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Full Length Research Paper

Cross sectional study on prevalence of bovine trypanosomosis and associated risk factors in Mao komo special woreda, benishahgul gumuz, Western Ethiopia

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Trypanosomosis is a chronic haemo-protozoal disease, which is a barrier to livestock and agricultural production. A cross-sectional study with the aim of determining prevalence rate of bovine trypanosomosis and risk factors was carried out from April 2016 to November 2017 in the Mao Komo district in the Benishangul-gumuz, Ethiopia. Buffy coat followed by thin blood smear technique were employed to identify the species of the trypanosomes. Out of total 384 cattle examined, 18 were infected with trypanosomes with the overall prevalence of 4.69%. High prevalence of *Trypanosoma congolense* was recorded in the area (65.7%) followed by *Trypanosoma vivax* and *Trypanosoma brucei*. The study revealed that there was statistically significant difference (p<0.05) of the prevalence in cattle with body condition. This is explained as there was higher prevalence of the diseases in cattle with poor body condition than medium and good body condition. Relatively higher prevalence was found in females and adult animals, and Fafafa peasant association but there was no significant (p>0.05) difference between the variables. In conclusion, bovine trypanosomosis is prevalent disease which has been negatively affecting livestock production in the study area. Therefore, strategic disease prevention and control programme is mandatory to improve livestock health and production in the study area.

Key words: Buffy coat, cattle, thin blood smear, Benishangul-Gumuz, trypanosomosis.

INTRODUCTION

Trypanosomosis is one of hemo protozoal disease which limits livestock production in tropical countries including Africa in general and Ethiopia in particular. The overall economic loss due to the disease was estimated

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between US $1408 and 1540 million per annum (Taylor et al., 2007). Most African trypanosomes are transmitted by tsetse flies, which inhabit many parts of the continent that extend about 15°N and 20°S of the equator (Mekonnen et al., 2012; Ilemobade, 2009), but the disease can also be transmitted by biting flies.

The disease can affect wide range of host including domestic and wild animals as well as human beings (STEP, 2012; Shimelis and Shibeshi, 2009). In Ethiopia, tsetse flies are confined to Southern, Southwestern and North Western regions between longitude 33°and 38°E and latitude 5°and 12°N an area covers 220000 km² (NTTICC, 2004). The presence of animal trypanosomosis is a major constraint to the introduction of highly productive exotic dairy animals and draught oxen to lowland settlement and resettlement areas for the utilization of large land resources (Cherenet et al., 2006). Since more than 90 percent of crop production in Ethiopia is dependent on animal draught power mainly on ploughing oxen, many large fields lie fallow due to a lack of these animals in trypanosomosis infested area, which worsens the food supply and living conditions in affected areas (MoARD, 2005; Van den Bossche et ai., 2006) . The most common species of *Trypanosoma* found in Ethiopia are *T. congolense*, *T. vivax* and *T. brucei* in cattle, sheep and goats. Camels are affected by *T. evansi* which is common species in camel rearing areas of the country while equines mainly horses are affected by *T. equiperdum* in some highland parts of the country (Geiger et al., 2005; Efrem et al., 2013).

The definite diagnosis of trypanosomosis depends on history followed by clinical sign and detection of the parasite through direct and/or indirect demonstration of the parasite (Dhami et al., 1999; Kumar et al., 2012; Sharma et al., 2012; Molalegne et al., 2011). Direct demonstration of the parasite can be accomplished with a blood smear in the form of a wet blood film with or without concentration for motile trypanosomes, buffy coat technique and giemsa stained blood smear and indirect demonstration of the parasite can be done by different serological and molecular tests like ELISA, IFAT CATT and PCR (Regassa and Abebe, 2004; OIE, 2004; Taylor and Authie, 2004). Strategic Control should be based on control of trypanosomosis and its vectors (Abebe, 2005; Ayele et al., 2012), implementing improved husbandry, management and selecting breeds which are more resistant to the disease animals can be given prophylactic drugs in areas with a high population of trypanosome-infected tsetse fly. Drug resistance must be carefully monitored by frequent blood examinations for trypanosomes in treated animals (IanMaudin et al., 2004; Sharma et al., 2012).

There are many research works indicating higher prevalence of animal trypanosomosis in different parts of Ethiopia, but still the disease remains one of the main obstacles to livestock production in Ethiopia. Many research done indicated that the disease is highly associated with the tsetse fly (Aweka, 2000; Addisalem et al., 2012; Lelisa et al., 2015). Regardless of this, there is no work done on bovine trypanosomosis in Mao Komo special woreda. Thus, this study were planned with the objectives to estimate the prevalence of bovine trypanosomosis and associated risk factors in selected areas and to identify the species of trypanosomes in the study areas.

MATERIALS AND METHODS

Study area description

The study was carried out at Benishahgul Gumuz Mao Komo special woreda west part of Ethiopia bordering Abay river tributaries. The climate condition of the area is ultimate with summer rainfall (April to October) and winter dry season (November to March) with mean annual rainfall of 1650 to 1800 mm. The altitude of the area is 1650 to 1850 m.a.s.l with daily average temperature of 27°C. The weather condition of the area includes kola 81% and woyina dega. The wild animals are baboons, monkey, bush pig, arthog and hyena. The major livestock reared in the area include cattle, goat, sheep, donkey mule, horse and chickens. In 73266 livestock population are estimated to exist. The livestock rearing system in the districts is traditional which depends on natural grass and crop residue (KMAO, 2015; CSA, 2014).

Study animals and sampling techniques

384 local breed cattle under extensive management system were randomly selected, from three peasant associations (100 from Shampoll, 124 from Totora, and 160 from Fafafa). The cattle were evaluated for body condition during sample collection. They were classified as poor, medium and good by observing the body condition of the animals in the field (Nicholson and Butterworth, 1996). The animals were also categorized into three age groups by dentition method (Gatenby, 1991).

Study design

The cross sectional study design was used between April 2016 to November 2017 with the aim of estimating the prevalence of bovine trypanosomosis in selected district.

Sample size

The sample size was determined following the formula given on the veterinary epidemiology book (Thrusfield, 2005) with 95% confidence interval and an expected prevalence of 50% and at 5% absolute precision.

$$n = \frac{(Zx)^2\text{-Pexp}(1\text{-Pexp})}{d^2}$$

Where: n = the required sample size
Pexp = the expected prevalence rate (50%)
Zx = the values of the required confidence interval (1.96)
d = desired absolute precision (5%). Therefore, the total sample

Table 1. Prevalence of Trypanosomosis based on sex.

Sex	Number of animal examined	Number of Affected (%)	X^2	P-value
Male	189	7 (3.70)	3.21	0.20
Female	195	11 (5.64)		
Total	**384**	**18 (4.69)**		

Table 2. Prevalence related with body condition.

Body condition	Animals examined	Positive (%)	X^2	p-value
Poor	129	13 (10.7)	13.14	00
Medium	132	3 (2.27)		
Good	123	2 (1.63)		
Total	**384**	**18 (4.69)**		

size is 385.

Sample collection and laboratory analysis

Blood samples were collected from the marginal ear vein into a heparinized capillary tube. Then one end (heparanized end) of the capillary tubes was sealed with crystal sealant. The samples were centrifuged at 12,000 rpm for five minutes to separate the blood cells. Then the packed cell volume (PCV) was determined and recorded followed by examination of buffy coat to detect the presence of motile parasites. Finally thin blood smear was made from positive buffy coat for identification of the species of the parasite (Murray et al., 1977; NTTICC, 2004; Kumela et al., 2014).

Data analysis

The collected data was entered into microsoft excel sheet. SPSS statistical software was used to analyse the data. The association between trypanosomosis infection rate and study variables (such as age, sex and PCV) was determined by Pearson's Chi- square (X^2) test. A statistical significant association between variables exists when $p<0.05$ and at 95% confidence level (CI) (Lelisa et al., 2015; Moti et al., 2013).

RESULTS

Out of 384 cattle examined, 18 (4.69%) were found to be positive with *trypanosoma*. out of the 18 cattle positive for trypanosomes, 2 (0.52), 4 (1.04%) and 12 (3.13%) cases were found to be infected by *Trypanosoma brucei, T.vivax* and *T.congolense,* respectively which was statistically non-significant ($p>0.05$).

DISCUSSION

This study revealed that from the total of 384 cattle examined, 18(4.69%) of them were positive for trypanosomes. This is higher than the studies in Bedele district of South-West Ethiopia (4.2%) (Lelisa et al., 2015), but lower than reports in Diga District of Eastern Wollega (6.86%) (KMAO, 2015), in Bure district Western Ethiopia 6.1% (CSA, 2014), in Mandura district North West Ethiopia (5.43%) (Lelisa et al., 2015), and in Haro Tatessa, South west Ethiopia (5.3%) (Zelalem and Feyesa, 2015). This might be due to the control measures against the fly, which is applied by Bedele National Tsetse and *Trypanosoma* Investigation and Control Center (NTTICC).

The prevalence reported in this study is in agreement with the previous study in Dangur district 11.27% (Bayisa and Getachew, 2015). Nonetheless, the prevalence was relatively lower than studies in Gawo Dale District of western Ethiopia (25%) (NTTICC, 2004), and in Abbay Basin area of North West Ethiopia (17.07%) (STEP, 2012). This difference might be due to abundance of the trypanosome vectors in the district. Highest prevalence of trypanosomosis was recorded in female 11(5.64%) than male animals 7 (3.70%) but there was no significant difference ($p>0.05$) between infection rate and sex (Table 1). This agrees with the previous reports (Moti et al., 2013; Tewelde, 2001; Girma et al., 2014; Leak, 1999). This might be due to female animals are prone to different physiological factors which causes susceptibility to the disease. This is disagreeing with that of the study in Eastern Gojam (Adane, 1995) and Western part of Ethiopia (Bogale et al., 2012). The possible suggestion for this might be due to regular intervention of the disease through vector control and the parasite by prophylactic trypanocidal drugs. Statistically significant difference was observed ($p<0.05$) (Table 2) between infection rate and body condition of the study animals, which indicates poor body condition is due to chronic nature of the trypanosomosis. This is explained as cattle with poor,

Table 3. Prevalence association with peasant associations (PAs).

PAs	Animals examined	Positive (%)	X^2	p-value
Shampoll	124	5 (4.03)		
Totora	100	4 (4.00)	1.50	0.83
Fafafa	160	9 (5.63)		
Total	**384**	**18 (4.69)**	**-**	**-**

Table 4. Prevalence of Trypanosomosis based on age group.

Age group	Animals examined	Positive (%)	X^2	P-Value
Young	52	2 (3.85)		
Adult	210	12 (5.71)	6.90	0.02
Old	122	4 (3.28)		
Total	**384**	**18 (4.69)**	-	-

Table 5. Prevalence rate based on PCV.

PCV category	Animals examined	Positive (%)	Mean PCV	X^2	P-value
<24	92	13 (14.13)	18.22		
24-37	290	4 (1.38)	23.05	16.96	0.00
>37	6	1 (16.67)	32.45		
Total	**384**	**18 (4.69)**	**24.57**	-	-

medium and good body condition was 13 (10.7%), 3 (2.27%) and 2 (1.63%), respectively. The disease in cattle with good body condition indicated recent infection that can be changed to chronic one if the animal will not be treated. This finding showed similarity with the previous reports, high prevalence in cattle with poor than medium and good body condition (Addisalem et al., 2012; Lelisa et al., 2015; Bayisa and Getachew, 2015).

The study also identified the association between prevalence and peasant association. In this case, higher prevalence was recorded in Fafafa 9 (5.63%) than Totora and Shampoll which were 4 (4.0%) and 5 (4.03%), respectively but there is no significant difference between the infection rate and peasant association (PAs) (Table 3). Similar findings were reported by (Mekonnen et al., 2012; Aweka, 2000). This might be due to similar agro ecology between the PAs. Among the three age categories of the cattle (1 to 2(young) age, 3 to 5(adult) age, and >5(old) age) highest prevalence was found in adult 12 (5.71%) than young 2 (3.85%) and old 4 (3.28%) animals but significant difference was not found (P>0.05) between age group (Table 4). This might be due to the animals are equally exposed to vectors and the number each group was not equal during sampling. It is agree with previous reports (Cherenet et al., 2006; Habtamu, 2009) in the Jawi district of the Amhara region, Northern Ethiopia.

Similarly the higher prevalence was recorded in animals those were anemic when compared to non-anemic animals (Table 5). The mean PCV values of infected and non-infected animals were 18.22 and 23.05, respectively which was statistically significant (P<0.05). This is due to the disease is chronic by nature and live in the blood circulation (Sharma et al., 2012; Taylor and Authie, 2004). Three species of trypanosomes were identified in this study: *T. congolense, T. vivax* and *T.brucei.* Among the three, *T. congolense* was highly prevalent 12 (3.13) followed by *T. vivax* 4 (1.04) and *T. brucei* 2 (0.52) (Table 6).The domination of the former species over the two species might be due to high abundance of a biological vector (*Glossina* spp.) than mechanical biting flies (Desquesnes and Dia, 2004). Another suggestion for this is the high number of serodems of *T. congolense* as compared to the two species and the development of better immune response to *T. vivax* by the infected animal (Abebe, 2005).

CONCLUSION AND RECOMMENDATIONS

The present study indicated bovine trypanosomosis is

Table 6. *Tyrpanosoma species* identified in study area.

No of animal examined	Total positive	Infection rate			X^2	P-value
		T. congolense	*T. vivax*	*T. brucei*		
384	18	12 (3.13%)	4 (1.04%)	2 (0.52%)	0.54	0.000

prevalent disease in Mao komo area. Higher prevalence was recorded in females, in adult cattle with poor body condition and in Fafafa peasant association. Similarly *Trypanosome congolense* is the major species in this study followed by *Trypanosoma vivax* and *Trypanosoma brucei*. Obviously the disease can be constraint to livestock production in the study area. Based on the above conclusions, the following recommendations were forwarded:

(i) Regular screening of the disease followed by early treating of positive animals with the trypanocidal drugs is necessary.
(ii) Integrated tsetse control strategy should be implemented in the area.
(iii) Awareness creation about the economic importance of the disease and its vectors for the stake holders is crucial.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Abebe G (2005). Trypanosomosis in Ethiopia. Eth. J. Biol. Sc. 4(1):75-123.

Adane M (1995). Survey on the prevalence of bovine trypanosomosis in and around Bahirdar, DVM Thesis, AAU, FVM, Debre Zeyit, Ethiopia.

Addisalem H, Tafere C, Beshatu F, Asamnew T (2012). Prevalence of Bovine Trypanosomosis in Addisamba and Amarit District of West Gojjam Zone, Amhara Regional State. Am. J. Sci. Res. 7(3):112-117.

Aweka K (2000). Study of trypanosomosis and its vectors in humbo and mereb districts. Ethiopa Vet. J. 4(1):61-63.

Ayele T, Ephrem D, Elias K, Tamiru B, Gizaw D, Mebrahtu G, Mebrat E (2012). Prevalence of bovine trypanosomosis and its vector density in Daramallo District, South Western Ethiopia. J. Vet. Adv. 2(6):266-272.

Bayisa K, Getachew D (2015). Trypanosomosis and its associated risks in cattle population of DangurDistrict of Beninshangul Gumuz Regional State, Western Ethiopia. Europ. J. App. Sci. 7(6):291-296.

Bogale B, Wodajo K, Chanie M (2012). Occurrence and identification of bovine trypanosomosis in Genji district, Western Ethiopia, Acta Parasitol. Glob. 3(3):38-42.

Cherenet T, Sani RA, Speybroeck N, Panandam JM, Nadzr S, Van den Bossche P (2006). A comparative longitudinal study of bovine trypanosomiasis in tsetse-free and tsetse-infested zones of the Amhara region, northwest Ethiopia. Vet. Parasitol. 140:251-258.

Central Statistical Agency (CSA) (2016). Agricultural Sample Survey, Statistical Bulletin, Ethiopia, Addis Ababa, pp. 39-47. Available at: http://www.csa.gov.et/survey-report/category/348-eth-agss-2016

Desquesnes M, Dia MI (2004). Mechanical transmission of *Trypanosoma vivax* in cattle by the African tabanids Atylotus fuscipes. Vet. Parasitol. 5:9-19.

Dhami DS, Juyal PD, Singla LD (1999). Seroepidemiology of *Trypanosoma evansi* infection by using CATT. Indian Vet. J. I76:842-844.

Efrem D, Bashatu F, Bacha B, Addisalem H, Misgana D (2013). Prevalence of bovine trypanosomosis in Lalo Kile District Kellem Wollega Zone, Oromia Regional State, and Western Ethiopia. Acta. Parasitol. Glob. 4(2):34-40.

Gatenby R (1991). The Tropical Agriculture, London and Beging Stock Mc Millan Education Ltd. ACCT. pp. 6-10

Geiger A, Gerard C, Frutos R (2005). Two tsetse fly species, *Glossina palpalis gambiensis* and *Glossina morsitans*, carry genetically distinct populations of the secondary symbiotic *Sodalis glossinidius.* Appl. Environ. Microbiol. 71:8941-8943.

Girma K, Meseret Z, Tilahun Z, Haimanot D, Firew L, Tadele K, Zelalem A (2014). Prevalence of bovine trypanosomosis, its vector density and distribution in and around Arba minch, Gamogofa Zone, Ethiopia. Acta. Parasitol.Glob. 5(3):169-176.

Habtamu G (2009). Current status of tsetse transmitted trypanosomes in Jawi district of Amhara region, north-west Ethiopia', DVM thesis, Faculty of Veterinary Medicine, Gondar University.

IanMaudin P, Holmes H, Miles A (2004). The trypanosome 1st ed, UK:CB publishing. pp. 113-147.

Ilemobade AA (2009). Tsetse and trypanosomosis in Africa. The challenges, the opportunities, Onderstepoort J. Vet. Res. 76:35-40.

KMAO (2015). Kao Mao Agricultural Office Annual Report, Benishangulgumuz, Ethiopia.

Kumar H, Gupta MP, Sidhu PK, Mahajan V, Bal MS, Kaur K, Ashuma, Verma S and Singla LD (2012) An outbreak of acute *Trypanosoma evansi* infection in crossbred cattle in Punjab, India. J. Appl. Anim. Res. 40(3):256-259.

Kumela L, Shihun S, Jemere B, Desie S (2014). Bovine trypanosomosis and its fly vectors in three selected settlement areas of Hawa-Gelan district western Ethiopia. Onderstepoort J. of Vet. Res. 81(1):1-5.

Leak SGA (1999). Tsetse biology and ecology. Their role in the epidemiology and control of Trypanosomosis. CABI publishing in association with the ILRI. pp. 152-210. Available at: https://www.cabdirect.org/cabdirect/abstract/19990500296

Lelisa K, Damena D, Kedir M, Feyera T (2015). Prevalence of bovine trypanosomosis and apparent density of tsetse and other biting flies in Mandura District, Northwest Ethiopia. J. Vet. Sci. Technol. 6(3):229.

Mekonnen A, Tesfaheywet Z, Getnet F (2012). A cross-sectional study on the prevalence of bovine trypanosomosis in Amhara region, Northwest Ethiopia. Livest. Res. Rural Dev. 24(8).

Ministry of Agriculture and Rural Development (MoARD) (2005). Standard Veterinary Diagnostic Manual. Volume III: Parasitology. Addis Ababa, Ethiopia. pp. 29-30.

Molalegne B, Yeshitla A, Tilahun Z, Hailu D (2011). Trypanosome infection rate in *Glossina pallidipes* and *Glossinafuscipesfuscipes* in Gojeb valley, Southwest Ethiopia. Glob. Vet. 6(2):131-135.

Moti Y, Derara B, Dalasa D, Senbeta T, Hailu D (2013). Bovine trypanosomosis and gastrointestinal helminthosis in settlement villages of Bedele district, South-western Ethiopia. Ethiop. Vet. J. 17(1):41-54.

Murray M, Murray PK, McIntyre WIM (1977). An improved parasitological technique for the diagnosis of African trypanosomosis. Trans. R. Soc. Trop. Med. Hyg. 71(4):325-326.

Nicholson M, Butterworth T (1996). A guide to body condition score in zebu cattle international livestock center for Africa, Addis Ababa, Ethiopia.

National Tsetse and Trypanosomosis Investigation and Control Center (NTTICC) (2004). Annual Report on Tsetse and Trypanosomosis Survey, Bedele, Ethiopia.

Organisation for Animal Health (OIE) (2004). Tsetse tranismited trypanomiasis in manual of diagonastic tsetse s and vaccine for treatment of terrestrial animals 5th edition pp. 235-245.

Regassa F, Abebe, G (2004). Current epidemiological situation of bovine trypanosomosis in Limu Shay tsetse controlled area of upper Didessa Valley. Ethiop. Vet. J. 13 (2):19-33.

Sharma P, Juyal PD, Singla LD, Chachra D, Pawar H (2012). Comparative evaluation of real time PCR assay with conventional parasitological techniques for diagnosis of *Trypanosoma evansi* in cattle and buffaloes. Vet. Parasitol. 190:375-382.

Shimelis D, Shibeshi S (2009). Prevalence and vector distribution of bovine trypanosomosis in control (Sibu Sire) and non control (Guto Gida) Districts bordering upper Anger valley of East Wollega Zone, Western Ethiopia. MSc Thesis, University of Gondar, Faculty of Veterinary Medicine, Gondar, Ethiopia.

STEP (2012). Ministry of Science and Technology, Southern Tsetse Eradication Project (STEP). Field Operation Manual of Tsetse and Trypanosomosis Control and Monitoring, Addis Ababa, Ethiopia, pp. 5-63.

Taylor K, Authie EML (2004). Pathogenesis of animal trypanosomosis. In the Trypanosomosis (ed.) I Maudlin, P Holmes, Miles M A, CABI Publishing. pp. 331-353.

Taylor MA, Cop R, Wall R (2007). Veterinary parasitology 3rd ed. UK Black well publisher. 99-103.

Tewelde N (2001). Study on the occurrence of drug resistant trypanosomes in cattle in the farming in tsetse control areas (FITCA) project in western Ethiopia, MSc thesis Addis Ababa University, Faculty of Veterinary Medicine Debre Zeit, Ethiopia. pp. 1-98.

Thrusfield M (2005). Veterinary Epidemiology, 3rd edn. Blackwell Science, Oxford.

Van den Bossche P, Esterhuizen J, Nkuna R, Matjila T, Penzhorn B, Geerts S, Marcotty T (2006). An update on the bovine trypanosomosis situation at the edge of Hluhuwe- IMfolozi Park, Kwazulu province, South Africa. Ondersteport J. Vet. Res. 73:77-79.

Zelalem A, Feyesa R (2015). Prevalence of bovine trypanosomosis in Harotatessa settlement area of Upper Dedessa Valley, Illubabor Zone, Southwestern Ethiopia. Acta Parasitol. Glob. 6(3):220-230.

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Full Length Research Paper

Major trematodes of cattle slaughtered at Hirna municipal Abattoir: Prevalence, associated risk factors and test agreement of sedimentation technique in Ethiopia

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A cross-sectional study was conducted to estimate the prevalence of fasciolosis and paramphistomosis in Hirna town, assess the associated risk factors and evaluate the diagnostic efficiency of fecal sedimentation technique for both flukes. On coproscopy, out of the total of 387 cattle examined, 24 (6.2%) and 21(5.43%) cattle were positive for *Fasciola* and *Paramphistomum*, respectively. Postmortem examination of hepatobilary organs and fore-stomachs of the slaughtered cattle (n=387) revealed adults of *Fasciola gigantic* (8.53%, n= 33) and *Paramphistomum* spp. (5.43%, n=21), respectively. There was statistically significant difference in prevalence of both *Fasciola* and *Paramphistomum* between medium and good body conditions. Cattle with medium body condition were more frequently affected by *Fasciola* (OR=13.64, 11.3%) and *Paramphistomum* (OR=8.26, 7.06%) than cattle with good body condition. Considering necropsy examination as gold standard, the sensitivity of fecal sedimentation technique compared and found to be 72.7% (kappa = 0.83) and 100% (kappa=1) in agreement for fasciolosis and paramphistomosis, respectively. Though the existing prevalence of fasciolosis and paramphistomosis is low, the presence of flukes pose enormous economic loss through liver condemnation, poor weight gain and productivity, treatment cost, predisposition to infectious diseases and death in severely affected young animals. Therefore, strategic deworming and further investigation on the ecology of the intermediate hosts and socioeconomic impact of the problem deemed necessary.

Key words: *Fasciola, paramphistomum,* cattle, coproscopy, necropsy, Hirna, Ethiopia.

INTRODUCTION

The huge livestock resource in Ethiopia is not efficiently and fully exploited due to several constraints including malnutrition, traditional management practice, poor genetic makeup and prevailing disease (Bekele et al.,

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1992). Among the prevailing disease of the country, trematodes are one of the main parasitic problems of cattle and other ruminants with potential zoonotic effect and significant economic loss mainly through mortality, liver condemnation, reduced production of meat, milk and wool, and expenditures for anthelmintics (Hillyer and Apt, 1997; Yilma and Mesfin, 2000).

Trematodes are neglected in the international public health in comparison with other disease affecting domestic ruminants and humans (Haridy et al., 2002). According to WHO report (2007), the infection was limited in the past to specific and typical geographical area (endemiotopes), but wide spread throughout the world, with an increasing report of human cases from Europe, American, Australia, Africa and Asia. As consequences, fasciolosis should be considered as potential zoonosis of major global and regional importance (WHO, 2007).

Fluke of ruminants, mainly *Fasciola* (liver fluke) and *Paramphistomum* (rumen fluke) are the most important flukes recorded from different parts of the world (Dreyfuss et al., 2006). The life cycles of flukes are always indirect, involving one or two intermediate hosts before invasion of definitive hosts. Snails such as genus *Lymnaea* for *Fasciola*, genus *Planorbis*, *Bulinus* or *Lymnaea* for *Paramphistomum* acts as an intermediate host (Kahn et al., 2005). They are narrowly dependent to their close environment (nature of the soil), and climatic conditions for survival and multiplication of the intermediate hosts and also for the survival and evolution of the intermediate stages (Dreyfuss et al., 2006).

Pathogenesis of fasciolosis varies according to the phase of parasitic development in the liver and species of the host involved, essentially the pathogenesis is two-told; the first phase occurs during migration in the liver parenchyma and is associated with liver damage and hemorrhage and the second phase occurs when the parasite reside in the bile ducts, and results from the haematophagic activity of the adult flukes and from the damage to the mucosa, by their cuticular spines (Bowman, 2014).

The adult paramphistomum in fore-stomach are essentially nonpathogenic even though large numbers may be present (Urquhart et al., 1996). At most there may be a localized loss of rumen papillae. The immature worms attach to the duodenal mucosa by means of posterior suckers causes severe enteritis, possibly necrosis and hemorrhage (Soulsby, 1986). In heavy infestation frank hemorrhage, duodenitis, hypoproteinemia and oedema may be produced with immature fluke deeply embedded in the mucosa. Severely affected animals exhibit anorexia and severe diarrhea (Brown et al., 2007).

Although there are numerous reports on the prevalence of cattle fasciolosis in different parts of the country (Solomon and Abebe, 2007; Gebretsadik et al., 2009; Fufa et al., 2009; Mihreteab et al., 2010, Abebe et al., 2011) and still paucity information on the epidemiology of *Paramphistomum*.

Moreover, the above studies were conducted in areas widely known to have suitable environmental conditions for the intermediate hosts and hence information gap is clearly seen pertaining to *Paramphistomum* in the presumed study area. Therefore, the study was conducted to determine the prevalence of fasciolosis and paramphistomum infection in cattle slaughtered at Hirna municipal abattoir, to compare the diagnostic efficiency of fecal sedimentation and postmortem examination for both flukes and asses some of the potential risk factors that might contribute to fluke infection.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Hirina municipal abattoir which is found in Hirna town in western Hararghe zone. Hirna, the capital city of Tullo woreda, is located at 375 km east of Addis Ababa at 9°13'N latitude and 41°6E longitude, and mean elevation of 1663 m above sea level.

The area has mean maximum and minimum temperature of 32 and 17°C, respectively, and receives an average 600 to 900 mm annual rainfall (Dawit et al., 2012).

Study design and study animal

Cross-sectional study design was used and fecal and parasitic samples were collected from a total of 387 cattle slaughtered at the abattoir. The study animals include adult male indigenous cattle breed presented to the abattoir for slaughter from various place of the eastern part of Ethiopia.

The cattle population in the area is composed of diversified local cattle breeds (locally called Harare Sanga) known for beef production, the '*Harerghe beef*'. The people in the area fatten their cattle with hand feeding/cut and carry system because of their small land holding plus the higher proportion of land being slop and hill top, usually left for cash crop production (Tadesse et al., 2014).

Study approach

Each animal selected for the study was further identified by, providing specific identification number that could be used for both ante-mortem and post mortem examinations. The sampled cattle were examined for the presence of the major trematodes of interest by coproscopic and post mortem examination. Identification of sampled animals, origin, age, sex, body condition score and general health condition of each study animal were recorded. The body condition score were classified into five categories using a technique recommended by Nicholson and Butterworth (1986).

Accordingly, body condition score were categorized as score 1(emaciated) to 5 (obese). For the purpose of this study, body condition score were categorized into three categories; namely: poor (Score 2), medium (Score 3 and 4) and good (score 5). Similarly, the animals' source was traced from the people who fetched them to slaughter. Generally the animals were hand-fed by the local farmers which had defined source.

Table 1. Logistic regression analysis of various risk factors against prevalence of trematode infection in cattle based on fecal examination.

Risk factors	Number examined	*Fasciola*		*Paramphistomum*	
		№ (%)	Adjus. OR (95% CI)	№ (%)	Adjus. OR (95% CI)
BCS					
Good	104	1 (0.96)	1	1 (0.96)	1
Medium	283	23 (8.12)*	9.17 (1.22-69.09)	20 (7.06)*	8.26 (1.11-62.54)
Origin					
Chafbanfe	77	7 (9)	1	4 (5.2)	1
Debaso	74	4 (5.4)	0.52 (0.14-1.87)	3 (4.1)	0.71 (0.15-3.31)
Doba	74	2 (2.7)	0.29 (0.06-1.48)	5 (6.8)	1.44 (0.37-5.65)
Hirna	162	11 (6.8)	0.77 (0.28-2.11)	9 (5.6)	1.15 (0.34-3.89)

BCS=body condition score; *= statistically significant (P<0.05), OR=odds ratio.

Coproscopic examination

Animals selected for this study were given identification number before feacal sampling. Fecal samples were collected directly from the rectum of these cattle, placed in universal bottle and closed tightly.

Bottles containing sample were labeled with the corresponding animals' ID and transported to Hirna regional laboratory for examination. Fecal sedimentation technique was employed to examine for *Fasciola* and rumen fluke eggs using method described by Antonia et al. (2002) and Bowman (2014).

Post mortem examination

After evisceration, the liver particularly the bile ducts and the gall bladder, rumen, reticulum and duodenum of 387 cattle were thoroughly examined (visual, palpation and incision If necessary were made depending on inspected organs) for trematode identification as these organs are known to be predilection site for adult and young liver and rumen flukes. Liver and rumen fluke recovery was conducted for identification following the approach of Soulsby (1986).

Data management and analysis

The data obtained from fecal examination and organ necropsy were recorded on special designed forms entered into spread sheet of Microsoft Excel. The data was coded and analyzed using STATA software version 11 (STATA corp., College Station, TX). Pearson's chi-square ($\times^2$) and logistic regression were used to evaluate the association between the prevalence of fasciolosis and the considered risk factors that is body condition score and origin.

Statistical analysis is considered as significant when P-value is less than 0.05 at 95% confidence level. Moreover, Kappa statistic was used to determine the degree of agreement between the two diagnostic methods employed (fecal sedimentation technique and necropsy finding) in the study. The kappa value was interpreted as: slight agreement (k< 0.2); fair agreement (k = 0.2 to 0.4); moderate agreement (k = 0.4 to 0.6); substantial agreement (k = 0.6 to 0.8); and almost perfect agreement (k > 0.8) (Thrusfield, 2005).

RESULTS

Coproscopic examination

Out of 387 cattle examined for the presence of eggs of *Fasciola* and *Paramphistomum* with simple fecal sedimentation technique, 24 (6.2%) and 21(5.43%) were positive for *Fasciola* and *Paramphistom* eggs, respectively. In this study there was no poor body condition score record.

However, there was a statistically significant difference in the prevalence of both *Fasciola* and *Paramphistomum* between medium and good body conditions score. Cattle with medium body condition were more likely to be affected by *Fasciola* (OR=9.17, 8.12%) and *Paramphistomum* (OR=8.26, 7.06%) than cattle with good body condition (Table 1).

Though, there was no statistically significant difference in the prevalence of fasciolosis and paramphistomosis among the cattle brought from different origins/sites. But, cattle brought from Chafebante were having the highest fasiolosis prevalence (9%) followed by those from Hirna (6.8%), Debeso (5.4%) and Doba (2.7%) (Table1).

Postmortem examination

Out of 387 cattle examined with postmortem to recover adult flukes in the liver and fore stomach, 33 (8.53%) were positive for fasciolosis and 21 (5.43%) were also positive for paramphistomiasis.

Fasciola gigantica was the only *Fasciola* species identified, similarly, *Paramphistomum cervi* and undifferentiated. There was a statistically significant (p<0.05) difference in the prevalence of both in liver fluke (*Fasciola)* and fore-stomach (*Paramphistomum*), between

Table 2. Logistic regression analysis of various risk factors associated with the prevalence of trematode based on postmortem examination.

Risk factors	Number examined	*Fasciola*		*Paramphistomum*	
		№ (%)	Adjus. OR (95% CI)	№ (%)	Adjus. OR (95%CI)
BCS					
Good	104	1(0.96)	1	1 (0.96)	1
Medium	283	32 (11.31)*	13.64 (1.83-101.51)	20 (7.06)*	8.26 (1.11-62.54)
Origin					
Chafbanfe	77	8 (10.39)	1	4 (5.2)	1
Debaso	74	5 (6.76)	0.56 (0.17-1.84)	3 (4.1)	0.71 (0.15-3.31)
Doba	74	3 (4.05)	0.39 (0.097-1.55)	5 (6.8)	1.44 (0.37-5.65)
Hirna	162	17 (10.49)	1.09 (0.44-2.70)	9 (5.6)	1.15 (0.34-3.89)

BCS=body condition score, *Significant variation ($p<0.05$).

Table 3. The presence or absence of *Fasciola* and *Paramphistomum* eggs in the feces of cattle (n=387) compared with adult fluke recovery in the liver and fore stomach.

Fecal examination	Adult *Fasciola* in liver		Total	*Paramphistomum* fore-rumen		Total
	Present	Absent		Present	Absent	
Eggs present (+)	24	0	24	21	0	21
Eggs absent (-)	9	354	363	0	366	366
Total	33	354	387	21	366	387

medium and good body conditions scores. Cattle with medium body condition score were more likely to be affected by *Fasciola* (OR=13.64, 11.3%) and *Paramphistomum* (OR=8.26, 7.06%) than cattle with good body condition (Table 2).

However, there was no statistically significant ($p>0.05$) difference in the prevalence of fasciolosis and paramphistomosis among the cattle brought from different origins despite the presence of minor difference in the prevalence (Table 2).

Diagnostic efficiency of coproscopy as compared to postmortem finding (gold standard)

Sensitivity and specificity of direct sedimentation technique were calculated from the results in Table 3 which sets out, the numbers of positive and negative test results in animals with and without flukes in their livers (Smith, 2009). Out of 387 cattle subjected to both fecal and liver examination, 33 had flukes in their livers but only 24 showed *Fasciola* eggs in their feces.

Accordingly, the sensitivity of a single examination by sedimentation method was found to be 72.7% and the specificity was 100% with substantial agreement between the two tests (κ = 0.83). The sensitivity of single sedimentation method in the detection of *Paramphistomum* eggs was found to be 100% and 100% specificity with complete agreement between coproscopy and necropsy (Table 3).

DISCUSSION

In this study, the prevalence of fasciolosis as indicated 6.2 and 8.53% by fecal and postmortem examination, respectively; is much lower than the previous reports made by several authors in different part of the country. Accordingly, 90.65% at Gondar abattoir (Yilma and Mesfin, 2000), 88.57% at Debre-Brehan abattoir (Tsegaye, 1995), 80% at Debre Berhan abattoir (Dagne, 1994), 56.6% at Ziway abattoir (Adem, 1994), 47% at Sodo abattoir (Abdul, 1992), 46.58% at Jimma abattoir (Tadele and Workue, 2007) and 28.63% at Hawassa abattoir (Rahmeto et al., 2010) were reported among others. Such big difference might be associated with community perception in treating animals on time and availability of veterinary service close to livestock producers. Early and mid nightees' veterinary service was not addressed to vast majority as, the result used (anthelmenthics) was poor as compared to recent years. Probably this might be the reason for high prevalence of parasitism as compared to the current finding; low prevalence has been reported by Fufa et al. (2009) at Wolaita Sodo (12.7%) and Daniel (1995) at Dire-Dawa abattoir (14.4%). Nature of the ecology of intermediate host where animals originated from also affects the prevalence of fasciolosis.

This significant difference in the prevalence of fasciolosis within the country is attributed mainly to variations in the ecological and climatic conditions such as altitude, rainfall, and temperature. However, differences in livestock management system and the ability of the inspector to detect the infection may also contribute. Water logged and poorly drained areas that support the survival and multiplication of snails are often conducive areas for fluke infection which contributes much (Soulsby, 1986; Urquhart et al., 1996; Bowman, 2014). In line with this, the animals bought to the abattoir for slaughter included in this study were mostly from ragged terrain with arid climate, where there are few suitable environments for multiplication of snails and cattle are feed with cut and carry system.

Though bovine fasciolosis exists in almost all regions of the country (Yilma and Mesfin, 2000), the species involved vary significantly with locality which is mainly due to difference in climatic and ecological condition such as temperature, attitude, rainfall and livestock management. In the current study, only F. gigantica was observed in the bile ducts of the affected livers, which was narrow shoulder elongated than F. hepatica. In line with this finding, Yilma and Malone (1998) indicated that *F. gigantica* is endemic in the entire western zone of the Ethiopia with localized foci in the south and east. This may thus be associated with the existence of favorable ecological biome for *Lymnaea natalensis*, the intermediate snail host (Urquhart et al., 1996).

The prevalence of rumen fluke in the present study (5.43%) is comparatively lower than the report of Abebe et al. (2011), who reported a prevalence of 57.52% in cattle in and around Jimma. Similarly, a study conducted by Menkir et al. (2007) at eastern Ethiopia (mainly in Haramaya, Harar, Dire Dawa and Jijiga) revealed prevalence of 21 and 25% for *Paramphistomum microbothrium* in goat and sheep, respectively. There was no clearly defined report on the prevalence of bovine paramphistomosis in Ethiopia especially at current study area. The major reason for such scanty information on the prevalence and geographic distribution of the fluke may be partly associated to the fact that, the adult *Paramphistomum* are considered as non- pathogenic and researchers' may not be interested to expand resources for such non-pathogenic types of cases.

The absence of statistical difference in the prevalence of *Fasciola* and *Paramphistomum* against the origins may be due to the similarity in elevation and ecology of the snail host observed in these sites (Chafebante, Debaso, Doba and Hirna). In line with the report of Abebe et al. (2011), these flukes were more frequent in cattle with medium body condition (with odds of 9.17 and 8.26 for *Fasciola* and *Paramphistomum*, respectively) than in cattle with good body condition score. As a predisposing factor or sequel, as the body condition improves/ increase, infection with *Paramphistomum* and *Fasciola* decrease. Both trematodes are known to proteinemia and feed on tissue plug and even damage the parenchyma of the liver (immature *Fasciola*) and the duodenum (immature *Paramphistomum*) which ultimately deplete protein from the host (Marquardt et al., 2000).

The lower prevalence of fasciolosis reported using fecal examination (8.12%) when compares to the necropsy (11.31%) and may be partly associated with hepatic fibrosis and hyperplastic cholangitis as a result of chronic infection (Urquhart et al., 1996), old age of parasites, host immunity of the animals, irregular egg discharge to the duodenum and certain group of animals that might have received drug treatment before sent to abattoir. On the other hand the prevalence of paramphistomosis was the same in both fecal and fore-stomach examination. The adult *Paramphistomum* in the fore stomachs are well tolerated, even when many thousands are present, feeding on the wall of the rumen or reticulum (Urquhart et al., 1996; Bowman, 2014). Moreover, adult *Paramphistomum* are very prolific and many eggs are expelled (Dreyfuss et al., 2006).

The study further indicated 72.7 and 100% sensitivity of the sedimentation diagnostic technique in relation to necropsy results of liver and fore-stomachs examination for fasciolosis and paramphistomosis, respectively. The two tests showed substantial (kappa = 0.83) and perfect agreement (kappa= 1) for fasciolosis and paramphistomosis, respectively. The present sensitivity result obtained for fasciolosis is comparable to the reports of 67.13% in Hawassa, Ethiopia (Rahmeto et al., 2010), 66.7% in Vietnam (Anderson et al., 1999) and 69% in Switzerland (Rapsch et al., 2006).

In this regard, the test suggests that about 27.3% (that is 9 out of 33) *Fasciola* infected animals may pass undetected with single examination of feces by sedimentation technique. This may be attributed partly to the fact that *Fasciola* eggs only appear in feces 8 to 15 weeks post infection, so most of pathological lesions had already occurred (Sanchez et al., 2002).

Furthermore, detection of *Fasciola* eggs can be unreliable during the patent period because the eggs are expelled intermittently depending on the evacuation of the gall bladder (Briskey, 1998). However, the sensitivity of the routine fecal sedimentation technique can be improved to approximately 92% through repeated sampling and testing (Rapsch et al., 2006).

CONCLUSION AND RECOMMENDATIONS

The present study revealed that flukes are less prevalent in the study area than the other parts of the country especially when it is compared in areas having high rainfall and favorable climatic condition for the intermediate snail hosts. However, the existing prevalence of fasciolosis and paramphistomosis can pose enormous economic loss through liver condemnation, poor weight gain and productivity, treatment cost, predisposition to infectious necrotic hepatitis and death in severely affected young animals.

In the study area, *F. gigantica* was the only species of *Fasciola* affecting cattle and body condition, score was a potential risk factor determining its occurrence. Moreover, the current study reflected the limitation of single fecal sedimentation technique in the detection of *Fasciola*. Nearly one cattle out of four cattle having *Fasciola* species in their liver can be undetected by this technique.

Based on the above findings, the authors recommend further detailed studies in different geography and seasons with larger sample size, possible to generate a complete data set on the epidemiology of fluke infections, their economic loss and ecology of intermediate host snails. Moreover, if fecal sedimentation or direct smear is used for the diagnosis of fasciolosis repeated sample should be used to increase its sensitivity.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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REFERENCES

Abdul JR (1992). Economic significance of Bovine Fasciolosis in Soddo. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University. Debre Zeit, Ethiopia.

Abebe F, Behablom M, Berhanu M (2011). Major Trematods of Cattle Slaughtered at Jimma Municipality Abattoir and their Intermediate Host in Selected Water Bodies of the Zone. J. Anim. Vet. Adv. 10(12):1592-1597.

Adem A (1994). Prevalence of Bovine and Ovine Fasciolosis; A preliminary survey around Zeway Region (Shewa). DVM thesis, Faculty of Veterinary medicine, Addis Ababa University, Debre Zeit, Ethiopia.

Anderson N, Luong TT, Vo NG, Bui KL, Smooker PM (1999). The sensitivity and specificity of two methods for detecting *Fasciola* infections in cattle. Vet.Parasitol. 83:15-24.

Antonia M, Conceiçao P, Rute M, Isabel H, Costa J, Correia C (2002). Evaluation of a simple sedimentation method for diagnosis of bovine fasciolosis. Vet. Parasitol, 105:337-343.

Bekele T, Kasali OB, Woldemariam W (1992). Endoparasite prevalence of the highland sheep in Ethiopia. Prev. Vet. Med. 13:93-102.

Bowman DD (2014). Georgis' Parasitology for Veterinarians. 10th edition, Elsevier, Saunders, St. Louis, Missouri 63043, pp. 300-361.

Briskey DW (1998). Diagnosis of liver fluke infection in cattle. Vet. Bull.68:1-4.

Brown CC, Baker DC, Barker IK (2007). *Alimentary System*. In: M.G. Maxie (Ed.) Jubb, Kennedy, and Palmer's Pathology of domestic animals. 5th edition. Elsevier, 2:220-262.

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.

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.

Dawit T, Diriba D, Birhanu M, Amene F (2012). The Problem of Environmental Pollution as Reflected in the Fore Stomach of Cattle: A Postmortem Study in Eastern Ethiopia. Global J. Environ. Res 6(2):61-65.

Dreyfuss G, Alarion N, Vignoles P, Rondelaud D (2006). Retrospective study on the metacercarial production of Fasciola hepatica form experimentally infected Galba truncatula in central France. Parasitol. Res. 98(2):162-166.

Fufa A, Loma A, Bekele M, Alemayehu R (209). Bovine fasciolosis: coprological, abattoir survey and its economic impact due to liver condemnation at Wolita Soddo municipal abattoir, Southern Ethiopia. Trop. Anim. Health Prod. 42(2):289-292.

Gebretsadik B, Kassahun B, Gebrehiwot T (2009). Prevalence and economic significance of fasciolosis in cattle in Mekelle Area of Ethiopia. Trop. Anim. Health Prod. 41:1503-1504.

Haridy FF, Gawisu N, Antonios T, Abdelgawad A (2002). The potential reservoir role of donkey and horse enzootic fasciolosis in Gharbi governorate, Egypt. J. Egypt. Soc. Parasitol. 32:561-557.

Hillyer GV, Apt W (1997). Food-borne trematode infections in the Americas. Parasitol. Today 13:87-88.

Kahn CM, Line S, Aiello SE (2005). The Merck Veterinary manual. 10th ed. White house station, N.J., USA, Merck and CO, pp. 273-276. Available at: www.merckvetmanual.com

Marquardt WC, Demaree RS, Grieve RB (2000). Parasitology and vector biology. 2nd ed. Academic press. London. PP. 243-300

Menkir M, Sissay T, Arvid U, Waller PJ (2007). Prevalence and seasonal incidence of nematode parasites and fluke infections of sheep and goats in eastern Ethiopia. Trop. Anim. Health Prod. 39(7):521-531.

Mihreteab B, Haftom T, Yehenew G (2010). Bovine Fasciolosis: Prevalence and its economic loss due to liver condemnation at Adwa Municipal Abattoir, North Ethiopia EJAST 1:39-47.

Nicholson MJ, Bufferworth MH (1986). A guide to body condition scoring of zebu cattle. ILCA, Addis Abeba (Ethiopia). Range lands program, A-F. Available at: www.fao.org/Wairdocs/ILRI/x5469E/x5469e0a.htm

Abebe R, Abunna F, Berhane M, Mekuria S, Megersa B, Regassa A (2010). 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. Ethiop. Vet. J.14:39-40.

Rapsch C, Schweizer G, Grimm F, Kohler L, Baur C, Deplazes P, Braun U, Torgerson PR (2006). Estimating the true prevalence of *Fasciola hepatica* in cattle slaughtered in Switzerland in the absence of absolute diagnostic test. Int. J. Parasitol.36:1153-1158.

Sanchez A, Pazsilva A, Suarez J, Panadero R, Pedreira J, Lopez C, Diez-Banoz P, Morondo P (2002). Influence of age and breed on natural bovine fasciolosis in an endemic area, Galicia, North Western Spain. Vet. Res. Commun. 26(5):361-370.

Smith P (2009). Large animal internal medicine. 4th ed. USA. Mosby. P. 905-910.

Solomon WM, Abebe W (2007). Prevalence study of ruminant fasciolosis in areas adjoining upper Blue Nile Basin, North Western Ethiopia. Ethiop. Vet. J. 11:68-90.

Soulsby EJL (1986). Helminths, Arthropods and Protozoa of Domesticated Animals, Seventh Edition, Balliere Tindall, London, UK. pp. 40-52.

Tadele T, Worku T (2007). The prevalence and economic significance of Bovine Fasciolosis at Jimma Abattoir, Ethiopia. Internet J. Vet.

Med. 3:15-17.
Tadesse E, Tucho TA, Hundesa F, Weldu G, Weldu T, Balay T K, Tibesso O (2014) Traditional cattle production in the highlands of Hararge: Case study for East and West Zones of the high lands of Harerge, Eastern Ethiopia. Basic Res. J. Agric. Sci. Rev. 3(12):122-133.
Thrusfield M (2005). Veterinary Epidemiology third edition, University of Edinburgh, Blackwell Science, pp.180-188. Available at: https://www.wiley.com/en-ng/Veterinary+Epidemiology%2C+4th+Edition-p-9781118280263
Tsegaye T (1995). Bovine Fasciolosis: Prevalence and economical importance assessment trial on cattle slaughtered out Debre Berhan Municipal Abattoir. *DVM thesis,* Faculty of veterinary medicine, Addis Ababa University. Debre Zeit, Ethiopia.
Urquhart G, Armour J, Duncan J, Dunn A, Jenning F (1996). Veterinary parasitology. 2nd ed. Scotland, Black well Science. pp. 102-119.
World Health Organiation (WHO) (2007). Report of the WHO Informal meeting on use of triclabendazole in fascoiosis control. Tech. Rep. WHO/CDS/NTD/PCT/2007,
Yilma JM, Malone JB (1998). A Geographic Information System forecast model for strategic control of fasciolasis in Ethiopia. Vet. Parasitol. 78:103-123.
Yilma JM, Mesfin A (2000). Dry season bovine fasciolosis in North Western part of Ethiopia. Revue. Med.Vet:151:493-500.

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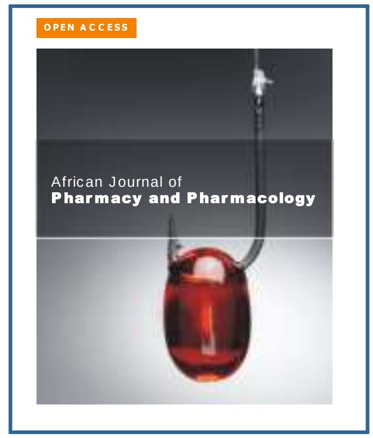

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