23% of the food subsistence value obtained from livestock production (Zelalem and Fletcher, 1993). The sheep population of the country is estimated to be 25.5 million (Central Statistical Authority, 2004). Despite the large size of the sheep population, the productivity per animal and the contribution of this sub-sector to the national economy is relatively low. Endo-parasitic infections, malnutrition, and management problems are known to be the main factors that affect productivity. The various species of gastro-intestinal and pulmonary nematodes, trematodes, and cestodes are known to be prevalent in Ethiopia (Bahiru and Ephraim, 1979; Bekele *et al*, 1981, 1982; Brook *et al*, 1985). As previously reported (Bergeon, 1968; Scott and Goll, 1977; Yilma, 1985; Yadeta, 1994), fascioliasis is one of the major parasitic disease that causes immense economic losses in livestock productivity.

Fascioliasis is caused by *Fasciola*, commonly referred to as liver flukes. Fascioliasis is a widespread parasitic disease of sheep, cattle, and occasionally humans. *Fasciola hepatica* and *F. gigantica* were commonly implicated. While *F. hepatica* has a worldwide distribution, but predominates in the temperate zones and cool areas of high altitude in the tropics and sub-tropics (Troncy, 1989). *F. gigantica* is mostly located in tropical areas (Urquhart *et al*, 1994). The geographical distribution of *F. hepatica* and *F. gigantica* is determined mainly by the distribution patterns of the snails that have a role as intermediate hosts (Pantalouris, 1965; Soulsby, 1982; Hall, 1986). In Ethiopia, both species co-exist at different altitudes (Graber, 1975).

The prevalence and distribution of fascioliasis varies from 11% in the Rift Valley to100% in the central highlands of Ethiopia (Erich, 1983).

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Fascioliasis was widespread, particularly in the north and the west of the Great Rift Valley, which divides the country into two parts of unequal size (Malone and Yilma, 1999).

In Ethiopia, the annual losses due to ovine fascioliasis were estimated at 48.4 million Ethiopian Birr (1 US$ = 2.07 ETB) per year, of which 46.5, 48.8, and 4.7% were due to mortality, productivity (weight loss and reproductive wastage), and liver condemnation at slaughter, respectively (Ngategize *et al*, 1993).

In Afar National Regional State, especially in Awash River basin, fascioliasis is the most important disease of sheep production. The main reason is that the Awash River and its tributaries create a favorable environment for the growth and multiplication of snails as intermediate hosts by providing moisture, from flooding during rainy season and from the irrigation schemes during the dry season. Unfortunately, the data regarding the prevalence and distribution of fascioliasis in sheep and other ruminant species are fragmented or not well documented. Therefore, seasonal coprological studies were designed to investigate the prevalence of *Fasciola* spp infections in this area and to associate the infection with breed, sex, and age.

## MATERIALS AND METHODS

### Description of the studied areas

Investigation of *Fasciola* spp infections was carried out from January to December 2005 in three districts (Gewane, Bure Mudaytu, and Amibera) of Middle Awash River Basin in Afar National Regional Sate. The sheep population was estimated at 24,308, 22,823, and 44,290 in Amibera, Gewane, and Bure Mudaytu Districts, respectively (Afar Forestry Action Program, 1998). The Middle Awash River Basin is located between latitude 8° to 10° N and longitude 38° to 42° E; and situated at lower altitudes, ranging from 850 m above sea level in the Melka Werer area to 550 m in the Gewane area. The areas are 270 to 365 km from Addis Ababa, the capital of Ethiopia. Gewane, Bure Mudaytu, and Amibera were selected because they are wet and low lying along the irrigated and flooding areas of Awash, an ecology which has the potential for transmission of ovine fascioliasis.

On the flood paths and near the Awash River, the area is covered with the acacia trees (*Prosopis juliflora*), while the rest of the area is covered with shrubs, bushes, or grass. After the introduction of irrigated agriculture in this area, it modified the ecology. Currently, these areas are cultivated for cotton, banana, and oil seeds. The majority of the population search for better grazing and watering sites for their livestock. The climate of the area is normally hot and dry. The rain falls between July and September, with a brief rainy period during March and April. The mean total annual rainfall of the areas ranges from 663.7 to 687.8 mm. The mean minimum and maximum temperature ranges between 33.2˚C to 42.8˚C, and 19.6˚C to 26.7˚C, respectively; the average humidity is around 50.4% to 52%.

### Sample collection

A total of 3,697 fecal samples were collected from nine selected sites of the three districts: 3,465 from Afar and 232 from Blackhead local sheep breeds, respectively; 2,845 samples were taken from females and 852 were taken from males. Age groups were classified as adult, young, and lamb.

Using a plastic glove, five grams of fresh fecal matter were collected from the rectum or during defecation. The samples were stored in plastic bags, well labeled, and placed in icebox until used. Coproscopic examinations were performed to detect *Fasciola* eggs using the standard sedimentation technique. The age of the animals was recorded by interviewing stockowners and using dental formula (Gatenby, 1991) for analysis. The study sites were randomly selected, the distribution of samples was the proportion of one herd per one study site, and all sheep in the herd were sampled. Samples were collected on a seasonal basis.

The seasons are traditionally classified as *kerma* (July-September), which is the long rainy season; *sugum* (March-April), which is the short rainy season; *hagai* (May-June) which is the hot-dry spell; and *gilal* (October-February) which is the cool season. *Gilal* is sometimes interrupted by rains in January and February and known as *dedda*.

Scoring of the body condition of animals was conducted during sample collection, according to the method described by Thompson and Meyer (1994).

**Data analysis**

Data were analyzed with a nested design using the chi-square test to analyze the relationships between sex, age, breed, and body condition. Infection rates, based on age and the seasonal variations in the prevalence of fascioliasis, were analyzed by the Pearson's correlation coefficient (Putt *et al*, 1988).

## RESULTS

Of the total, 489 (13.2%) were positive for *Fasciola* spp parasites (Table 1). Several factors were associated with a higher prevalence of liver fluke infection. Geographically, the *Fasciola* spp prevalence in the three districts ranged from 11.3 % in Bure Mudatyu to 17.4% in Amibera

Table 1
Factors associated with *Fasciola* spp infections of sheep in Middle Awash River Basin of Afar Regional State, Ethiopia.

| Factors | Category | No. examined | No. positive (%) |
|---|---|---|---|
| District | Gewane | 1,712 | 223 (13.0)[a] |
| | Bure Mudaytu | 1,296 | 146 (11.3)[a] |
| | Amibera | 689 | 120 (17.4)[b] |
| Sites | Gewane: | | |
| | Egele | 721 | 95 (13.2)[a] |
| | Gebaya Bora | 482 | 66 (13.7)[a] |
| | Galela Dora | 509 | 62 (12.2)[a] |
| | Bure Mudaytu: | | |
| | Debel | 659 | 86 (13.1)[a] |
| | Beadafore | 411 | 41 (9.9)[b] |
| | Gelalu | 226 | 19 (8.4)[b] |
| | Amibera: | | |
| | Aleysumalie | 297 | 50 (16.8)[a] |
| | Ambash | 174 | 29 (16.7)[a] |
| | Awash Sheleko | 218 | 41 (18.8)[a] |
| Breed | Afar | 3,465 | 468 (13.5)[a] |
| | Blackhead | 232 | 21 (9.1)[a] |
| Sex | Male | 852 | 114 (13.4)[a] |
| | Female | 2,845 | 375 (13.2)[a] |
| Age | < 1 year | 444 | 36 ( 8.1)[a] |
| | 1-2 year | 819 | 89 (10.9)[a] |
| | > 2 year | 2,434 | 364 (14.9)[b] |
| Season | Cool dry | 951 | 257 (6.9)[a] |
| | Short rainy | 825 | 153 (4.1)[b] |
| | Hot dry | 933 | 49 (1.3)[c] |
| | Main rainy | 988 | 30 (0.8)[c] |
| Body condition | Poor | 2,306 | 450 (19.5)[a] |
| | Good | 1,391 | 39 (2.8)[b] |
| Total | | 3,697 | 489 (13.2) |

Different superscripts within subgroup represent statistical significance of different prevalence ($p < 0.05$).

($p < 0.001$). The high incidence of *Fasciola* spp infections was found at Awash Sheleko (18.8%) of Amibera District, Debel (13.1 %) of Bure Mudatyu District, and Gebaya Bora (13.7%) of Gewane District.

There was an insignificantly higher prevalence of *Fasciola* spp infections among the Afar breed (13.5%) as compared with the Blackhead (9.1%) breed ($p > 0.05$). The prevalence of *Fasciola* spp among male sheep (13.4 %) was higher than that among females (13.2 %), but this difference was not statistically significant. A higher *Fasciola* spp infection prevalence ($p < 0.001$) was found among sheep of >2 years (14.9 %) when compared with sheep of 1-2 years (10.9 %) or < 1 year old (8.1 %).

Higher seasonal prevalence of ovine fascioliasis in the study areas was found during cool season (6.9 %), followed by the short rainy period (4.1%). During hot season, most animals were returned from the wet grazing areas to the farms nearby the Awash River. Animals were possibly infected at this time. From November, the prevalence of the disease increased and clinical signs were observed. During rainy season, animals moved from place to place in search of grazing areas. Because of this, the prevalence was relatively low.

The prevalence of ovine fascioliasis in animals of different body conditions was indicated that animals with a poor body condition were more highly infected than animals with a good body condition ($p < 0.001$).

## DISCUSSION

Comprehensive knowledge of parasite ecology is crucial to sustainable control because parasites interact differently with hosts in specific climatic, managerial, and production environments (Almeria and Uriate, 1999; Waller, 1999; Papadopoulos *et al*, 2003). Our data indicated that the exposure of domestic sheep to *Fasciola* spp infections in Middle Awash River Basin in Afar National Regional Sate was common, with an overall prevalence of 13.2%. The results concurred with Graber (1975), who noted that fascioliasis was rare in the Rift Valley areas, Ethiopia. In contrast to our findings, Michael *et al* (2005) have reported prevalence rates of 56.3% for ovine fascioliasis in the Upper Awash River Basin. This difference may be due to different agro-ecological conditions, traditional pasture management practices, the pattern of movement of the animals from grazing near water logged areas, and agricultural irrigation practices during rainy season.

The variation in prevalence between the different locations was also likely due to the differences in landscape, such as swampy areas, and agricultural irrigation practices. During the rainy season, the amount of the rainfall flooding Awash River created a favorable condition, which favored the development of the intermediate host (snail) and the transmission of the diseases. Irrigation based on agricultural practice and the swampy areas were important ecologies for the continuity of the lifecycle of fascioliasis. Similar findings were previously reported (Graber, 1975; Urquhart *et al*, 1994; Michael *et al*, 2005; Solomon, 2005).

Climate conditions, particularly rainfall, were frequently associated with differences in the prevalence of *Fasciola* spp infection because this was suitable for intermediate hosts like snails to reproduce and to survive longer under moist conditions. The Middle Awash River Basin has a rainy season for five months, which facilitates parasitic survival in such an environment. Moreover, the flooding areas were found to have a significant influence on the risk of *Fasciola* spp infection since this enhanced a predisposing factor for many snails to complete their life cycles.

The difference in *Fasciola* spp infection between sheep breeds was previously reported (Pralomkarn *et al,* 1997). In Ethiopia, sheep are usually reared under non-intensive conditions, whereby animals may be brought out to graze and wander freely.

Solomon (2005) has suggested that fascioliasis equally affect both sexes. In this study, a higher prevalence of parasitic infection was not associated with sex ($p > 0.05$). However, although not statistically significant, males actually had a higher infection prevalence than females. This might be because all the animals were also grazing similar pastureland.

Although climatic conditions are consistent throughout the Middle Awash River Basin area, the prevalence of *Fasciola* spp in sheep varied slightly, from 11.3% in Bure Mudaytu District to 17.4% in Amibera district. Thus, these geographical differences in prevalence might be due to agricultural irrigation practices and the time spent by animals grazing near the Awash River. The intensity of infection is reportedly related to the availability of the intermediate hosts; thus, better snail control and separate grazing for different age groups would likely reduce the infection rate and the prevalence of fascioliasis among sheep in Ethiopia.

Our study indicated that sheep in Middle Awash River Basin were usually infected with *Fasciola* spp parasites. Economic evaluations consistently show that major losses due to parasitism affected animal production rather than mortality; and in Middle Awash River Basin, parasitism could influence the productivity, morbidity, and mortality of these animals (Githigia *et al*, 2001). Parasite-nutrient interactions were probably exacerbated by the effects of poor nutrition and management practices, which lead to decreased efficiency in feed utilization.

Young animals had a lower prevalence of *Fasciola* spp infections in this study. This finding was consistent with other reports, and it was not surprising because naive kids have maternal immunity. Higher infection rates were found in adults in other age groups ($p < 0.05$). Based on this finding, it can be suggested that the higher exposure risk of adults may be due to physiological differences, such as stress, pregnancy, lambing, inadequate nutrition, and infectious diseases. Similar results were reported by Ayalew (1994).

Hunter (1953) observed that a well-fed animal was not in trouble with worms, and usually a poor diet resulted in more helminth infections. Furthermore, helminthes also led to a loss of appetite and poor utilization of food, which results in a loss of body weight. Hawkins and Morris (1978) demonstrated that weekly growth rates of wool and live weight decreased with increasing fluke burdens in sheep.

In conclusion, the *Fasciola* spp infected sheep examined in this study harbored parasites and acted as reservoirs for transmission. Observed differences in the prevalence of parasitic infections between districts were probably due to differences in management systems. A strategic control program must be launched to prevent the increase of parasites in the environment and to avoid heavy contamination of the pasture by fecal eggs. Traditional pasture management (*eg*, restriction of animals during rainy season around Awash River) should be encouraged. Awareness must be created among stockowners regarding fascioliasis.

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## REFERENCES

Afar Forestry Action Program. Afar Forestry Action Program Technical Report. Volume II (3) Livestock and fodder production. Addis Ababa: Afar Forestry Action Program, 1998.

Almeria S, Uriarte J. Dynamics of pasture contamination by gastrointestinal nematodes of cattle under extensive management systems: proposal for strategic control. *J Vet Parasitol* 1999;83:37-47.

Ayalew T. Preliminary survey of sheep helminthiasis in Kimbibit district, North Shoa. 8th Conference of the Ethiopian Veterinary Association, Addis Ababa, Ethiopia. Addis Ababa: Ethiopian Veterinary Association, 1994:86-94.

Bahiru G. Ephraim M. A preliminary survey of bovine fascioliasis in Ethiopia. *Ethiop J Agric Sci* 1979;1:5-12.

Bekele M, Fesha G, Shibru T. Observations in *Dictyocaulus filaria* in Wollo and Arsi administrative region of Ethiopia. *Ethiop J Agric Sci* 1981;3:75-80.

Bekele M, Shibru T, Fesha G. Survey study of gastrointestinal helminths in sheep slaughtered at the Addis Ababa abattoir, Ethiopia. *Ehiop J Agric Sci* 1982;4:87-94.

Bergeon P. Report to the government of Ethiopia on veterinary parasitology survey. Rome: FAO, 1968:105 pp.

Brook L, Fesha G, Shibiru T. Studies on fascioliasis in four selected sites in Ethiopia. *Vet Parasitol* 1985;18:29-37.

Central Statistical Authority. 2004 Statistical abstract. Addis Ababa: Central Statistical Authority, 2004:473 pp.

Erich J. Investigation on fascioliasis in the Ethiopian Highlands around Debere Berhan. Leiden: Leiden University, 1983:29 pp. Thesis.

Gatenby RM. The tropical agriculturalist: sheep (Tropical Agriculture Series). London: Macmillan Education, 1991:154 pp.

Githigia SM, Thamsborg SM, Munyua, WK, Maingi N. Impact of gastrointestinal helminths on production in goats in Kenya. *Small Rum Res* 2001;42:21-9.

Graber M. Helminths and helminthiasis of domestic and wild animals in Ethiopia. *Bull Anim Health Prod Afr* 1975;23:57-86.

Hall MTB. Disease and parasites of livestock in the tropics. 2nd Intermediate Tropical Agriculture Series. London: Longman, 1986:207 pp.

Hawkins CD, Morris RS. Depression of productivity in sheep infected with *Fasciola hepatica*. *Vet Parasitol* 1978;4:341-51.

Hunter GC. Nutrition and host relationships. *Nutr Abstr Rev* 1953;23:705-14

Malone JB, Yilma JM. Predicating out breaks of fasciolosis: from Ollerenshaw to satellites. In: Dalton JP, ed. Fasciolosis. Wallingford, UK: CABI, 1999:411-34.

Michael A, Beyene P, Yilma J, *et al*. Infection prevalence of ovine fascioliasis in small-scale irrigation schemes along the Upper Awash River Basin. *J Ethiop Vet Assoc* 2005;9:19-27.

Ngategize PK, Bekele T, Tilahn G. Financial losses caused by ovine fascioliasis in the Ethiopian Highlands. *Trop Anim Health Prod* 1993;25:155-61.

Pantalouris EN. The common liver fluke, *Fasciola hepatica*. Oxford: Pergamon, 1965:259 pp.

Papadopoulos E, Arsenos G, Sotiraki S, Deligiannis C, Lainas T, Zygoyiannis D. The epizootiology of gastrointestinal nematode parasites in Greek dairy breeds of sheep and goats. *Small Rum Res* 2003;47:193-202.

Pralomkarn W, Pandey VS, Ngampongsai W, *et al*. Genetic resistance of three genotypes of goats to experimental infection with *Haemonchus contortus*. *Vet Parasitol* 1997; 68:79-90.

Putt SNH, Shaw APM, Woods AJ, Tyler L, James AD. Veterinary epidemiology and economics in Africa. Addis Ababa: International Livestock Center for Africa, 1988:129 pp, (ILCA manual no 3).

Scott JM, Goll PH. The epidemiology and antihelmintic control of ovine fascioliasis in the Ethiopian Highlands. *Br Vet J* 1977; 133:273-80.

Solomon W. Effect of strategic anthelmintic treatment intervention on ruminant fascioliasis in Upper Blue Nile Basin, North Western Ethiopia. Addis Ababa: Addis Ababa University, 1965:78 pp. MSc Thesis.

Soulsby EJL. Helminths, arthropods and protozoa of domestic animals. 7th ed. London: Baillere Tindall, 1982:809 pp.

Thompson J, Meyer H. Body condition scoring of sheep 1994. [Cited 2006 Aug 30]. Available from: URL: http://extension.oregonstate.edu/catalog/html/ec/ec1433/#anchor5425968

Troncy PM. Fascioliasis of ruminants. In: Manual of tropical veterinary parasitology.

Wallingford: CABI, 1989:63-74.

Urquhart GM, Armour J, Duncan JL, Dunn AM, Jennings FW. Veterinary parasitology. Oxford: Longman Scientific, 1994:98-109.

Waller PJ. International approaches to the concept of integrated control of nematode parasites of livestock. *Int J Parasitol* 1999;29:155-64.

Yadeta B. Epidemiology of bovine and ovine fascioliasis and distribution of its snail intermediate host in western Shoa . Debere Zeit, Ethiopia: Addis Ababa University, 1994. 35 pp. DVM Thesis.

Yilma J. Study on ovine fascioliasis and other helminth parasites at Holeta. Addis Ababa: Addis Ababa University, 1985:45 pp. DVM Thesis.

Zelalem A, Fletcher I. Small ruminant productivity in the central Ethiopian mixed farming systems. In: IAR, Addis Ababa, Ethiopia: 4th National Livestock Improvement Conference, 13-15 November 1991, 1993:141-7.