Austin Journal of Veterinary Science & Animal Husbandry

Open Access

Austin Publishing Group

Research Article

Prevalence of Fasciola Infection in Small Ruminant in and Around Hirna

Dina J[1] and Henok A[2]*

[1]East Harerge Zone, Kurfachale District Livestock and fish Resourse Development Office, Ethiopia

[2]Hirna Regional Veterinary Laboratory, Ethiopia

***Corresponding author:** Henok Abebe, Hirna Regional Veterinary Laboratory, P.O>Box 36 Ethiopia; Email clexhena@gmail.com

Received: July 11, 2018; **Accepted:** September 04, 2018; **Published:** September 11, 2018

Abstract

A cross sectional study was conducted in and around Hirna town (Tullo districts) from November 2014 to June 2015, to estimate the prevalence of Fasciola spp infection and assess the associated risk factors in sheep and goats based on faecal examination. For this purpose, a total of 384 sheep and goats were coprological examined. Data about the assumed risk factors were also obtained from the animals' owners during faecal sample collection. Data were analyzed using SPSS software. Accordingly, an overall prevalence of 32.03% was observed (33.9% in sheep and 29.5% in goats). There was significant difference (P > 0.05) in the prevalence of Fasciola infection among peasant association and their prevalence was as follow: Odabelina (49.1 %) followed by Lubudhekeb (41.7 %) and the remained peasant association were Kirakufis (35.4%), (Reketafura (27.3%), Ifabas (23.6), Hirna 01 (22.6%) and Hirna 02 (16.7%).

There was no statistically significant variation (p>0.05) by sex, age, breed and body condition score but on age basis the prevalence of *fasciolosis* was highest (36.8%) in age of animals above three years followed by those animals that have age one to three years (31.2%) and the lowest prevalence (30%) was observed in Small ruminants less than one year old .The present study revealed that animals with medium body condition score (35.6%) were more likely affected by fasciola infection than animals with poor (31.1%) and good (29.6%) body condition scores. In conclusion, this study has revealed that Fasciola spp are important parasites affecting small ruminants in the study area and favorable environmental conditions are available in the area for the breeding and survival of the snail intermediate host. Therefore, concerned professionals and local stakeholders should give due attention towards the control of the parasite. The prevalence of ovine and caprine *fasciolosis* in the study area should be reduced by sustainable and integrated control programs which include strategic application of anthelmintic, efficient farm and grazing management by Veterinarians and owners in the study area.

Keywords: Hirna; Prevalence; Fasciola; Small Ruminant

Introduction

Ethiopia possess the largest livestock population in Africa, with an estimated population of 7.8 million equines, 1 million camels, 47.5 million cattle, 39.6 million chickens, 26.1 million sheep and 21.7 million goat (CSA 2009).Small ruminants play a significant role in maintaining household stability by providing meat, milk, skin and wool, generate cash income and play traditional social and religious roles [1]. The small ruminants in Ethiopia are the dominant livestock, providing up to 63% of cash income and 23% of the food subsistence value obtained from livestock production .Sheep and goat population in the country and the huge potential therein; the productivity per animal and the contribution of this sub-sector to the national economy is relatively low due to multitude of constraining factors including malnutrition, diseases, improper health care and other management problems [2].

Both infectious and parasitic diseases are common traits that affect productivity [2]. Parasitic infections pose a serious health threat and limit the productivity of livestock due to the associated morbidity and mortality. Vast numbers of parasitic diseases are incriminated to play a detrimental role in hampering small ruminant production leading to serious economic loss. Helminthiasis, especially Parasitic Gastro-Enteritis (PGE) constitutes a serious health problem and limitation to the productivity of small ruminants throughout the world due to the associated morbidity, mortality, and cost of treatment and control measures [3].

Gastro-intestinal helminthiasis is considered as one of the major parasitic problem that constrained livestock improvement programs in Ethiopia. One of the helminthiasis that causes immense direct and indirect losses especially in domestic ruminants is *fasciolosis*. *Fasciolosis* is one of the most prevalent helminths infections of small ruminants in different parts of the world and an economically important zoonotic disease of domestic livestock, especially cattle, sheep, and goat, as well as occasionally man. *Fasciolosis* is a disease of sheep, goat, and cattle but occasionally affects humans, thus considered as a zoonotic infection [4]. According to [5,6] the taxonomic classification of the organisms that cause *fasciolosis* is presented as follows: Phylum:- Platyhelminthes; Class:-Trematode;

Citation: Dina J and Henok A. Prevalence of Fasciola Infection in Small Ruminant in and Around Hirna. Austin J Vet Sci & Anim Husb. 2018; 5(3): 1047.

Sub-class- Deigned; Super Family:- Fasciolidea; Genus:- Fasciola; Species:- Fasciola hepatica and Fasciola gigantic. The disease is caused by digenean trematodes of the genus Fasciola, commonly referred to as liver flukes. The two species most commonly implicated as the etiological agents of *fasciolosis* are Fasciola hepatica and Fasciola gigantic (family Fasciolidae). Fasciola hepatica has a worldwide distribution but predominates in temperate zones while Fasciola gigantica is found on most continents, primarily in tropical regions.

The snails of the family Lymnaesidae transmit both F. hepatica and F.gigantica. Infestation with *fasciolosis* is usually associated with grazing wet land and drinking from the snail infesting watering places [7].

The life cycle of Fasciola spp. is a typical of Digenetic trematodes. Eggs laid by the adult parasite in the bile ducts of their hosts pass into the duodenum with the bile. The eggs then leave the host through the faces. At this stage, eggs are still not embryonated, further development to maturation taking approximately two weeks [8].

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 the adult flukes and from the damage to the bile duct mucosa by their cuticular spines [9].

Clinically, *fasciolosis* is often seen as a chronic wasting disease. In cattle, sub-acute or acute outbreaks occasionally occur, whereas in sheep and goats, acute and subacute diseases are more frequent. The clinical signs of acute disease are characterized by sudden deaths, weakness, anemia, and dyspnea. Subacute and chronic *fasciolosis* is characterized by progressive loss of condition, anemia, hypoalbuminemia, and emaciation, pallor of the mucous membranes, submandibular edema, and ascites. In milder infections clinical signs may or may not be readily observed, however, a decreased appetite and interference with post-absorptive metabolism of protein, carbohydrates and minerals, may have a significant effect on production [10]. Liver fluke infection in lambs and kids is characterized by anemia, edema, weight loss, and death [11].

Apart from the presence of typical clinical signs, suggestive hematological and biochemistry findings, typical macroscopic and histological findings the laboratory confirmation may be depend mostly of fecal sedimentation tests, serology tests (ELISA) and possibly in some regions of the world PCR tests were used for diagnosis of *fasciolosis* [12].

The treatment recommended depends on the nature of the disease and some of the available anthelmintic are not effective against immature fluke and so are not recommended in acute fluke outbreaks. Chemotherapy with drugs remains the most cost-effective way of treating parasitic diseases, and is usually at the heart of any major control campaign. Compared to environmental engineering, drug treatment is very cheap [13].

Several control methods against ruminant *fasciolosis* are available and either be used independently and as a combination of two or more of them. These methods involve reduction in the number of intermediate snail hosts by chemical or biological means, strategic application of anthelmintic, reduction in the number of snails by drainage, fencing, and other management practices, and reduction in the risk of infection by planned grazing management [14].

Control of parasitic diseases is crucial to improve the productivity of the animals. In most *fasciolosis* endemic areas, the control of the intermediate snail host population offers a good opportunity for the reduction of transmission and is generally effective when combined with one or more other methods such as chemotherapy or environmental sanitation. Although eradication of the snail hosts is the most effective method of total fluke controls this, however, is often very difficult in low-lying, wet areas with a mild climate. Other useful methods of fluke control include biological control of the intermediate host, fencing the waterlogged area and so on.

Draining swamps, building sewage systems, and providing clean water supplies are used to control water-borne /including snail borne/ helminths but it is very expensive compare to chemotherapy [13].

Less frequent strategic treatments with a possible yearly rotation of anthelmintic or anthelmintic combinations that are effective against both immature and adult flukes has been reported to provide the best method of successful control of *fasciolosis* [15].

The temperature, rainfall, and altitude of the study area are also favorable for the development of the intermediate host and Fasciola species. The objectives of this study are:

- To determine the current prevalence of small ruminant *fasciolosis* in Tullo Woreda, Western Hararghe Zone, Ethiopia.
- To assess the fauna of intermediate snail hosts in grazing and watering points.
- To assess the potential risk factors associated with *fasciolosis*.

Materials and Methods

Study area

The study was conducted in peasant association sectional study was conducted from November 2014 to June 2015 in and around Hirna town of Tullo districts which is located 371km from Finfine in eastern direction, 45km from chiro zonal town. The area is mainly covered by an irregular topography with depression, numerous Chain Mountains, flat lands, scattered trees, and dense shrubs of vegetation. The woreda characterized by main season's in a year. The dry season (bega) which extends from January to the ends of April and long rain, season (keremt) that extends from July to the ends of September. The district has mean annual temperature ranging from 18^0c-26^0c and mean annually rainfall ranging from 550m-800m.a.s.l (above sea level). The agro-ecological zone of the district highland (dega) 40%, amid high land (weynedega) 57% and 3% kola. The topography of the district is medium high land 1500m.a.s.l, high land 1500-2500 and very high land >2500m.a.s.l and relative humidity 21.9%-65%. Climate conditions of altitude is 1500-3100m.a.s.l and the soil type of the district are clay 43%, sand 55% and silt soil 2%.

Study design

A cross-sectional type of study was used to determine the prevalence of *fasciolosis*. It involves categorization of the study population according to their specific geographic origin (PAS), Body

Condition Score (BCS), sex, species and age to estimate the prevalence of *fasciolosis* and assess the associated potential risk factors.

Study population: The study population consists of sheep and goats of local breed with different age, sex, and body condition category of small holders in mixed crop-livestock from randomly selected peasant association (PAs) of Tullo district. Animals were kept in small flocks of three to five animals per household and were used mainly for income generation and meat production. As in many parts of the country, the feed sources were natural grazing and crop residues with minimum extra supplement and health intervention. Moreover, the quality and supply of feed resources were seasonally variable, the problem being serious in the dry season.

Sample size determination: To determine the sample size, a prevalence rate of 50% was used. The required sample size for the study were determined by the formula given in [32] with 95% confidence interval, 5% desired absolute precision,

$$N = 1.96^2 \times Pexp\ (1\text{-}Pexp) / d^2$$

where n= required sample size, Pexp= expected prevalence, D= desired absolute precision. Accordingly, 384 shoat animals sampled from peasant associations of Tullo District.

Sampling method and procedure: Fecal samples were collected directly from the rectum for coprological examination, of each sheep and goat using disposable plastic gloves and placed in clean screw -capped universal bottle and each sample was clearly labelled with species, age, sex, sampled site and body condition score and processed. Faecal samples were preserved with 10% formalin solution to avoid the eggs developing and hatching and the sample was forwarded to Hirna veterinary Regional Laboratory

Study methodology

Coprological study: Coproscopic examination performed by simple sedimentation technique; the pellet or feces was crushed with pistil and mortar then mixed with water after that filter by sieve to another container and stayed for few minutes and discarded the supernatant then put on the slide and examined under the 10-x magnification.

Sedimentation technique: A spoonful of feces thoroughly mixed with 30ml of tap water on container; suspension was poured through tea strainer on another container and left for 10 min. The supernatant was removed and washed by water this step repeated until the solutions become cleared. Finally, small quantity of the deposit was taken using a pipette and put on microscope slide, a cover slip was applied and examined microscopically under the 10x magnification power.

Data analysis

Data and information about small ruminants' *fasciolosis* were entered into Microsoft Excel spreadsheet and analyzed by SPSS version 20.0 software. Descriptive statistics were summarized. The prevalence was calculated for all associated risk factors as the number of infected individuals divided by the number of individuals sampled multiplied by 100. Factors thought to be associated with the prevalence of *Fasciolosis* infection were analyzed by Pearson's chi-square test to account for confounding and interaction between variables. In the analyses, the confidence level was held at 95% and P-value less than 0.05 was considered as significant.

Table 1: Prevalence of small ruminant *fasciolosis* in seven different kebele.

kebele	Examined	Positive	Prevalence (%)	X^2	p-value
Reketafura	44	12	27.27	19.4	0.004
Lubudhekeb	72	30	41.7		
Kirakufis	65	23	35.4		
Ifabas	55	13	23.6		
Odabelina	53	26	49.1		
Hirna 01	53	12	22.6		
Hirna 02	42	7	16.7		
Total	384	123	32.03%		

Table 2: Prevalence of *fasiolosis* in small ruminant species.

Species	Examined	Positive	Prevalence	X^2	p-value
Ovine	218	74	33.9	0.85	0.357
caprine	166	49	29.5		
total	384	123	32.03		

Results

Out of 384 fecal samples taken from shoats, the coprologicall examination result showed, an overall prevalence of 32.03% (123). The specific prevalence of *fasciolosis* in this study was 33.9% and 29.5% in sheep and goats respectively (Table 2). Kebele, age, sex, species, and body condition scores were considered as the potential risk factors for the occurrence of *fasciolosis* in the study area.

The present study shows that there is a significant difference ($p<0.05$) on the prevalence of shoat *fasciolosis* in different Kebeles of. Among this kebele where the highest prevalence was observed in Odabelina (49.1%) followed by Lubudhekeb (41.7%) (Table 1).The result indicated that 30.7% observed in male of small ruminants, which was the lowest prevalence when compared with the prevalence of *fasciolosis* in female small ruminants, which was 32.9% (Table 3).

An attempt was made to see the prevalence of *fasciolosis* in different age groups of small ruminants and the highest prevalence was investigated in the age of shout above three years of age (36.8%) and followed by shots with age group between one to three years (31.51%) while the lowest prevalence were observed in those shout that have age below one years (30%) (Table 4).

The high infection rate of *fasciolosis* were observed in medium body condition animals 35.6% and followed by good body condition animals(shout) 29.6% while the lowest infection rate of *fasciolosis* were observed in the poor body condition animals 31.1% .

Discussion

The overall prevalence of Fasciola spp infection in small ruminants observed in this study was 32.03%. The result of the present study conducted by coprological investigation also proved. The current prevalence observed in sheep was lower than that reported by previous studies in the country (56%) in Awash River Basin [16], 45.6% in Oda Bultum district, Western Hararghe [30], 49% in and around Dawa-Cheffa, Kemissei area [17] 39.5% in Adigrat (Gebreizgaber et al., 2012) and 43.75% in Haru district, western Ethiopia [18].

Table 3: Prevalence of *fasholosis* in three age group.

Age	Examined	Positive	Prevalence	X^2	p-value
< 1 year	40	12	30	0.87	0.647
1-3 years	276	86	31.2		
>3 years	68	25	36.8		
Total	384	123	32.03		

Table 4: Prevalence of *fasholosis* in small ruminant with different body condition.

body condition score	Examined	Positive	Prevalence	X^2	p-value
Poor	90	28	31.1	1.25	0.535
Medium	135	48	35.6		
Good	159	47	29.6		
Total	384	123	32.03		

The result of the present study showed significantly higher prevalence of *fasciolosis* in sheep than goats, which were agreed with earlier, report [16]. This could be due to the difference in the feeding behavior of the two species of animals and the nature of their immunological reaction to the parasite. Sheep are grazers and they graze near the ground, while goats are browsers. Such feeding behaviors increase the chance of exposure for sheep and reduce that of goats [19]. Sheep and cattle could not develop strong immunity [20] and sheep are thought to acquire little resistance to *fasciolosis* [21].

This clear and high variation was probably due to the difference in agro-climatic conditions conducive for the intermediate host and the parasite. Only few swampy and water lodging areas were observed in the present study area and the water sources for the animals were mainly small ponds. The season of study might be another factor for the lower prevalence in the current study because the study carried out in dry season when most of the snail habitats were dried up. The feeding system of the animals in the present study area could also be another possible factor for the low prevalence as the animals were observed to depend entirely on grazing on open dry lands and tethered at homesteads, which might reduce the chance of exposure to Fasciola infective stage (encysted metacercariae).The reason for these variations might also be due to the differences in temperature, moist, humidity and soil that might favor multiplication of intermediate host; snails [22] also suggested that the difference in prevalence and severity of the disease syndrome are evident in various geographical regions depending on the local climatic conditions, availability of permanent water (marshy area) and system of management.

In the current study the prevalence of *fasciolosis* in goats was 29.5% which was higher than the previous study in different parts of the country reported by [23] 7.5% from Hawassa Zuria and Dale Districts, prevalence of 9.4% reported from Jimma area by [24] and 15.9% prevalence in and around Hirna West Hararge was reported by [25] in around Asella [26] and 8.8% prevalence Climate conditions, particularly rainfall, were frequently associated with differences in the prevalence of fasciola infection because this was suitable for intermediate hosts like snails to reproduce and to survive longer under moist conditions [16].

The specific prevalence of the disease in different peasant association of studied areas were 49.1% (Odabelina), 41, 7% (Lubudhekeb), 35.4% (Kirakufis), 27.3% (Reketafura), 23.6% (Ifabas), 22.6 % (Hirna 01), and 16.7% (Hirna 02). Statistical analysis of the prevalence among peasant associations showed the presence of significant difference ($p<0.05$). This significant difference is due to an irregular topography of study areas a wide range of altitude (1600-3100m), settled marshy area of Lubudhekeb, Kirakufis and Odabelina and irrigated land of the remained area.

The present study of *Fasciolosis* was higher in older animals 36.8% over three years of age followed by animals, which have 1-3 years of age 31.2%, and those less than one years old 30%, which is in agreement with the result of other workers [27]. The higher infection rate in older animals could be due to long time exposure to disease entity and their grazing habit close to submerge areas. Similarly, [28] reported that the high infection rates in older animals associated with age and consequently longer exposure time to disease.

The prevalence of the disease in female and male animals recorded as 30.7% and 32.9% respectively. There was no significant difference ($p>0.05$) between the two sexes indicating that sex seems to have no effect on the prevalence of the disease. The absence of statistical association between sex and prevalence of parasites is in agreement with that of [28] and in disagreement with other reports [22] who found higher infections in female animals than males with a significant difference between them.

The present prevalence of *fasciolosis* found to be 35.6%, 31.1% and 29% in medium, good, and poor body conditions respectively without significant difference, which was disagreed with previous report by [29,31].

Conclusion and Recommendation

The result of present study indicated that Fasciola, spp is an important parasite in sheep and goats in Hirna and around (Tullo) districts. Though the prevalence in current study was low as compared to other research findings, the study has clearly shown the existence of host-parasite-vector and environment interactions in the area. Low prevalence in the present study may be due to the season or examination procedure or since the study was conducted during dry season. Prevalence was determined based on the results of the conventional coprological examination [33-36].

This procedure has its own limitations due to the contributed intermittent output of eggs by host. This study revealed that age, sex, species, Kebele (peasant association) and body condition score of the animals as the major risk factors for Fasciola infection in the studied area. Therefore, these factors are considered whenever a control intervention is launched in the area. Furthermore, it is recommended that a further a longitudinal study need to be conducted in the study area in order to collect a complete epidemiological data about the parasite, intermediate host and environmental interaction. Based on the present finding and general knowledge of the disease, the following recommendation was forwarded:

- Preventive measures rather than curative treatment need to be carried out.
- Chemotherapy and destruction of accessible snail habitats.

- Supplementation of important nutrients in the feed of the animals in the dry season.
- Awareness creation activities, such as training should be conducted to animal owners.
- Avoiding low-lying pastures have also significantly importance for controlling fluke infections.
- Periodic anthelmintic treatment should be given to get the maximum benefits from shoat.

Acknowledgement

The author would like to thank the stuff of Hirna Regional Veterinary Laboratory for their support during research.

References

1. Alemayehu Z, Fletcher I. Small ruminant productivity in the central Ethiopian mixed farming system. Institute of Agricultural Proceeding. 1995; 4: 1941-1947.
2. Ademosun AA. Constraints and prospects for small ruminant research and development in Africa Small Ruminant Development in Africa. pp: 1-5.African Journal of Basic & Applied Sciences. 1992; 6: 43-49.
3. Silvestre A, Chartier C, Sauve C, Cabaret J. Relationship between helminth species diversity, intensity of infection and breeding management in dairy goats. Vet Parasitol. 2000; 94: 91-105.
4. WHO: Report of the WHO Informal Meeting on use of triclabendazole in fascioliasis control. 2007.
5. Dunn AM. Veterinary Helminthology. Second Ed. Butler and Tanner, Ltd. London, UK. 1978; 15-159.
6. Souls by EJL. Helminth, Arthropod and Protozoa of Domestic Animals. 7th Ed. BaillereTindall, London, Uk. 1982; 809.
7. Payne W. An introduction to animal husbandry in the tropics, Black well science. Oxford. London. 1990; 4: 47-74.
8. Joseph CB, Hutchinson GW, Stephen L. Liver fluke disease in sheep and cattle. NSW Department of Primary Industris. 2007; 1-10.
9. Behm CA, Sangster NC. Pathology, Pathophysiology and clinical aspects. In: *Fasciolosis* (Dalton, J. P. Ed.). CABI Publishing, Wallingford. UK. 1999; 185-224.
10. Ray MK. Fasciola hepatica: A Review of the Economic Impact in Cattle and Considerations for Control. Veterinary Therapeutics. 2001; 2: 1-11.
11. Yilma J, Malone JB, Mesfin A. Dry season ovine *fasciolosis* in Northwestern part of Ethiopia. Revue Méd.Vét. 2000; 151: 493-500.
12. Steyl JAC. Severe necrohaemmorhagic tracts in liver due to migrating immature flukes. DVM Thesis, Faculty of Veterinary Science, Onderstepoort. 2010; 1-7.
13. Gaasenbeek CPH, Moll L, Cornelissen JBWJ, Vellema P, Borgsteede FHM. 2001.
14. Hansen J, Perry B. The Epidemiology, Diagnosis and Control of Helminth Parasite of Ruminants: A Handbook. Animal production and health division, FAO, Rome, Italy. 1994; 17.
15. Parr SL, Gray JS. A strategic dosing scheme for the control of *fasciolosis* in cattle and sheep in Ireland. Veterinary Parasitology. 2000; 88: 187-197.
16. Ahmed S, Muhammad N, Roomana G, Muhammad Z, Abdul Razzaq. Diversity and Prevalence of Trematodes in Livers of Sheep and Goat in Quetta, Pakistan. Pakistan J. Zool. 2005; 37: 205-210.
17. Bitew M, Ibirahim N, Abdela A. Study on prevalence of ovine *fasciolosis* in and around Dawa-Chaffe, Kamissie. Afr.J. Agric. Res. 2010; 5: 2981-2985.
18. Bogale B, Keno D, Chanie M. Ovine *fasciolosis*: episode and major determinants in Haru District, Western Ethiopia. Acta Parasitological. Globalize. 2012; 3: 07-11.
19. Dawit K, Adem H. Abattoir survey on the prevalence and monitory loss associated with *Fasciolosis* in sheep and goats. International Journal of Livestock Production. 2011; 2: 138-141.
20. Phiri IK, Phiri AM, Harrison LJ. Serum antibody isotype response of Fasciola-infected sheep and cattle to excretory and secretary products of Fasciola species. Vet. Parasitol. 2006; 141: 234-42.
21. Dargie J. The impact on production and mechanism of pathogenesis of trematode infections in cattle and sheep. Int. J. Parasitology. 1987; 17: 453-463.
22. Urquhart GM, Duncan JL, Armour J, Dunn AM, Jenning. Veterinary Parasitology. Second Edition. BlacwellScince. UK. 1996; 103-113.
23. Mekuria S, Misganaw E, Abebe R. Epidemiological Survey on Small Ruminant *Fasciolosis* in Hawassa Zuria and Dale Districts, Sidama Zone, Southern Ethiopia. 2014.
24. Kedir S, Deressa B, Tigre W. Small ruminant *fasciolosis* in Jimma area of South Western Ethiopia: Its epidemiology and minimum monetary loss. Global Veterinarian. 2012; 9: 635-641.
25. Henok, Mokonnen A. Study on Prevalence and risk factors of *Fasciolosis* in Small ruminant in and around Hirna town, DVM Thesis, Faculty of Veterinary medicine, Jimma University, Jimma, Ethiopia. 2011; 1-5.
26. Dinka A. Preliminary study on the prevalence of small ruminant (ovine and caprine) *fasciolosis* in and around Asella (Arsi), DVM Thesis, Addis Ababa. University, Ethiopia. 1996.
27. Tasawar Z, Minir U, Hayat CS, Lashari MH. The prevalence of Fasciola hepatica in goats around Multan. Pak Vet J. 2007; 27: 5-7.
28. Keyyu JD, Monrad J, Kyvsgaard NC, Kassuku AA. Epidemiology of Fasciola gigantica and Amphistomes in Cattle on Traditional, Small-scale Dairy and Large-scale Dairy Farms in the Southern Highlands of Tanzania. Trop Anim Health Prod. 2005; 37: 303-314.
29. Eyerusalem G, Yeshitila, Mihreteab B. Prevalence of ovine *fasciolosis* in Adigrat. North East Ethiopia. Global Veternaria. 2012; 9: 92-96.
30. Tesfaheywet Z. Helminthosis of Sheep and Goats in and around Haramaya, Southeastern Ethiopia. J. Anim. Hlth. Vet. Med. 2012; 4: 48-55.
31. ARDO. Agricultural and Rural Development Office of Tullo Woreda, Western Hararge, Oromia Region. 2014.
32. Thrusfield M. Survey, in Veterinary Epidemiology, 2nd edn. Blackwell science ltd, Oxford. 2005; 178-198.
33. Ahmad EF, Marvichitr, Jumwason S, Koonawoothtthin S, Achoothessa, Jittapalapong S. Prevalence of fasciola species infections of sheep in the middle Awash River Basin, Ethiopian. Southeast Asian J. trop.Med.Publ. Health. 2007; 38: 51-52.
34. Central Statistical Authority (CSA). Federal Democratic Republic of Ethiopia, Central Statistical Authority, Agricultural sample survey (2008/2009), Report on livestock and livestock characteristics (Privet and Peasant Holdings). Addis Ababa. 2009; 120.
35. Michael Asrat. Infection prevalence of ovine *fasciolosis* in irrigation schemes along the Upper Awash River Basin and effects of strategic anthelmintic treatment in selected upstream areas. MVSc Thesis, Faculty of Veterinary Medicine, Addis Ababa University, School of graduate studies Department of Biology, Ethiopia. 2004; 9-22.
36. Zelalem A, Fletcher I. Small ruminant productivity in the central Ethiopian mixed farming systems. In: IAR, Addis Ababa, Ethiopia: 4 National Livestock Improvement Conference. 1991; 141-147.