Acta Parasitologica Globalis 8 (3): 150-156, 2017
ISSN 2079-2018

DOI: 10.5829/idosi.apg.2017.150.156

Prevalence and Economic Significance of Fasciolosis in Bovine in and Around Debretabor Town

[1]*Abebaw Balemual and* [2]*Manohar Murali*

[1]Department of Veterinary Clinical Medicine, Gondar, Ethiopia
[2]Department of Veterinary Pathology, Gondar, Ethiopia

Abstract: A cross-sectional study was conducted from October 2013 to April 2014 to determine the prevalence of bovine fasciolosis and its associated risk factors in and around Debretabor town. The current finding revealed that the overall fasciolosis prevalence was 20.5% (79/384). Similarly, the prevalence of the parasites in female and male also showed that it was 17.5% (10/ 57) and 20.2% (66/327) for *Fasciola hepatica* and 1.8 % (1/57) and 0.6% (2/327) for *Fasciola gigantica*, respectively. At the same time the prevalence of the parasites in adult and young for *Fasciola hepatica* was 21.5% (71/331) and 9.4% (5/53) but that of *Fasciola gigantica* was 0.6% (2/331) and 1.9% (1/53). Similarly the prevalence in local and cross breeds were also determined and it was 19.3% (63/326) and 22.4% (13/58) for *F. hepatica* and 0.9% (3/326) and 0% (0/58) for *F. gigantic*, respectively. In addition, animals originated from highland and lowland had the prevalence of 20.5% (73/356) and 10.7% (3/28) for *F. hepatica* and 0% (0/356) and 10.7% (3/28) for *F. gigantica* respectively. The difference of the prevalence between highland and lowland was statistically significant ($P<0.05$). The current finding also showed the prevalence of *F. hepatica* in poor, medium and good body condition animals was 72.7% (8/11), 19.3% (58/300) and 13.7% (10/73), respectively but that of *F. gigantica* was 9.1% (1/11), 0.7% (2/300) and 0% (0/73), respectively. A total of 384 snails were collected and identified including-*Lymnea natalensis* 11.2% (43/384), *Lymnea trancatula* 42.7% (164/384) and other *Lymnea* spp and Genus *Bivalvia* 46.1% (177/384).

Key words: Age · Body Condition · Breed · Cattle · *Fasciola Gigantica* · *Fasciola Hepatica* · Prevalence · Snails

INTRODUCTION

Ethiopia has a high livestock population, but productivity is low as a result of disease, malnutrition and other management problems. Parasitism is one of the major bottle necks to livestock development in the tropics [1, 2]. Fasciolosis is of economic importance in cattle and sheep, but it may infect all domestic animals, human and many of wild spp. The two important species of this genus are *Fasciola hepatica* and *F. gigantica* [3, 4]. Cattle and sheep are the most important definitive hosts of *F. hepatica* and *F. gigantica*. In cattle, they cause commonly a chronic disease and the severity often depends on the nutritional status of the host [5]. They are responsible for wide spread morbidity and mortality in cattle and sheep characterized by weight loss, anemia, hypoproteinaemia and unthriftiness. The disease is responsible for substantial economic loss which include; death, loss in carcass weight, reduction in milk yield, condemnation of the affected liver, decline in production and productivity, predispose animals to other diseases and cost of treatment expense [6].

The parasite has cosmopolitan distribution but more common in places where water logging remains for many months. The spread of Fasciolosis is largely dependent on the ecology of the snails which act as intermediate hosts and the snails of genus Lymnaea are mainly involved as intermediate host in the life cycles. *Lymnaea natalensis*, aquatic snails is important for *F. gigantica* in Africa whereas *Lymnaea truncatula*, an amphibious snail

Corresponding Author: Abebaw Balemual, College of Veterinary Medicine and Animal Science Department of Veterinary Clinical Medicine Tewodros Campus, University of Gondar Gondar, Ethiopia P.O. Box: 196.
Tel: +251931758018 / +251918150354.

with wide distribution throughout the world, is the most common intermediate host for *F. hepatica*. Temperature of 10 °C or above is necessary for both snails to breed and for the development of parasite [7]. In Ethiopia *F. hepatica* and *F. gigantica* infections occur in areas above 1800 meter above mean sea level and below 1200 meter mean sea level, respectively, which has been attributed to variations in the climatic and ecological conditions such as rain fall, altitude, temperature and livestock management system [8]. *Fasciola gigantica* is wide spread in most part of the tropical Africa, especially in the humid, sub-humid, mixed altitude and high altitude. Agro-ecology, irrigation and seasonal features have influence on the prevalence of fasciolosis. In the tropical regions, fasciola is considered the single most important helminthes infections of cattle with prevalence rate of 30-90% in Africa, 25-100% India and 25-90% Indonesia [9]. The economic significance of fasciolosis in Ethiopia has been reported by several workers [10, 8]. Infestation of domestic ruminants with *F.hepatica* (temperate liver fluke) and *F. gigantica* (tropical liver fluke) caused significant economic loss estimated at over US $ 200 million per annum to the agricultural sector worldwide with over 600 million animal affected [11, 12].

The life cycle of fasciola spp is typical of digenetic trematode which is characterized by indirect life cycles [13]. Pathogenesis of fasciolosis varies according to the phase of parasitic development in the liver and the species of host involved [7]. Clinically fasciolosis may be acute, subacute or chronic, characterized by anemia, jaundice, abdominal pain and bottle jaw. Necropsy finding may vary with the phase of parasite which includes the liver and biliary phases [14].

The clinical pathology findings include sever normchronic anemia, eosinophilia, sever hyper albuminemia, increased glutamate dehydrogenase and gamma glutamyl transpeptidase levels [15]. Diagnosis of fasciolosis is based on grazing history, clinical signs and laboratory examination of dung samples, clinical pathology and post mortem examination. For bovine fasciolosis the drug of choice is triclabendazole, rafoxanide, closantel and nitroxynil [16]. Control of the fasciolosis may be approached by reducing the population of the intermediate hosts by using chemicals and biological control of snail's habitats and by using anthelminthics [7]. Considering the economic importance of Fasciolosis in Ethiopia the present study is undertaken to find out its prevalence in and around Debretabor with the following objectives:

- To study the prevalence of fasciolosis by coprological examination in bovine in and around Debretabore
- To study the prevalence of bovine fasciolosis by post mortem examination
- To study the occurrence of Fasciolosis in different breeds, age groups and sex of bovines.
- To collect and identify snails in and around Debretabore for identification of the genus *Lymnaea*

MATERIALS AND METHODS

Description of Study Area: Debretabor is a town and a woreda in north-central Ethiopia.It is located in the debub Gondar of the Amhara region and about 100 kilometers southeast of Gondar and 50 kilometers east of lake Tana. This historic town has a latitude and longitude of $11^{0}51'N38^{0}1'E$ with an elevation of 2706 meters above mean sea level. Based on 2007 national census conducted by the central statistical agency of Ethiopia, this town has a total population of 55596 of whom 27644 are men and 27952 women. The climate is warm and temperate. In winter there is much less rain fall than in summer. The average annual temperature is 15 $^{0}{}_{C.}$ The average annual rain fall is 1497 mm [20].

Study Population: A cross-sectional study was conducted from October 2013 to April 2014 following simple random sampling in and around Debretabor town. A total number of 384 animals were randomly selected to determine the prevalence of bovine fasciolosis, which included male and female animals of different age group and breeds. Study materials also included cattle brought to Abattoir for slaughter from places in and around Debretabor.

Study Design and Methodology

Sampling Method and Sample Size Determination: The sample size was calculated using the formula given by Thrusfield (1995) by applying an expected prevalence of 50% at 95% confidence level and 5% absolute precision. No report was available regarding the prevalence of bovine fasciolosis at debretabor town.

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

Where:
n=required sample size
Pexp=expected prevalence
d=desired absolute precision

Based on this the sample size to be studied was calculated as 384.

Sample Collection and Examination of Dung Sample: Dung samples were collected directly from the rectum of each animal presented for slaughter and clinic at Debretabor using sterile disposable plastic gloves and samples were placed in tightly closed universal bottles. Each sample was serially numbered and simultaneously location or place from where the animal was brought, breed, age and sex of the animal were recorded. Similarly the body condition, physiological status namely whether lactating or pregnant was also recorded. From slaughtered animals both dung sample and parasites were collected after recording the gross lesions. The parasites were fixed in 10% Formalin for further laboratory identification. All the samples collected were processed and examined in the parasitological laboratory on the day of collection. Coprological examination for the detection of fasciola eggs was performed using sedimentation technique [18]. A compound microscope (10× and 40 × objective lens) was used to examine the prepared fecal samples for the detection of fasciola egg. To differentiate between eggs of paramphistome spp and fasciola spp, a drop of methylene blue solution (1%) was added to the sediment. Eggs of fasciola spp showed yellowish color while egg of paramphistome spp stained by methylene blue and granule transparent [21]. The snail samples from surrounding areas particularly around the water bodies was collected and preserved in 10% formalin for further studies.

Examination of Fluke: Liver of slaughtered animals were examined for gross lesions and all the lesions were documented. Pathognomonic lesions of liver pertaining to different stages of development of fluke were recorded and flukes were collected. Liver lesions along with flukes were preserved in 10% Formalin for further examination. For fasciola spp identification, samples of the worms were preserved in universal bottles which contained 70% ethanol. The samples were subsequently transported to the laboratory for further identification. Identification of fasciola spp involved was carried out as described by Soulsby [22].

Collection and Examination of Snails: Collection of snails: During a period extending from November 2013 to April 2014 snails were randomly collected from water bodies (low-lying swampy areas, water logged areas, drainage ditches and most vegetation and edge of lakes) of six kebele of Debretabor area including tsegure, gribi, selamko, abaregay, werkie and burrotekona by using glove, palm-leaf trap and sieve made from cloth that can pass water through and which was tied a long stick. The snails were gathered from 0.5-0.75 meters of river side and kept in a plastic flask with fresh water. Temperature, depth and pH of water bodies were estimated under field conditions during the study. The individual snails collected were brought to the laboratory in separate glass jars. The jars were covered with muslin cloth to allow aeration. During transit, natural habitat vegetation found in the water of collection was used as food while leaves of lettuce were provided as food in the laboratory.

Identification of Snails: The collected snails were washed thoroughly and cleaned from mud and debris. The snails could not shed larvae under the prevailing room conditions; hence they were crushed with a view to examine their internal contents for the presence of trematode larvae. The experiments were performed at room temperature and individually snail's frozen (-20°C) in microfuge tubes for further examination. Four to ten snails per population, representing each ecotype and sharing the same shell morphology, were euthanized in hot water and placed in 70% ethanol for morphological determination of their genitalia. These snails were identified on the basis of the length of their reproductive organs and the shape of the bursa copulatrix according to taxonomic keys. Furthermore, two additional snails per population showing the same morphology as mentioned above were selected for molecular identification. Identification of the snail species was made by studying the morphological features of the shell based on given traits for the major snail categories. *Lymnaea natalensis* measures 25x14.5 mm. The spire is generally much less high than the aperture. The surface may have spiral rows of small transverse grooves, but always lacks strong spiral ridges of periostracum. *L.truncatala* is 11x6 mm (often smaller), comparatively small with the spire about as high as the aperture and strongly convex whorls. Genus *bivalvia* is characterized by large size (5-7 cm), hard shell and delicious in many of African country. Generally, Snails are classified according to the shell morphology described by Mansourian [23] and Malek [24].

Data Management and Analysis: All raw data generated from this study were coded and entered in Ms Excel database system. Prevalence was calculated as percentage value. Using SPSS version computer program, data were analyzed. Chi-square test was used to determine the variation in infection prevalence between sex and age.

Statistical significance was set at P < 0.05 or less to determine whether there is significance differences between the parameters measured between the groups.

RESULTS

Coprological and post mortem examination survey result of the 384 cattle subjected to both fecal and liver examination, 40 (18.4%) were positive for Fasciola eggs from 217 cattle while 39 (23.3%) had adult flukes from167 cattle slaughtered, which showed that the sedimentation technique used for Fasciola egg assessment has failed to detect eggs from some fecal samples. Out of 40 fecal samples found to be positive for fasciolosis during coprological examination, 38 (17.5%) was *F. hepatica*, 2 (0.9%) *F. gigantica*. From the 39 liver found to contain fasciola infection during post mortem inspection, 38 (22.8%) harbored *F.hepatica*, 1 (0.6%) *F.gigantica*. The study result at post mortem inspection of livers demonstrated that the predominant species of bovine fasciolosis was *F. hepatica* (22.8%) followed by *F. gigantica* (0.6%).

The study revealed that the overall prevalence of bovine fasciolosis was 20.5 (79/384). The prevalence between female and male cattle also showed that it was 17.5% (10/57) and 20.2% (66/327) for *F. hepatica* and 1.8% (1/57) and 0.6% (2/327) for *F. gigantica* in as indicated in (Table1).

Table 1: Prevalence of bovine fasciolosis by sex

Sex	Total examined	Prevalence in % *F.hepatica*	*F.gigantica*	P- value
Male	327	66(20.2%)	2 (0.6%)	0.608
Female	57	10(17.5%)	1 (1.8%)	
Total	384	76(19.8%)	3 (0.8%)	

The prevalence of bovine fasciolosis between the age group also indicated that the prevalence of *F. hepatica* was 9.4% (5/53) and 21.5% (71/331) in young and adult cattle, respectively. Similarly, the prevalence of *F. gigantica* in young and adult cattle were 1.9% (1/53) and 0.6% (2/331) and the difference between the prevalence of the parasites in both sex were not statistically significant (P>0.05) (Table 2).

Table 2: Prevalence of bovine fasciolosis by age

Age	Total examined	Prevalence in % *F. hepatica*	*F. gigantica*	P-value
Young	53	5 (9.4%)	1(1.9%)	0.08
Adult	331	71(21.5%)	2(0.6%)	
Total	384	76(19.8%)	3(0.8%)	

Similarly, the prevalence of the parasites between the different breeds was also assessed and the prevalence of *F. hepatica* in local and cross breeds were 19.3% (63/326) and 22.4% (13/58) respectively and that of *F. gigantic* was 0.9% (3/326) and 0% (0/58) respectively. The statistical result also showed that there was no significance difference between breeds (P>0.05).

Table 3: Prevalence of bovine fasciolosis by breed

Breed	Total examined	Prevalence in % F. hepatica	F. gigantica	P-value
Local	326	63(19.3%)	3(0.9%)	0.670
Cross	58	13(22.4%)	0(0%)	
Total	384	76(19.8%)	3(0.8%)	

In addition, the prevalence of the different parasites were also assessed based on the origin of the animals and it was found that these originated from highland and low land had the prevalence of 20.5% (73/356) and 10.7% (3/28) for *F. hepatica* and 0% (0/356) and 10.7% (3/28) for *F. gigantic* respectively. The difference between the prevalence of the parasites between the two origin was statistically significant (P<0.05) as indicated in (Table 4).

Table 4: Prevalence of bovine fasciolosis by origin

Origin	Total examined	Prevalence in% *F. hepatica*	*F. gigantica*	P-value
High land	356	73(20.5%)	0(0%)	<0.001
Low land	28	3(10.7%)	3(10.7%)	
Total	384	76(19.8%)	3(0.8%)	

The prevalence of both fasciola based on the body condition of the animals were also assessed and the prevalence for *F. hepatica* was 13.7% (10/73), 19.3% (58/300) and 72.7% (8/11) in good, medium and poor body conditioned animals and its rate for *F. gigantic* was 0% (0/73), 0.7% (2/300) and 9.1% (1/11) in good, medium and poor body condition cattle respectively. The difference among the body condition of the animals were statistically significance (P<0.05).

Table 5: Prevalence of bovine fasciolosis by body condition

Body condition	Total examined	Prevalence in % *F. hepatica*	*F. gigantica*	P-value
Good	73	10(13.7%)	0(0%)	<0.001
Medium	300	58(19.3%)	2(0.7%)	
Poor 11	8(72.7%)	1(9.1%)		
Total	384	76(19.8%)	3(0.8%)	

Snail Survey Result: A total of 384 snails were collected and identified; *L.natalensis* accounted 11.2% (43/384) while *L.truncatala* and other Lymnaea spp and Genus *bivalvia* accounted for 42.7% (164/384) and 46.1% (177/384) respectively.

Table 6: Prevalence of snail or lymnaea spp

Snail	Total examined	Prevalence in %
L.natalensis	43	11.2% (43/384)
L.truncatala	164	42.7% (164/384)
Other Lymnaea spp and Genus Bivalvia	177	46.1% (177/384)
Total	384	100% (384/384)

Table 7: Number of snail's collection in different kebele

Type of snails	Selamko	Tsegure	Abaregay	Gribi	Workie	Burrotekona
L.natalensis	14	7	5	10	5	2
L.truncatula	46	29	28	11	14	36
Other lymnus spp and Genus Bivalva	76	38	14	15	19	15

DISCUSSIONS

Fasciolosis is widespread ruminant health problem and causes significant economic losses to the livestock industry in Ethiopia. As reported by Brook, Lemma *et al.* and Heinonen *et al.* [25, 26] water logged and poorly drained areas with acidic soils in the highlands are often endemic areas for fasciolosis. The overall abattoir prevalence of fasciolosis in the present study was 20.5% which is lower than that of the study conducted by Abdul [27] and Adem [28] who recorded 47% and 56.6% at Sodo and Ziway municipality abattoirs respectively, but it is higher as compared to the study conducted by Daniel [29] who reported a prevalence of 14.4% which is more or less similar with that of the current study. Moreover, the result of study is lower than that of the prevalence conducted by Gebretsadik *et al.* [30] who recorded 24.32%.

The prevalence of the parasites among female and male animals as per present study, it was 17.5% (10/ 57) and 20.2% for *F. hepatica* and 1.8% and 0.6% for *F.gigantica* respectively. This finding was similar with the study conducted by Thrusfield [31] who also reported a higher prevalence of these parasites in males than females. This might be attributed to the proportion of animals sampled during the post mortem examination, as most of the time male animals were slaughtered in the slaughter houses as compared to female animals. The variation of the prevalence between male and female animals was not statistically significant (P>0.05).

The prevalence of the parasites in adult and young animals for *F. hepatica,* it was 21.5% and 9.4% but for *F.gigantica* it was 0.6% and 1.9% respectively. This finding was lower than that of the study conducted by Abebe [32] who recorded the prevalence of 30.04% and 35.97% in adult and young animals respectively. Even though such variation of the prevalence existed it is not statistically significant (P>0.05). Moreover, the prevalence in local and cross breeds was also determined and it was 19.3% and 22.4% for *F. hepatica* and 0.9% and 0% for *F. gigantic* respectively. This variation might be due to the management of the animals as most of the local animals were reared in the extensive system of management which makes them easily susceptible to the parasites. Even though, it was higher in cross breeds than local breeds it was not statistically significant (P>0.05). Similarly, animals originated from highland and lowland has the prevalence of 20.5% and 10.5% for *F. hepatica* and 0% and 10.7% for *F. gigantica* respectively. The current finding is lower than the study conducted by Rahmeto *et al.* [33] who recorded the prevalence of 58.9% and 10.6% respectively. This might be due to the geographical variation which is important for the multiplication of the intermediate host. Similarly, variation in climate-ecological conditions such as altitude, rainfall, temperature, livestock management system and suitability of the environment for survival and distribution of the parasite as well as the intermediate host might have played their own roles in such differences. One of the most important factors that influence the occurrence of fasciolosis in a certain area is availability of suitable snail habitat [34]. In addition, optimal base temperature to the levels of 10 ºC and 16ºC are necessary for snail vectors of *Fasciola hepatica* and *Fasciola gigantica*, respectively [35]. The differences in the prevalence of these two parasites existed in the two agro ecological zones was statistically significant (P<0.05).

The prevalence of the parasites in the different body condition of the animals were also determined and its prevalence for *F. hepatica* and *F.gigantica* in poor body condition was 72.7% and 9.1% but in medium body condition 19.3% and 10.7% and in that of good body condition animals it was 13.7% and 0%, respectively. The current finding is higher for *F. hepatica* in animals having poor body condition than that was reported by Mihreteab *et al.* [36] who has recorded 23.1%. This might be due to the fact that animals with poor body condition are usually less resistant and are consequently susceptible to diseases. The prevalence of the parasites in medium body condition in the present study recorded for *F. hepatica* was 14.5% and for *F.gigantica* 8.1% respectively.

However, Mihreteab *et al.* [36] recorded lower prevalence of 13.9%. The prevalence in the different body conditions of the animals varied which was statistically significant (P<0.05).

The present study revealed the presence of two genea of snails in the study areas,which included Lymenea and Bivalvia. Among Lymenea genus *L. truncatula (*Principal intermediate host) for *F.hepatica* was occurring second to Genus Bivalvia and other lymnaea spp, while *L. natalensis*, the major intermediate host of *F.*gigantica was found to be the least. A total of 384 snails were collected and identified including-*Lymnea natalensis* 11.2% (43/384), *Lymnea trancatula 42.7%* (164/384) and other Lymnea spp and Genus bivalvia *46.1%* (177/384).

CONCLUSION

In the current finding the abattoir prevalence of the parasites showed that the disease is common in most parts of the zone, as most of the animals were from the different sites of the zone. The most predominant *Fasciola* in the zone was *F.hepatica* which might be due to suitability of the environment for multiplication of the intermediate hosts. The study on the prevalence in the different breeds of the animals also indicates that the occurrence of the parasite was higher in local breeds than in cross breeds and it was also common in male animals as compared to female. Similarly, the parasite mostly affects animals originated from high land and in adult animals. The results show that the disease is common in the region due to different activities such as irrigation to lands leading to formation of water collection and ponds which merits attention by the responsible bodies to control the parasites. Therefore based on the current findings the following points are recommended

- Strict rules and regulations should be in place and enforced for hygienic meat inspection.
- Awareness should be created among for farmers about the disease prevalence and transmission.
- Veterinary service to be extended to the disease prevalent areas with provision of modern antihelemthtics for treatment of affected animals.
- Agriculture department should initiate actions for control of snails through drainage of stagnant water in swampy areas.
- Regular deworming of animals before and after the rainy season should be done.
- Applications of molluscides are important in the control of the intermediate hosts.
- Further epidemiological investigations should be initiated to assess the worm burden in Ethiopia to study the associated risk factors and indirect economic losses.

REFFERNCES

1. Kassa, T., 1999. Veterinary helmintology, University of Veterinary science and oxford: Butter worth Heinemann. pp: 9.
2. Menkil, M.J., A. Uggla and P. Waller, 2007. Prevalence and seasonal incidence of nematode parasite and fluke infections of sheep and goats in eastern Ethiopia, Tropical Animal Health and Production, 39(7): 521-531.
3. World Health Organization, 1995.Control of food born trematode in infectious, technical reports series, 849 (61).
4. Okewole, E., G.A.T. Aogundip, J.O. Adjani and A.A. Olaniyan, 2000. Clinical evaluation of the chemo prophyllaxia regime against Ovine helmenthiosis in a fasciola endemic farm in Ibadan, Nigeria, Israel, Journal of Veterinary Medicine, 56(1): 15-28.
5. Graber, M., 1978. Helminthes and helminthiasis of domestic wild animals of Ethiopia.
6. Anne, M., Zajac and A.C. Gray, 2006. Veterinary clinical parasitology.7thed. American Association of the Protozoologist. pp: 185-210.
7. Urquhart, G.M., J. Armour, A.M. Dunn and F.W. Jennings, 1996.Veterinary parasitology, 2nded. pp: 103-113.
8. Yilma, J.M. and J.B. Malone, 1998. A geographical information system forecast model for strategic control of fasciolosis in Ethiopia: Vet. Parasitool., 78(2): 103-123.
9. Spithill, T.W. and J.P. Dalton, 1998. Progress in the development of liver fluke vaccine parasitology, 14(60): 224-228.
10. Tadele, T. and T. Worku, 2007. The prevalence and economicsignificance of Bovine fasciolosis at Jimma, Abattoir, Ethiopiaa: The internet journal of Veterinary Medicine, 3(15).
11. Boray, J.C., S.M. Gafar, W.E. Howard and R.E. Marsh, 1985. Fluke of domestic animals: In parasites, pests and predators. New York: Elsevier. pp: 179-218.
12. Hillyer, G.V. and W. Apt, 1997. Food borne trematod: Infections in the Americas parasitolgy. 13: 87-88.
13. Bowman, D.D., R.C. Lynn, M.L. Eberhard and A. Ana, 2003. Parasitology for veterinarians. 8thed. New York; Saunders, pp: 115-122.

14. Radostits, O.M., C.C. Gay, K.W. Hinchcliff and P.D. Constable, 2007. Veterinary Medicine, a Text book of the disease of cattle, horse sheep, pigs and goats. 10th ed. London: Saunders Elsevier. pp: 1576-1580
15. Radostits, O.M., D.C. Blood and C.C. Gay, 2004. Veterinary Medicine: A Text book of the disease of cattle, sheep, goat, pig and horse. 9thed. ElBS: Tindal., pp: 1230-1240.
16. Tasfu, E.B., T. Getachew, A. Ahmed, B. Nega, M. Girma and W. Legesse, 2006. Plot control of fasciolosis and related animal fluke infections by use of endoded and reduced morbidity towards sustainability and improved productivity, Ethiopia. Vet. Journal, 10(2): 63-66.
17. Taylor, M.A., R.L. Coop and R.L. Wall, 2007. Veterinary parasitology. 3rded. London: Blackwell. pp: 85-89.
18. Kahn, C.M., B.A. and M.A. 2005. Merck Veterinary manual. 9thed. pp: 273-275.
19. Andrews, A.H., R.W. Blowey and R.G. Eddy, 2003. Bovine Medicine - Disease and Husbandry of cattle, 2nded. Blackwell. pp: 276-278.
20. Ministry of Agriculture and Rural Development (MoARD, 2008)
21. Hansen, J. and B. Perr, 1994. The epidemiology, diagnosis and control of helminth parasite of ruminants: A hand book. Rome, Italy: Animal production and health division, FAO. pp: 171.
22. Soulsby, E.G.L., 1989. Helminthes, arthropods and protozoa of domestic animals: Bailliere Tindal., pp: 29-42.
23. Mansourian, A., 1992. Fresh water snail fauna of Iran. Ph.D. Thesis: Tehran Medical Sciences University, Iran (in Persian).
24. Malek, E.A., 1980. Snail transmitted parasitic diseases. Vol I and II, CRC Press
25. Brook, Lemma, Fisseha, Gabreab, Shibru and Tedla, 1985. Studies on fasciolosis in four selected sites in Ethiopia. Veterinary Parasitology, pp: 29-37.
26. Heinonen, M., G. Pute and S. Kebede, 1995. The effect of anti-parasitic treatment against fasciolosis on cross breed and Zebu Cows in Ethiopia. World Review of Animal Production, 82(1): 40-46.
27. Abdul, J.R., 1992. Economic Significance of Bovine Fasciolosis and Hydatidiosis, in Soddo, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
28. Adem, A., 1994. Prevalence of Bovine and ovine Fasciolosis: A Preliminary Survey Around Ziway Region (Shewa), DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
29. Daniel, F., 1995. Economic Importance of organs condemnation due to Fasciolosis and Hydatidosis in cattle and sheep slaughtered at Dire Dawa Abattoir, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University Debre Zeit, Ethiopia.
30. Gebretsadik, B., B. Kassahun and T. Gebrehiwot, 2009. Prevalence and economic significance of fasciolosis in cattle in Mekelle Area of Ethiopia. Tropical Animal Health and Production, 41(7): 1503-1504.
31. Thrusfield, M., 1995. Veterinary Epidemiology. 2nded. University of Edinburg: Blackwell science, pp: 180-188.
32. Abebe, F., M. Behbelom and M. Berhanu, 2011. Medwell. Journal of animal and Veterinary Advances 10(12): 1592-1597. ISSBN: 16805593
33. Rahmeto, A., A. Fufa, B. Mulugeta, M. Solomon, M. Bekele and R. Alemayehu, 2008. Fasciolosis: Prevalence, financial losses due to liver condemnation and evaluation of a simple sedimentation diagnostic technique in cattle slaughtered at Hawassa Municipal abattoir, Southern Ethiopia, Hawassa University, Faculty of Veterinary Medicine, Hawassa, Ethiopia
34. Nicholson, M.J. and M.H. Butter worth, 1986. A guide to condition scoring of zebu cattle. International livestock center for Africa, Addis Abeba, Ethiopia: Northern Turkana, Kenya, Vet. Parasitol., 104: 85-91.
35. Delahunt, A. and R.E. Habel, 1986. Teeth apply Vet.anatomy,W.B. sounders company. pp: 4-6.
36. Mihreteab, B., T. Haftom and G. Yehenew, 2010. Bovine Fasciolosis: Prevalence and its economic loss due to liver condemnation at Adwa Municipal Abattoir, North Ethiopia, School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma, EJAST, 1(1): 39-47.