

Full Length Research Paper

Prevalence of bovine fasciolosis in and around Inchini town, West Showa Zone, Ada'a Bega Woreda, Central Ethiopia

Abdi Assefa¹, Zerihun Assefa^{2*}, Desta Beyene¹ and Fanta Desissa²

¹Haramaya University, Faculty of Veterinary Medicine, P. O. Box.138, Haramaya, Ethiopia.

²Addis Ababa University, College of Veterinary Medicine and Agriculture, P. O. Box, 34, Debre - Zeit, Ethiopia.

Received 25 November 2014; Accepted 10 April 2015

The study was conducted from November, 2008 to March, 2009 in six kebeles of Ada'a Berga Woreda, West Showa Zone, in and around Inchini town and indicated that bovine fasciolosis is widely spread with high prevalence, inducing economic loss to livestock production in the region. From a total of 573 cattle coprologically examined during the study period, 291 animals were found positive for liver fluke infection with an overall prevalence rate of 50.79%. There was no statistically significant difference ($p > 0.05$) in infection rates between male and female animals. Analysis of infection rates on the basis of age of cattle indicated negative or inverse correlation and there were significant differences ($p < 0.05$) between different age groups. A significant difference ($p < 0.05$) was observed among studied months with highest monthly prevalence in November and lowest in January. The infection rates (60.48%) were significantly higher ($p < 0.05$) in poor body condition than good body condition animals (11%) and this signifies the importance of fasciolosis in causing weight loss which is the characteristic sign of chronic fasciolosis. Of the total 196 bovine livers examined at Inchini municipal abattoir, 107(54.49%) animals were found positive for liver fluke and 68.22% of livers harbored *Fasciola hepatica*, 8.04% *Fasciola gigantica* and 23.37% infected by both species of *Fasciola*. This study indicates fasciolosis is the major parasitic health problem in the area and creates economic impact by condemnation of the affected liver. Therefore, proper attention should be paid for strategic deworming, animals should not be allowed to graze in water reservoir areas and further research on meteorological condition of snail infection is highly recommended.

Key words: Abattoir, Ada'a Berga, bovine, fasciolosis, prevalence, West Showa zone.

INTRODUCTION

Bovine fasciolosis is an economically important parasitic disease of cattle caused by trematodes species of the genus *Fasciola*, which migrate in the hepatic parenchyma

and establish and develops in the bile ducts. Fasciolosis caused by *fasciola hepatica* and *Fasciola gigantica*, is one of the most prevalent helminth infection of ruminants

*Corresponding author. E-mail: assefa.zerihun@yahoo.com. Tel: +251912138186.

Author(s) agree that this article remain permanently open access under the terms of the [Creative Commons Attribution License 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

in different parts of the world. It causes significant morbidity and mortality (Okewole et al., 2000; WHO, 1995).

The snails of the genus *lymnae* are mainly involved as an intermediate host in the life cycle of fasciolosis. The epidemiology of fasciolosis is dependent on the ecology of the snail intermediate host. *lymnae truncatula* is the most common intermediate host for *fasciola hepatica* in different part of the world (Njau et al., 1991) and in Ethiopia (Graber et al., 1975). It is an amphibious or a mud-dwelling snail which prefers moist temperature condition (15 to 22°C) though it appears that variants found in the tropics have adaptation to higher temperature mostly in the lowland areas and can breed and survive at 26°C with sufficient moistures. The most important intermediate hosts of *Fasciola gigantica* are *Leptodactylus natalensis* and *Leptodactylus auriallaria* (Urquhart et al., 1996; Dunn, 1978; Soulsby, 1982). *L. natalensis* is the recognized intermediate host for *F. gigantica* (Yilma and Malone, 1998). This snail is strictly an aquatic snail often found in Africa and requires well oxygenated none polluted water bodies and can aestivate during dry periods. Optimal temperature requirement for the completion of parasite developmental stages within the snail is 22 to 26°C. However, in irrigated areas, snail breeding is less circumscribed and well continues all year around, except for period's extreme temperature levels (Souls, 1982).

F. hepatica is a temperate species and it is found in Southern America, Northern America, Europe and Australia and Africa, but found in the highlands of Ethiopia and Kenya. It is the major cause of liver fluke disease in Ethiopia. Its tropical counterpart, *F. gigantica*, on the other hand is widely distributed in tropical countries, in Africa and Asia. In Ethiopia, *F. gigantica* is found at an altitude below 1800 m above sea level while *f. hepatica* is found at altitude between 1200 to 1560 m above sea level (Yilma and Malone, 1998). Mixed infection by the two species can be encountered at 1200 to 1800 m above sea level (Mulugeta et al., 1989).

The clinical features of fasciolosis can have acute, sub acute and chronic forms. Acute fasciolosis occurs as disease outbreak following a massive, but relatively short-term, intake of metacercariae (Urquhart et al., 1996). The high fluke intake is often the result of certain seasonal and climatic conditions combined with a lack of appropriate fluke control measures. It typically occurs when stocks are forced to graze in heavily contaminated wet areas as a result of over stocking and /or drought. Animals often affected by acute fasciolosis especially sheep and goat may display no clinical signs prior to death while some may display abdominal pain, discomfort and may develop jaundice (Souls, 1982; Urquhart et al., 1996). Death usually results from blood loss due to hemorrhage and tissue destruction caused by the migratory juvenile flukes in the live resulting in traumatic hepatitis (Urquhart et al., 1996).

Sub-acute fasciolosis is caused by ingestion of a moderate number of metacercariae and is characterized by anemia, jaundice and ill-thrift. The migrating fluke causes extensive tissue damage, hemorrhage and in particular liver damage. The result is severe anemia, liver failure and death in 8 to 10 weeks (Urquhart et al., 1996). Chronic fasciolosis is the most common clinical syndrome in sheep and cattle. It occurs when the parasite reaches the bile ducts. The principal effects are bile duct obstruction, destruction of liver tissue, hepatic fibrosis anemia and submandibular edema (Mitchell, 2003). In addition to these, a condition known as "black disease" is a complication, which usually is fatal. Here, a secondary infection due to the bacterium *clostridium novyi* type B, proliferating in necrotic lesions produced by the young larvae migrating in the liver is responsible for the fatal outcome (Radostits et al., 2007). Chronic fasciolosis provides the right environment in the liver for the germination of the spores of the bacterium. This form of the disease is much more common particularly in man. In humans the presence of the flukes causes a number of non-specific symptoms including malaise, an intermittent fever, mild jaundice, anemia eosinophilia and frequently pain under the right costal margin (Chhabra and Singla, 2009). Furthermore, *fasciola* species do not appear to be fully adapted to using man as a definitive host, as the flukes may often give rise to entopic infections, particularly in the lungs and sub cutaneous tissues, where they may be found encysted (Slifko et al., 2000).

Pathogenesis of fasciolosis varies according to the parasitic development phases parenchymal and biliary phases. The parenchymal phase occurs during migration of flukes through the liver parenchyma and is associated with liver damage and hemorrhage. The biliary phase coincides with parasite residence in the bile ducts and results from the haematophagic activity of adult flukes and forms the damage to the bile duct mucosa by their cuticular spines (Urquhart et al., 1996).

Hypoalbuminemia and hypoglobulinemia commonly occur in liver fluke infections in all host species. During the parenchymal stage of the infection, liver damage caused by the migrating flukes compromise liver function, which was reflected in decline in plasma albumin concentrations, attributed partly, to reduce rate of synthesis and partly to an expansion of the plasma volume (Behm and Sangstes, 1999; Urquhart et al., 1996).

Fasciolosis is known by different local names in various part of Ethiopia that vary according to the region and language. In Amharic it is called 'kulkult', 'Wadammo', 'Yegubet till'. In Oromia region it is known as 'Dada'o', 'Losh'a', and 'Rammo tiruu'. In Tigray language it is termed as 'Ifil' (Adem, 1994).

The economic losses caused by bovine fasciolosis indicated that the productive efficiency was reduced by 8% in mild infection and over 20% in severe infection. In sub Saharan Africa, data on bovine fasciolosis reported up to 60% incidence rates, up to 50% liver condemnation

rates, up to 5% reduction in weight gain (Ross, 1970; Hyera, 1984), 16% loss in daily milk production (Bahru and Ephrem, 1979) and annual loss of 198kg of body weight per fluke (Ogunrinade et al., 1982).

Diagnosis of fasciolosis may consist of tentative and confirmatory procedures. A tentative diagnosis of fasciolosis may be established based on prior knowledge of the epidemiology of the disease in a given environment, observation of clinical sign, information on grazing history and seasonal occurrence. Confirmatory diagnosis however, is based on demonstration of fasciola eggs through standard examination of faeces in the laboratory, post mortem examination of infected animals and demonstration of immature and mature flukes in the liver (Souls by, 1982; Urquhart et al., 1996).

Several workers have reported the presence and economic significant of fasciolosis in Ethiopia. The prevalence of the disease is known to be relatively high (Bahru and Ephrem, 1979) causing considerable economic loss in livestock production. However, few attempts have been made to study the epidemiology of this parasitic problem in various section of the country with the specific aim of determining the parasitic burden, especially in relation to months of the year, rain fall, temperature, humidity, altitude and other related factors. This information is very important in planning control programs and also estimating the economic burden to the country as a result of this parasite.

Ada'a Berga is found in suitable geo ecological zone for occurrence of fasciolosis and the area has also several water reservoirs. However, little information is available regarding the coprological and abattoir prevalence of fasciolosis. Therefore, this study was aimed to know the prevalence of bovine fasciolosis in and around Inchini town, to determine the liver pathology and to the generate base line data for future research of bovine fasciolosis on the study area.

MATERIALS AND METHODS

Study area

The study was conducted from November, 2008 to March, 2009 in and around Inchini town, Ada'a Berga Woreda, West showa Zone, Central Ethiopia. Geographically, the area is located at 64 km North west of Addis Ababa on the road of Mughher cement Enterprise and located at 9° 12' to 9° 37' N latitude and 38° 17' to 38° 36' E longitude. According to the publication bureau of planning and economic development for Oromia regional state, West showa office (1998) the maximum and minimum temperature of the woreda is 25 to 10°C, respectively and an annual rain fall ranging from 918 to 1368 mm and an altitude ranges from 1400 to 3270 m above sea level.

Ada'a Berga Woreda has a climatic condition of 21% highland, 54% mid latitude and 75% lowland. Based on the altitude, there are three main agro-climatic regions can be identified, "Daga" (28%), "Winodega" (38%) and "Kola" (34%) areas. The soil types in the area are black (43%), Red (37%) and Brown (mixed) (25%). The rain is bi-modal with short rainy season, february to march and long rainy season from june to september. According to the information

obtained from the veterinary section of Ada'a Berga Woreda veterinary clinic Report, 2007/2008, the total live stock population of this Woreda was estimated as 119,277 cattle, 42,308 sheep, 51,828 goats and 20,685 equines.

Study animals

A total of 573 cattle found in Inchini town and its surroundings (Deku kitto, Gatira Nabe, Bishan Dimmo, Maru Chobot and Sire Berga) were selected randomly from each kebeles and subjected to qualitative coproscopic examination. In this study both indigenous and cross breeds of animal found under the extensive grazing systems were included. In the abattoir study, adult male and female indigenous animals were provided for slaughter from different localities in the woreda's and surrounding areas. Prior to slaughtering, animals were identified using their identification numbers and all important information were recorded on prepared format.

Study design

A cross-sectional study was designed to determine prevalence of fasciolosis in the area. Coprological examination of live animals and post mortem survey on animal (cattle) slaughtered at Inchini municipal Abattoir were carried out in this study. Moreover, pathological lesion of livers was categorized.

Coprological examination

Fecal samples were directly collected from the rectum of each and were transported to Akilu Lemma Institute of Pathobiology (ALIPB) for detailed coprological examination. Samples that were not processed within 24 h of collection were stored in a refrigerator at 4°C. In the laboratory, coproscopic examinations were performed to detect fasciola eggs using the sedimentation (Hansen and Perry, 1994). Age estimation of animals involved in the study was done based on their dental eruption formula and number of rings on their horns; the age of the animal were determined and classified as young (< 4 years) and adult (> 4 years) (Cringoli et al., 2002). Body condition scoring of animals involved in the study was made according to Nicholson and Sayers (1986). The score ranges from 1 (emaciated) to 5 (very good) by observing the body conformation of the animal. Then scores were classified as poor (for 1, 2 and 3 BCS) and good (for 4 and 5, BCS).

Abattoir survey

Livers of slaughtered animals (196) at Inchini municipal abattoir during study period were carefully inspected for presence of liver flukes first by visual inspection to observe enlarged bile ducts and irregularity of the morphology of the liver, then by palpation and carrying out multiple incisions of all visible bile ducts and their branches to look for adult fasciola lodged there. Sex and breed and result of the slaughtered animals were registered. The recovered liver flukes during the survey in slaughter house were morphologically (on basis of size and shape) identified as *F. hepatica* and *F. gigantica* (Souls, 1982) and pathology of affected livers were grouped into three; slightly affected: if none or only one enlarged or duct is seen before cutting and cutting revealed enlarged or calcified bile ducts and/ or flukes; moderately affected: if more than one enlarged bile duct was visible before cutting and severely affected: if atrophy of left lobe and hyperplasia of the right lobe is seen giving the liver triangular shape (Ogunrinade et al., 1982).

Sample size determination

A random sampling method was employed in both study type (field and abattoir survey). To determine the sampling unit, the sampling frame consists of a list of 31 PAs of Ada'a Berga Woreda were obtained from the documents of the agricultural office of the Woreda. Then six kebeles from 31 PAs were randomly selected by lottery systems. The samples were taken by simple random selection from each six kebeles. To determine the sample size, a fasciolosis prevalence rate of 50% was taken into consideration since there was no research work on fasciolosis in the area. The desired sample size for the study was calculated using the formula given by Thrusfield (1995) with 95% confidence interval and 5% absolute precision.

$$n = \frac{(1.96)^2 P \exp(1 - P \exp)}{d^2}$$

Where: n= sample size. P exp= Expected Prevalence. d^2 = Absolute precision

Accordingly, the estimated sample size was 384 animals; however, to increase the precision 573 cattle were included in the study.

Statistical analysis

Data was entered into Ms excel and checked for errors that occurred during data entry. Any error was sorted and corrected. Finally, data analysis was made through STATA 7.0 version. The association of fasciola infection rates on the basis of age, sex and body condition was compared using X^2 test (chi-square). Infection rates on the basis of age and sex on the prevalence of fasciolosis were also analyzed by the Pearson's correlation coefficient (Putt et al., 1988). P-Value < 0.05 was considered as statically significant.

RESULTS

Coprological findings

Examination of 573 feecal sample revealed that 291 (50.79%) were found positive for fasciola eggs. There was no significant difference between study kebeles. However, highest prevalence was observed at Gattira Nabe (67.05%) kebele followed by Bishan Dimmo (55.56%), Deku kitto (48.74%), Inchini (45.46%), Maru Chobot (43.10%) and the lowest was seen at Sire Berga (37.78%) (Table 1). There was significant difference among study months ($p < 0.05$). The highest prevalence of fasciolosis was noted in November (90.04%) and December (80.34%), that is during the beginning of the dry season and the least prevalence was recorded in January (17.89%) and February (18.69%) that is during the dry season (Table 2). Present study indicated 50.39 and 51.09% prevalence of fasciolosis in male and female, respectively. No significant difference ($p > 0.05$) was seen between sexes (Table 3). Analysis of the prevalence rates in different age group showed negative/inverse correlation that is, as age increases the infection decreases. Similarly, there was also statistically significant difference ($P < 0.05$) among cattle of different

age groups (Table 4).

The result of present study showed a significant difference among body condition score ($p < 0.05$). Infection rates of fasciolosis in 'Poor' body condition group was significantly higher than animals with good body condition group (Table 5). Regarding breeds, prevalence rates of 56.94% in local breeds and 14% in Holstein cross (Friesian \times Horoo) breed were registered. Analysis of the result of breed basis shows significant variations ($P < 0.05$) (Table 6).

Abattoir survey

Out of 196 livers of slaughtered animals examined, 107 livers found infected with adult liver fluke of which highest infection was recorded due to *F. hepatica* 73 (68.22%), *F. gigantica* 9 (8.41%) and 25 (23.36%) mixed infection with both *F. hepatica* and *F. gigantica* (Figure 1). Analysis of liver lesion intensity of 107 infected livers indicated that 51(48%) were lightly affected, 42 (39%) moderately and 14 (13%) severely infected (Figure 2).

DISCUSSION

Bovine fasciolosis exists in almost all regions of Ethiopia (Graber, 1975; Bahru and Ephrem, 1979). However, the prevalence rate, epidemiology and *Fasciola* species involved vary with locality. This is mainly attributed to the variation in the climatic and ecological conditions such as altitude, rainfall, temperature and management systems of livestock. Based on the result of this study, bovine fasciolosis found a significant disease in Ada'a Berga woreda, with an overall prevalence of 50.79%. This is in close agreement with other reports, such as 86% in keffa (Bahru and Ephrem, 1979), 84.4% at Bahir Dar abattoir (Fekadu, 1988), 80% in and around Debre Berhan (Dagne, 1994) and 82.5% in Western Showa (Yadeta, 1994). However, majority of these reports are higher prevalence as compared to current prevalence. This may be due to the expansion of animal health extension and veterinary services that means the opening of animal health post at kebeles/peasant association level and the intervention of nearby private veterinary drug shops (pharmacies). This enables the farmers to have more access for disease control and intervention.

Infection rate of bovine fasciolosis in Gattira Nabe was relatively higher than the other five study sites; this may be attributed to the existence of more favorable environment for both the snail intermediate host and the parasite in Gattira Nabe kebele which has heavy dark-brown clay soil (with slightly acidic PH), which has high capacity of water retention and is mostly marshy area for long periods during the dry season.

The overall abattoir survey prevalence of bovine fasciolosis (45.59%) observed in this study is in harmony with report of Bahru and Ephrem (1979) from Gondar,

Table 1. Prevalence of bovine fasciolosis at different Kebeles in and around Inchini town

Site	No. examined	No. of -ve animals	No. of +ve animals	Prevalence (%)
Deku Kitto	277	142	135	48.74
Gatira Nabe	88	29	59	67.05
Bishan Dimmo	72	32	40	55.56
Maru Chobot	58	33	25	43.10
Sire Berga	45	28	17	37.78
Inchini 01	33	18	15	45.46
Total	573	282	291	50.79

Pearson $\chi^2 = 15.2205$, $pr = 0.009$

Table 2. Monthly prevalence rate of fasciolosis in the field survey

Month	No. examined	No. Negative	No. Positive	Prevalence (%)
November	135	13	122	90.04
December	102	20	82	80.39
January	123	101	22	17.89
February	107	87	20	18.69
March	106	61	45	42.45
Total	573	282	291	50.79

Pearson $\chi^2 = 220.72$, $Pr = 0.000$.

Table 3. Prevalence of Bovine Fasciolosis on Sex basis.

Site	No. of examined animals	No. of -ve animals	No. of +ve animals	Prevalence (%)
Male	254	126	128	50.39
Female	319	156	163	51.09
Total	573	282	291	50.79

Pearson $\chi^2 = 0.0280$, $Pr = 0.867$.

Table 4. Prevalence of bovine fasciolosis in different age group

Age group	No. of examined animals	No. of -ve animals	No. of +ve animals	Prevalence (%)
Adult	100	79	21	21
Young	473	203	270	57.08
Total	573	282	291	50.79

Pearson $\chi^2 = 42.9997$, $Pr = 0.000$.

Yehenew (1985) around Lake Tana, Fekadu (1988) around Bahir Dar and Yohannes (1994) from Bahir Dar abattoir reported prevalence rates of 61, 56, 62.2 and 61.97%, respectively. However, the prevalence report of these workers are relatively higher than the present

finding and this variation might be attributed to the differences in the infestation level of the study areas and the previous works were conducted during the wet period of the year when infestation rates of fasciolosis is expected to be high.

Table 5. Prevalence of bovine fasciolosis and body condition scoring.

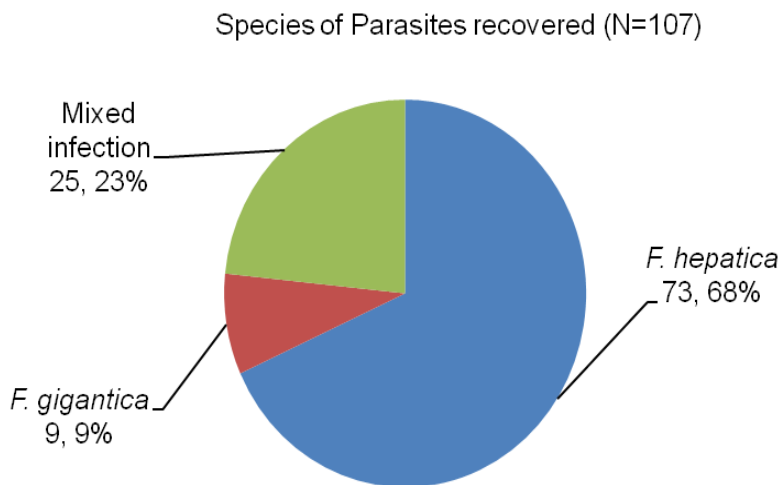
Body condition	No. of examined	No. of positive	Prevalence (%)
Poor (BCS 1, 2 & 3)	463	280	60.48
Good (BCS 4 & 5)	108	11	11
Total	573	291	50.79

Pearson $\chi^2 = 126.4644$, Pr = 0.000.

Table 6. Prevalence of bovine fasciolosis in local and cross breed.

Breed	No. of examined animal	No. of -ve cases	No. of +ve cases	Prevalence (%)
Local	490	211	279	56.94
Cross	83	71	12	14.46
Total	573	282	291	50.79

Pearson $\chi^2 = 51.2478$, Pr = 0.000.

**Figure 1.** Species of *Fasciola* encountered in affected livers during postmortem examination.

Prevalence rate of 50.39 and 51.09% was recorded in male and female animals, respectively. There was no statistically significant difference ($P > 0.05$) between the two sexes, this signifies that sex has no impact on the infection rate and both male and female animals are equally susceptible and exposed to the disease. Similar results that support the present finding were reported by Yehenew (1985), Fekadu (1988), Rahmeto (1992) and Dagne (1994). However, some workers found higher prevalence rate in the male than female; their justification is related to the management system with longer exposure of males out door when females are kept indoor at the beginning of lactation (Balock and Arthur, 1985).

Statistical analysis of infection rates on the basis of age

indicated a significant differences ($P < 0.05$) among different age groups. The decrease in infection rate (prevalence rate) as age increase is the result of acquired immunity which is manifested by humoral response and tissue reaction in bovine liver due to previous challenge (Ogunrinade et al., 1982). Dwinger et al. (1982) also reported the increased resistance (low prevalence) as age increases is most likely related to the higher level of tissue reaction seen in bovine liver, severe fibrosis which impedes the passage of immature flukes, acquired resistance, thickening, stenosis and calcification of bile ducts, assumed unfavorable site for adult parasites and consequently fasten their expulsion. Consistent with current finding, several studies done by Fekadu (1988),

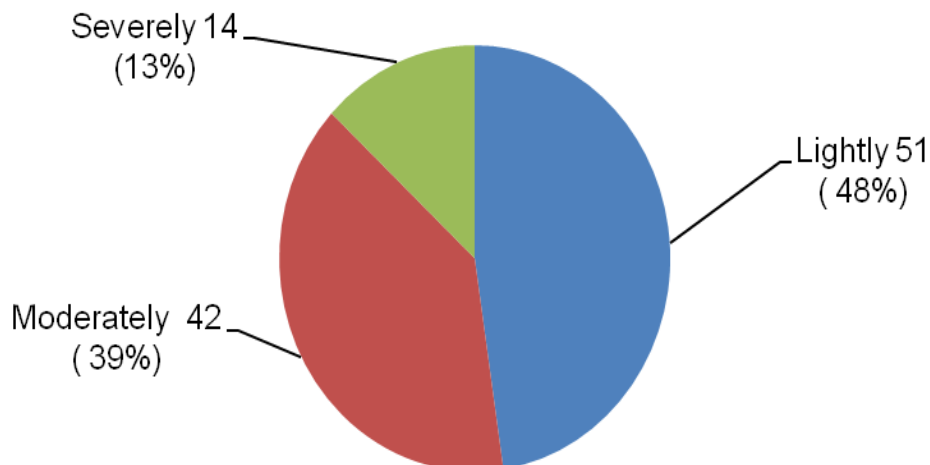


Figure 2. Number of liver affected and its conditions of the pathological lesion.

Rahmeto (1992) and Dagne (1994) in different parts of Ethiopia stated inverse correlation of prevalence rate and age of cattle.

There was a statistically significant association ($p < 0.05$) between fasciola prevalence and body condition of the animals in which infection rates in poor body condition animals was significantly higher than that of good body condition. This signifies the importance of fasciolosis in causing weight loss and is the characteristic sign of the disease. Chronic fasciolosis is the commonest form of the disease in cattle and one of the characteristic sign is weight loss (emaciation) (Graber, 1975; Troncy, 1989; Urquhart et al., 1996). This finding concur with study report of Bekele (2010) reported high prevalence in cattle with poor body condition compared to cattle in medium and good body condition.

The species of fasciola involved in causing the disease in the study area was studied on 107 fasciola infected livers during postmortem examination of slaughtered animals. The result of the study indicated *F. hepatica* (68.22%), *F. gigantica* (8.41%) and mixed infections (23.36%). The predominant species involved in causing bovine fasciolosis in the study area is *F. hepatica* and is associated to the existence of favorable ecological condition for the study area such as swamp areas around the lake and marshy areas in the low-lying plain areas and temporary shallow ponds favorable habitat for *I. truncatula* (intermediate host of *F. hepatica*) and this allows the existence of *F. hepatica* in the study area. Borders of lake, Flood-prone areas, and low-lying marshes and drainage ditch areas are favorable habitat for *I. natalensis* (intermediate host of *F. gigantica*) (Troncy, 1989).

Mixed inflection by both species of fasciola may occur in the liver of the same animal and this attributed to the existence of ecological conditions conducive for replication of both species of snails and intermingling of

cattle from various grazing areas. Similar results which support the present finding were reported by Graber (1975), Fekadu (1988) and Adem (1994). This is attributed mainly to the variation in the climatic and ecological conditions such as altitude, rainfall temperature and livestock management systems (Yilma and Malone, 1998). Additionally Graber (1975) and Dagne (1994) reported that in Ethiopia *f.hepatica* and *F. gigantica* infection occur in areas above 1800 m.a.s.l and below 1200 m.a.s.l., respectively which supports the present study.

CONCLUSION

The present study concluded that fasciolosis is the most wide spread and prevalent parasitic disease affecting the health and productivity of animal in the study area. Additionally, abattoir study revealed that bovine fasciolosis is prevalent disease in the study area, causing great economic losses as a result of condemnation of affected liver.

RECOMMENDATIONS

Proper attention should be paid for strategic deworming; animals should not be allowed to graze in water reservoir areas. Moreover, further research on the epidemiology of the disease, biology and ecology (meteorological) of intermediate host snails (*Iymnaea*) to overcome difficulties in planning and programming control strategies is highly recommended.

Conflict of interest

Authors have none to declare.

REFERENCES

- Adem A (1994). Prevalence of bovine and ovine Fasciolosis: A preliminary survey around Zeway region, Showa, Ethiopia. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia p. 61.
- Bahru G, Ephrem M (1979). Preliminary survey of Bovine Fasciolosis in Ethiopia. *Ethiop. J. Agric. Sci.* 1(1):5-12.
- Balock FC, Arthur RJ (1985). A survey of fasciolosis in beef cattle killed at Abattoir in southern Queensland. *Aust. Vet. J.* 62(10):320-326.
- Behm CA, Sangster NC (1999). Pathology, Pathophysiology and clinical aspects in Fasciolosis (Dalton J.P. ed.). CABI Publishing, Wallingford, UK pp. 185-224.
- Bekele M, Tesfay H, Getachew Y (2010). Bovine Fasciolosis: Prevalence and its Economic loss due to Liver Condemnation at Adwa municipal Abattoir, North Ethiopia. *Ethio. J. Appl. Sci. Technol.* 1:39-47.
- Chhabra MB, Singla LD (2009). Food-borne parasitic zoonoses in India: Review of recent reports of human infections. *J. Vet. Parasitol. Rev.* 23(2):103-110.
- Cringoli G, Rinaldi L, Veneziano V, Capelli G, Malone JB (2002). A cross Sectional coprological survey from an area of southern Italian Apennines. *J. Vet. Parasitol.* 108(2):137-143.
- Dagne M (1994). Survey on Prevalence and Economic Significance of Bovine Fasciolosis in Debre Berhan region. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
- Dwinger RH, Leriche PD, Kuhne GI (1982). Fasciolosis in beef cattle in North West Argentina. *Trop. Anim. Health Prod.* 14:167-171.
- Fekadu R (1988). A preliminary Survey of Bovine Fasciolosis around Bahir Dar and Evaluation of the fluckicidal activity of rafoxanide and closantel preparations. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
- Graber M (1975). Helminthes and Helminthiasis of domestic and wild animals of Ethiopia. *Bull. Anim. Health. Prod. Afr.* 23:57-86.
- Hansen J, Perry B (1994). The Epidemiology, Diagnosis and Control of Helminth Parasite of Ruminants: A Handbook. Animal production and health division, FAO, Rome, Italy p 171.
- Hyera JMK (1984). Prevalence, Seasonal variation and Economic significance of Fasciolosis in cattle as observed at Iringa abattoir between 1978 and 1980. *Bull. Anim. Health Prod. Afr.* 3:356-395.
- Mitchell GBB (2003). Treatment and Control of liver fluke in sheep and cattle. Technical notes November, Sac 2003. West mains roads, Edinburgh, UK.
- Mulugeta HS, Getachew T, Taffesse M, Getachew WM, Kinfe G, Teshome Y (1989). The significance of Helminthic parasite in livestock production. In: The 3rd livestock improvement Conference, May 24-26, Addis Ababa, Ethiopia.
- Nicholson MJ, Sayers AR (1986). Reliability, reproducibility and sequential use of condition scoring of *Bos indicus* cattle. *Trop. Anim. Health Prod.* p. 29.
- Njau BC, Scholtens RG (1991). The role of traditionally harvested hay in the transmission of ovine fasciolosis in the Ethiopian highlands. *Vet. Res. Commun.* 15(5):369-372.
- Ogunrinade AF, Okan ED, Fasan M (1982). The prevalence of Bovine fasciolosis in Nigeria. *Trop. Anim. Health Afr.* 29:381-397.
- Okewole EA, Ogundipe GAT, Adejinmi JO, Olaniyan AO (2000). Clinical Evaluation of three Chemo prophylactic Regimes against Ovine Helminthosis in a Fasciola Endemic Farm in Ibadan, Nigeria. *Israel J. Vet. Med.* 56 (1):15-28.
- Putt SNH, Shaw APM, Woods AJ (1988). Veterinary Epidemiology and Economics in Africa. ILCA, Manual No. 3. ILCA, Addis Ababa, Ethiopia.
- Radostits OM, Blood DC, Gay CC (2007). A text book of the disease of cattle, sheep, goats, pigs and horse: Veterinary Medicine 10th edition Bailliere, Tindall, London, UK pp. 1576-1580.
- Rahmeto A (1992). Fasciolosis Clinical occurrences, Coprological, Abattoir and Snail survey in and around Wolisso. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
- Ross FB (1970). The Epidemiology of fasciolosis in Northern Ireland. *Vet. Res.* 87: 370-372.
- Slifko R, Smith HV, Rose JB (2000). Emerging parasite zoonoses associated with water and food. *Int. J. Parasitol.* 30(12):1379-1393.
- Soulsby EJJ (1982). Helminth, Arthropod and Protozoa of Domestic Animals. 7th edition. Bailliere Tindall, London, UK p. 809.
- STATA (2005). Statistical Data analysis. Stata version 7.0, especial Edition. Stata corp 49-05 Lakeway Drive, College station, Texas 77845 USA. 800 STAYA - PC.
- Thrusfield M (1995). Veterinary Epidemiology 2nd edition, University of Edinburgh, Black well science, UK pp. 180-188.
- Troncy PM (1989). Helminths of livestock and Poultry in Tropical Africa. In: Fischer. (1989). Manual of tropical veterinary Parasitology. CAB International, UK pp. 63-73.
- Urquhart GM, Armour J, Duncan JL, Dunn AM, Jennings FW (1996). *Veterinary Parasitology* 2nd Edition. Oxford, Longman Scientific and technical press, UK. pp. 100-109.
- WHO (1995). Control of food borne Trematode infections. Technical Report Series 849 p 61.
- Yadeta B (1994). Epidemiology of bovine and ovine fasciolosis and distribution of its snail intermediate host in Western Showa. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia p. 35.
- Yehenew M (1985). Prevalence of fasciolosis at Gondar clinic and around Lake Tana. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia p 25.
- Yilma JM, Malone JB (1998). A Geographic Information System forecast model for Strategic control of fasciolosis in Ethiopia, Faculty of Veterinary Medicine, Addis Ababa University. *Vet. Parasitol.* 78:103-123.
- Yohannes T (1994). Bovine Fasciolosis: Prevalence and Economic Importance Assessment trial on cattle slaughtered at Bahir Dar municipal abattoir. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.