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Prevalence of Gastrointestinal Strongyles Parasites of Small Ruminants in and Around Haramaya, Ethiopia

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Abstract: A cross-sectional study was conducted from November 2014 to March2015 in and around Haramaya, Eastern Hararghe zone of Oromia region, Ethiopia, with the aim to determine the prevalence of gastrointestinal strongyles of small ruminants and to identify the possible risk factors together with the major genera of strongyle larva. During the study period a faceal sample was randomly collected from a total of 364 of small ruminants (182 sheep and 182 goats). Standard parasitological methods including floatation (coproscopic) and ovaculture were employed in the study. Out of these, 335 (92%) animals were found positive for one or mixed strongyles infection of which, 94% in sheep and 90.1% in goats were recorded in this study. The predominant strongyles genera recorded during present study were *Haemonchus (*76.1%), *Trichostrongylus* (56.3%), *Oesophagostomum* (33.1%), *Bunostomum* (20.1%) and *Chabertia* (5.2%) descending order of prevalence both in sheep and goats. The rate of mixed infection was 287 (78.8%) and the highest rate was recorded with *Haemonchus* and *Trichostrongylus* 124(43.2%). In our study, there was no association between different potential risk factors tested. Even though significant was not observed in the present study, slightly higher prevalence of strongyles observed in ovine, young, female and semi- intensive than in caprine, adult, male and small holder managmant systems. In conclusion, high prevalence of strongyles was recorded in study area and affecting wellbeing of the animals. Therefore, strategic deworming of animals, when conditions are most favorable for larval development on the pasture, using broad spectrum antihelminthics, indoor feeding and rotational grazing should be applied and also further study should be warranted on the impact of strongyles on small ruminant.

Key words: Haramaya · Ethiopioa · Prevalence · Small ruminant · Strongyles

INTRODUCTION

Ethiopia possesses an estimate of 26.1 million sheep and 21.7 million goats [1] which are well adapted to local climatic and nutritional conditions and contribute greatly to the national economy. In the diverse agro-climatic zones of Ethiopia, small ruminants are important source of income for rural communities and are one of the nation's major sources of foreign currency from exports [2]. Studies have revealed that ruminants contribute 80 % of the total food production from livestock in tropical Africa, of which small ruminants account for about 22 %. However, the economic benefits remain marginal due to poor nutrition, poor animal production systems, reproductive inefficiency, management constraints and general lack of veterinary care [3, 4] coupled with infectious and parasitic disease have led to reduce productivity of small ruminants. All grazing sheep and goats are infected with a community of these strongylid nematodes, whose combined clinical effect is the condition known as parasitic gastroenteritis [5].

Sheep and goats, requiring little inputs, play vital role in rural economy through provision of meat, milk, blood, cash income, accumulating capital, fulfilling cultural obligations, manure and contribute to the national economy through the export of live animals, meat and skins [6].

Gastrointestinal strongylid of small ruminant are transmitted directly. Many factors linked to this relationship determine the type and severity of infection. Host-related factors are age, immunity, sex, species and genetic resistance; parasite-related factors include life

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history, duration of the survival of larvae in the environment and their location in the host; environmental factors include climate, weather, season, type of vegetation. The interactions between host and parasite mainly determine the potential for disease to occur and the pattern of infection, whereas the interaction between host-environment and parasite environment influence disease transmission [7, 8].

Strongyles gastrointestinal parasites of sheep and goat are among the endoparasite infections that are responsible for economic losses in developing countries, through reduce their productive and reproductive potential [9] due to decreasing voluntary feed intake and feed conversion efficiency [7].

The prevalence of gastrointestinal strongylid in tropical and subtropical areas has adversely affected the production potential of sheep and goats, leading to countless deaths and insidious economic losses in livestock sector [10]. The clinical form results in direct losses attributed to acute illness and death, premature slaughter and rejection of some parts of meat inspection. But, indirect losses include the diminution of productive potentials such as decreased growth rate, weight loss in young, reduced work capacity, cost of treatment and control of helminthosis [11]; and late maturity [12]. The subclinical forms are the most common and of great economic importance on the level of infection from mild to heavy parasite levels with a range of symptoms can be seen as from simply alter normal growth and gain rates to variable amount of diarrhea, weight loss, poor hair coats, decreased appetite, hypoproteinemia and anemia [13]. The effect of infestation by gastrointestinal strongyles varies according to the parasite concerned, the degree of infestation and other risk factors such as species, age and intensity of worm burden [14].

Although considerable work has been done on endoparasites of sheep and goats in many parts of Ethiopia [9, 15- 18] and losses from clinical and sub-clinical level including losses due to inferior weight gains, lower milk yields, condemnation of organs and carcasses at slaughter and mortality in massively parasitized due to parasitic diseases were reported [16,19], yet small ruminants under intensive and extensive production systems are extremely susceptible to the effects of wide range of helminthes endoparasites. There is a limitation in scope and coverage of most of the studies conducted in Ethiopia on sound of strongyles in small ruminant [15] particularly in the present study area. Therefore, the objective of this study was to determine the prevalence of GIT strongyles of small ruminant and identify the possible risk factors of the disease in and around Haramaya.

MATERIALS AND METHODS

Study Area Descriptions: The study was conducted from November 2014 to March 2015 in and around Haramaya, Oromia region, Eastern Ethiopia. The area is approximately 14 km from west of Harar and 510 km east from Addis Ababa. The estimated animal population in the area is about 63,723 cattle, 79,950 sheep, 120,350 goats, 30,280 donkeys, 480 camels and 120,235 chickens. The production system of the district is mixed type. Topographically, it is situated at altitude of 1600 to 2100 m above sea level with the mean annual temperature and relative humidity of 18°C and 65%, respectively. Geographically, it is located 041º 59' 58" N latitude and 09º 24' 10"S longitudes. There are four seasons; a short rain season (from March to mid-May), a short dry season (from end of May to end of June), a long wet season (early July to mid-October) and a long dry season (end of October to end of February). The Haramaya area receives an average annual rain fall of approximately 900 mm, with a bimodal distribution pattern, picking in mid-April and mid-August. The vegetation that constitutes the available pasture lands in this area is predominantly native grasses and legumes interspersed with open acacia shrub land [20].

Study Animals: The study animals including small holder and semi-intensively reared sheep and goats, which are produced inside the farms and bought from other farms and/or local market which found around Haramaya University. During study period, both sex and age groups of both sheep and goats of local origin which grazing in pasture fields were included. Those animals with the age of less than one year were considered as young while those greater than or equal to one were considered as adults according to the classification of age groups [17].

Study Design: A cross-sectional study was conducted from November 2014-March 2015 to determine the prevalence of strongyles gastrointestinal parasites in small holder and semi-intensively reared sheep and goat in and around Haramaya and also compare the occurrence of the strongyles gastrointestinal parasites between species, sex and age reared and the management practiced within them.

Sampling Strategy and Sample Size Determination: By using simple random sampling methods and 95% confidence interval with required 5% precision, the sample size will be determined by the formula of Thrusfield [21].

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

n= required sample size
Pexp=expected prevalence
d= required precision

The expected prevalence of gastrointestinal strongyles parasites in eastern Ethiopia was 97.3% (Abebe and Esayas, 2001). Based on the above formula the total sample size is 41 but to increase the precision, 364 small ruminants were examined out of which 182 were Ovine and 182 were Caprine.

Study Methodology

Sample Collection: For each animal, approximately (10 - 15 g) faecal sample was collected per rectum where possible for freshly voided faeces. The faecal sample was put in a sterile bag coded with the locality, species, age and sex of the animal was identified and transported to Haramaya University Veterinary Parasitology laboratory to be processed. Samples were kept in refrigerator at 4°C to be examined for coproscopy.

Coproscopic Examination: For corposcopic examination of the fecal samples, a simple test tube flotation technique described by Hansen and Perry [12] was employed and the slides prepared were examined under microscope (x10) and positive samples for strongyles egg was followed by coproculture and Baermann technique [22]. Eggs of the different helminthes were identified on the basis of morphological appearance and size of eggs [23].

Ovacultuer and Larval Identification: For the identification of certain genera of strongyles, ovaculture was performed to obtain larval stages as described by Van Wyk and Mayhew [24]. Faecal samples containing parasitic eggs that could not exactly be identified were finely crushed with a pestle and mortar and were placed in a Petri-dish which was closed and incubated at 26 -28°C for 7 days. After incubation, samples were wrapped by double gauze and hanged over the beaker which filled by the warm water for 24 hours and examined for the presence of larvae and the third stage larvae (L3) were recovered by Bermann technique. L3 parasites were counted and identification of the hatched L3 was performed on the basis of key morphological differences described by Van Wyk *et al*. [22].

Data Analysis: The data which was collected from the study area, result obtained from fecal culture, was recorded in the format developed for this purpose and later on entered in to micro soft excel and associations different variables were compared using chi-square test and the level of significance was set at $p<0.05$.

RESULTS

During the study period, the overall prevalence of the gastrointestinal strongyles was 335 out of 364 (92%) in small ruminants. Fecal samples were cultured to determine the genera prevalence of strongyles as shown in Table 1 and the dominant genus from cultured larvae was *Haemonchus* species (50.0%) whereas the least genus identified was *Chabertia* (5.2%)

From 364 of small ruminants, 182 ovine and 182 caprine were sampled and 171 ovine and 164 caprine were positive to gastrointestinal strongyles, with 94% and 90.1% of prevalence in ovine and caprine, respectively, with x^2=1.84 and p-value>0.05. From age groups, 94.8% and 90% prevalence of strongyles was encountered both in young and adult, respectively. The $x^{2=}$2.8 and the (p >0.05). The prevalence of the strongyles in female was 93.9% and in male was 91%, with the x^2=0.97 and (p>0.05). From the 119 semi intensive and 245 small holder of sheep and goat, 93.3% and 91.1% of strongyles were encountered both in semi intensive and small holder, respectively, with the x^2=0.37 and P=0.54 (Table 2).

As mentioned in Table 3, from 364 fecal samples the overall prevalence of strongyles was 92.0% and the percentage proportion of *Haemonchus was* 82.7% followed by *Trichostrongylus* species 61.2%, whereas the least percent was identified as *chabertia* 5.6% in both and sheep and goat.

There were mixed infections among the genera of strongyles which encountered about 287(78.8%). *Haemonchus* with *Trichostrongylus* species accounted the highest percentage (43.2%) and the least mixed infection occurred with *Oesophaostomum* and *Chabertia* which accounted 0.3% (Table 4).

Table 1: Prevalence of strongyles larvae in small ruminants

larvae	No of positive	caprine	ovine	Overall Prevalence (%)
Haemonchus spp.	277	133(73.1%)	144(79.1%)	76.1
Trichostrongylus spp.	205	91(50.0%)	114(62.6%)	56.3
Oesophagostomum spp.	123	55(30.2%)	68(37.4%)	33.8
Bunostomum spp.	73	32(17.6%)	41(22.5%)	20.1
Chapertia spp.	19	8(4.4%)	11(6.0%)	5.2
Total	335	164(90.1%)	171(94%)	92.0

95% CI: 88.8-94.6

Table 2: Prevalence of strongyles of small ruminants based on different assumed risk factors

Risk factor	attribute	Total animal examined	No positive	Prevalence (%)	x^2	p- value
Species	Ovine	182	171	94.0	1.84	0.175
	Caprine	182	164	90.1		
Age	Young	154	146	94.8	2.8	0.094
	Adult	210	189	90.0		
Sex	Male	233	212	91.0		
	Female	131	123	93.9	0.97	0.33
Management	Semi-intensive	119	111	93.3	0 37	0.54
	Small holder	245	224	91.4		
Total		364	335	92.0		

Table 3: Percentage of each Genus of strongyles in proportion

	Strongyles larvae					
Species	*Haemonchus*	*Trichostrongylus*	*Oesophagostomum*	*Bunostomum*	*Chapertia*	Total positive
Ovine	144(42.9%)	114(34.03%)	68(20.3%)	41(12.24%)	11(3.28%)	177
Caprine	133(39.7%)	91(27.2)	55(16.42%)	32(9.5%)	8(2.4%)	164
Total	277(82.7%)	205(61.2%)	123(36.72%)	73(21.8%)	19(5.6%)	335

Table 4: Mixed infection among genera of strongyles

Strongyles larvae	*Haemonchus* spps (%)	*Trichostrongylus* spps (%)	*Oesophsgostomum* spp (%)	*Bunostomum* spps (%)	*Chabertia* Spp (%)
Haemonchus spps	0	124 (43.2)	71 (24.72)	(16.2)	5 (1.7)
Trichostrongylus spps	0	0	54 (18.9)	21(7.14)	7 (2.0)
Oesophsgostomum spps	0	0	0	9 (3.0)	1 (0.3)
Bunostomum spps	0	0	0	0	2 (0.7)
Chabertia spp	0	0	0	0	0

DISCUSSION

Gastrointestinal strongyles of small ruminants are important among the endoparasites infections that are responsible for economic losses through increased mortality as well as indirect loss through reduced productivity related to reduction of food intake, stunted growth, reduced work capacity, cost of treatment and control of helminthosis. The coprological and ovaculture examination were performed to determine the existence of strongyles which encountered an overall prevalence of 92% in small ruminants examined.

The higher prevalence rate observed in our findings could be due to difference in management system of the animals [16]. Besides, communal grazing, where large numbers of the animals were kept together mixed could contribute for the higher prevalence of the parasites. This was further explained that, increase the degree of pasture contamination leading to higher prevalence rate [16]. The study showed that 94% and 90.1% prevalence of strongyles both in sheep and goats, respectively, were infected with one or more genera of strongyles. This result was comparable with the result of Niguse *et al* [25], 86.3% in Jijiga, Ethiopia, [15] 95.6% in Eastern part of Ethiopia and [26] 80.0% South western Kenya, respectively. On the other hand, the result was higher than the results of Regassa *et al*. [16] and Terefe *et al.* [27] and Lemma and Abera [28] and Shimelis *et al*. [18] and Zeryehun [9] who reported a prevalence of 50.2% in Western Oromia, 72% in Bedelle, 41.49% in Dembia, 46.07% in Gondar Ethiopia and 67.45% in Eastern Ethiopia, respectively.

The difference in the GIT strongyles in the present study compared with the previous studies in the country could be due to the existence of different climatic or environmental factors that could support survival and development of infective larval stage of most helminths [29, 30].Very favorable climate and environment like humidity and temperature which generally supported parasitic growth and development [16, 18]. There were direct relationship between moisture and prevalence of parasitosis [16] while desiccation suppressed the development and growth of parasite [18]. Furthermore, most of the helminthes species were susceptible to desiccation in dry climatic conditions that resulted from the high temperature at which even eggs failed to develop into larvae Lima *et al*. [31] thereby decreases/increase the infection rate.

In this study, almost similar prevalence of gastrointestinal strongyles was observed both in sheep and goats, which was in agreement with other works in Ethiopia [32] and elsewhere in the world [33, 34]. This was due to both species of animals were sharing the same environments and nearly equally susceptible to the nematodes. Even though statistically significant was not observed in the present study. The higher prevalence of gastrointestinal strongyles observed in sheep other than goats agreed with the report of Kumsa and Wossene, [35]. This could be due to the grazing habit of the sheep, where they grazed closer to the ground fostering opportunity of exposure to parasites.

However, contrary reports from Western part of Ethiopia showed that prevalence of gastrointestinal strongyles was 56.6% in ovine and 60% in caprine (Regassa *et al*.[16] and Eastern parts of Ethiopia 97.03% in ovine and 100 % in caprine [15] and in which high prevalence of strongyles observed in goat than sheep elsewhere [36]. It was assumed that sheep had a considerably higher imuunological response to gastrointestinal parasites compared with that of goats [37].

Regarding age groups, 94.8% and 90% prevalence of strongyles were encountered in young and adult animals, respectively. According to this study, no statistically significant difference was observed in age groups of the sheep and goats in all identified gastrointestinal strongyles. This finding was in agreement with other study carried out in Northern Gondar, Ethiopia, in which significant was not observed in age, where 35.68% and 35.66% in young and adult [18] and similar other study was done elsewhere[38]. This was due to gastrointestinal nematode parasites affected both age equally and equal opportunity of both age groups to exposure and also they were from the same ecological area. Even though significant importance was not observed, high prevalence of gastrointestinal strongyles occurred in young than in adult [8, 39]. The study further revealed that sex of the animal did not show significant association with the prevalence of the parasites. The absence of association between sexes was consistent with previous reports by Keyyu *et al* [40] and Regassa *et al*. [16] and Ghanem *et al*. [41] and Zeryehun, [9]. However, Shimelis *et al.* [18] reported a higher prevalence of helminth infection in females. In contrast, Gualy *et al.* [42] and Raza *et al.* [36] had documented higher prevalence of helminth infection in rams.

From the 119 semi-intensive and 245 small holder of sheep and goat 93.3% and 91.1% of strongyles were encountered both in semi intensive and small holder, respectively. However, statistically significant was not observed, high prevalence occured in semi-intensive farm due to the animals were overstocking and contributing to pasture degradation and soil erosion, this forced the animals to graze closer to faecal material, which resulted in uptake of higher numbers of infective larvae. Thus, high stocking density increased the level of contamination of the pasture with the free-living larval stages of the gastrointestinal strongyles [12].

The coprological investigation in the present study revealed that out of 364 small ruminants, 335 (92%), of which 171 (94%) sheep and 164 (90.1%) goats were positive for GIT strongyles which could be classified as five genera of GIT strongyles in which *Haemonchus* was established as the predominant strongyles, accounting for 73.1% and 79.1% of the total worm burden both in caprine and ovine respectively during the study period. Next were 50.0% and 62.6% *Trichostrongylus*, 30.2% and 37.4% *Oesophagostomum,* 17.6% and 22.5% *Bunostomum and* 4.4% and 5.6.% *Chabertia ovina* both caprine and ovine respectively in decreasing order. The GIT strongyles found in this study had also been reported previously in other part of the country Sissay *et al.* [43] and Zeryehun [9] and Hailelul [44] and Regassa *et al.* [16] and Shimelis *et al.* [18] and Kumsa [17].

Higher prevalence of *Haemonchus* larvae in faecal cultures during this study were in accordance with studies in other countries [45]. This can be due to the high biotic potential of *Haemonchus* resulting in rapidly taken up dominance at times when environmental conditions on pasture were favorable for the development and survival of the free living stages [36]. In addition, communal grazing contributed to the observed increased

availability of infective larvae of gastrointestinal strongyles on pasture [12]. The next dominant parasite during study period was *Trichostrongylus* species with prevalence of 62.6% and 50.0% of the total worm burden both in ovine and caprine, respectively and the least one was *Chabertia* spp 5.6% and 4.4% total worm burden both in ovine and caprine, respectively, this result agreed with [43].

The current study had shown the presence of mixed infection characterized by the presence of two or more strongyles genera both in sheep and goats and this was in agreement with the findings of other researchers in the country [4, 9, 15, 16, 17 and 47]. Those mixed infections had been suggested to be an important cause of morbidity and loss of production in sheep and goats [17]. Moreover, the presence of interaction and compromization of the immune system of the host by mixed infection has been described to increase their susceptibility to other diseases or parasites [48]. This was due to communal grazing increased the degree of pasture contamination leading to mixed infection [16].

CONCLUSION AND RECOMMENDATIONS

The present study showed that GIT strongyles of small ruminants prevalent in the study area affecting wellbeing of the animals. Five genera of GIT strongyles were recorded, *Haemonchus* spp., *Trichostrongylus* spp.,*Oesophsgostomum* spp., *Bunostomum* spp. and Chabertia spp., during study period, among those species *Haemonchus* spp. was the predominant while *Chabertia* spp. was lower in both sheep and goats. The majority of sheep and goats were infected by two and more parasite types. Among the assumed risk factors tested, none of them showed significant association with the occurrence of the strongyles parasites. Therefore, strategic deworming of animals, when conditions are most favorable for larval development on the pasture, using broad spectrum anti-helminthes with proper pasture and animal management, avoid communal grazing with other animals to avoid cross parasite contamination and further study should be warranted with species based identification and the impact of strongyles parasites on small ruminants should also be studied.

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REFERENCES

1. CSA., 2009. (Central Statistical Authority) Federal Democratic Republic of Ethiopia Agricultural Sample Enumeration Abstract.
2. Alemayehu, Z. and I. Fletcher, 1995. Small ruminant productivity in the central Ethiopian mixed farming system. Institute of Agricultural Proceeding, 4: 1941-1947.
3. Ademosun, A.A., 1992. Constraints and prospects for small ruminant's research and development in Africa. Small Rum.Dev. Afr., pp: 1-5.
4. Banks, D.J.D., R. Singh, I.A. Barger, B. Pratap and L.F. Le Jambre, 1990. Development and survival of infective larvae of Haemonchus contortus and Trichostrongylus colubriformis in a tropical environment. International Journal of Parasitology, 20: 155-160.
5. Zajac, A.M., 2006. Gastro-intestinal nematodes of small ruminants. Life cycle, anthelmintics,and diagnosis. Veterinary Clinics, Food Animal Practice., 22: 529-541.
6. Bayou, A., 1992. Prevalence of Gastrointestinal Helminths of Small Ruminants in Illubabor. DVM Thesis, FVM, AAU.
7. Kanyari, P.W., B. Kagira and R. Mhoma, 2009. Prevalence and intensity of endoparasites in small ruminants kept by farmers in Kisumu Municipality, Kenya. Livestock Res. Rural Develop, 21: 12-15.
8. Qamar, M.F., A. Maqbool, M.S. Khan, S. Ahmad and M. Akram, 2009. Epidemiology of Haemonchosisin sheep and Goats under different manage mental conditions Muneer Veterinary World, 2(11).
9. Zeryehun, T., 2012. Helminthosis of sheep and goats in and around Haramaya, southeastern Ethiopia. J. Vet. Med. Anim. Health, 4: 48-55.
10. Al-Quaisy, H.K., A.J. A-Zubiady K.L. Altaif and T.A. Makkawi, 1987. The pathogenicity of haemonchosis in sheep and goats in Iraq, I. Clinical parasitology and hematological findings. Vet. Parasitol, 24: 221-228.
11. Pedreira, J., A.P. Silva, R.S. Andrade, J.L. Suarez, M. Arias, C. Lomba, P. Diaz, C. Lopez, P.D. Banos and P. Morrondo, 2006. Prevalence of gastrointestinal parasites in sheep and parasite control practices in North-West Spain. Prev. Vet. Med., 75: 56-62.

12. Hansen, J. and B. Perry, 1994. The Epidemiology, Diagnosis and Control of Helminth Parasites of Ruminants. 2nd edition. Nairobi, Kenya; ILRAD.
13. Agnessens, J.E., P. Claerebout, F. Dorny, H. Borgsteede and J. Vercruyee, 2000. Nematode parasitism in adult dairy cows in Belgium. Vet. Parasitol., 90: 83-92.
14. ILCA., 1990. (International Livestock Center for Africa) Annual report. Addis Ababa, Ethiopia.
15. Abebe, W. and G. Esayas, 2001. Survey of ovine and caprine gastro-intestinal helminthosis in Eastern part of Ethiopia during the dry season of the year; Revue Méd. Vét, 152: 379-384.
16. Regassa, F., T. Sori, R. Dhuguma and Y. Kiros, 2006. Epidemiology of Gastrointestinal Parasites of Ruminants in Western Oromia, Ethiopia. Int. J. Appl. Res. Vet. Med., 14(1): 51-57.
17. Kumsa, B., A. Tolera and A. Nurfeta, 2010. Comparative efficacy of seven brands of albendazole against naturally acquired gastrointestinal nematodesin sheep in Hawassa, Southern Ethiopia, Turk. J. Vet. Anim. Sci., 34: 417-425.
18. Shimelis, D., A. Asmare and T. Wudu, 2011. Epidemiology of gastrointestinal helminthiasis of small ruminants in selected sites of north Gondar zone, northwest Ethiopia. Ethiop. Vet. J., 15(2): 57-68.
19. Tilahun, G., 1995. Epidemiology of helminth parasites of small ruminants in midlowland Ethiopia. In: Gray GD, Uilenberg G, Jacobsen LL (Eds.), Parasitology Research in Africa. Proceedings of an IFS (International Foundation for Science) workshop, Bobo- Dioulasso, Burkina Faso, pp. 255-269.
20. HADB., 2014. Haramaya Woreda Agricultural Development Bureau.
21. Thrusfield, M., 2007. Veterinary Epidemiology. Blackwell Science Limited, USA, pp: 180-181, 224-225.
22. Van Wyk, J.A., J. Cabaret and L.M. Michael, 2004. Morphological identification of nematode larvae of small ruminants and cattle simplified. Vet. Parasitol. 119: 277-306.
23. Foriet, W., 1999. In: Reference Manual of Veterinary Parasitology. 5th (ed). Wiley Blackwell, New York, USA, pp: 22-26.
24. Van Wyk, J.A.E. and Mayhew, 2013. Morphological identification of parasitic nematode infective larvae of small ruminants and cattle. A practical lab guide', Onderstepoort Journal of Veterinary Research, 80(1): 539.
25. Niguse, A., D. Shimelis and T. Feyera, 2014. Epidemiology and Chemotherapy of Gastrointestinal Parasites of Sheep in and Around Jigjiga, Eastern Ethiopia.European Journal of Biological Sciences. 6(2): 46-53.
26. Maichomo, M.W., J.M. Kigira and J. Walker, 2004. Point prevalence of gastrointestinal parasites in calves, sheep and Gaots in Magadi division, Southwestern Kenya. Onderstepool J. Vet. Res., 71(4): 257-261.
27. Terefe, G., U. Faji and Y.H. Tolossa, 2013. Field investigation of anthelmintic efficacy and risk factors for anthelmintic drug resistance in sheep at Bedelle District of Oromia Region, Ethiopia. Ethiop. Vet. J. 17(2): 37-49.
28. Lemma, D. and B. Abera, 2013. Prevalence of ovine gastrointestinal nematodes in and around Asella, South Eastern Ethiopia.Journal of Veterinary Medicine and Animal Health, 5(8): 222-228.
29. Rossanigo, C.E. and L. Grunder, 1995. Moisture and temperature requirements in feces for the development of free living stages of gastrointestinal nematodes of sheep and cattle and deer. J. Helminthol., 67: 357-362.
30. Andrews, S.J., 1999. The life cycle of Fasciola hepatica. In: Dalton JP (ed) Fasciolosis. CAB, Wallingford, pp: 1-29.
31. Lima, W.S., 1998. Seasonal infection pattern of gastrointestinal nematodes of beef cattle in Minas Gerais State-Brazil. *Vet. Parasitol.* 74:203–214.
32. Teklye, B., 1991. Epidemiology of end parasites of small ruminants in sub-Saharan Africa. Proceedings of Fourth National Livestock Improvement Conference. Addis Ababa, Ethiopia; 13: 157-11.
33. Waruiru, R.M., M.N. Mutune and R.O. Otieno, 2005. Gastrointestinal parasite infections of sheep and goats in a semi-arid area of Machakos District, Kenya. Bull Anim Health Prod Afr. 53(1): 25-34.
34. Asif, M., S. Azeem and S. Nazir, 2008. Prevalence of Gastrointestinal Parasites of Sheep and Goats in and around Rawalpindi and Islamabad, Pakistan. J. Vet. Anim. Sci., 1: 14-17.
35. Kumsa, B. and A. Wossene, 2006. Abomasal nematodes of small ruminants of Ogaden region, eastern Ethiopia, prevalence, worm burden and species composition. Revue Med. Vet, 157(12): 27-32.
36. Raza, M.A., Z. Iqbal, A. Jabbar and M. Yaseen, 2007. Point prevalence of gastrointestinal helminthiasis in ruminants in southern Punjab. Pakistan J Helminthol., 81: 323-328.

37. Urquhart, G.M., J. Armour, J.L. Duncan, A.M. Dunn and F.W. Jennings, 1996.Veterinary Parasitology. 2nd edition. Blackwell Science, pp: 345-45.
38. Kakar, M., M. Lateef, A. Maqbool, A.J. Makhdoom, A. Farhat, J. Saadullah, R. Abdul, K. Essa and S. Haider, 2013. Prevalence and Intensity of Ovine Gastrointestinal Nematodes in Balochistan, Pakistan. Pakistan J. Zool., 45(6): 1669-1677.
39. Assefa, D. and L. Sissay, 1998. Preliminary investigation on seasonal occurrence of parasites around sheno. In: fifth national conference of society of animal production. ESAP. Addis Ababa, Ethiopia, pp: 128-137.
40. Keyyu, J.D., A.A. Kassuku N.C. Kyvsgaard, A.L. and Willingham, 2003. Gastrointestinal nematodes in indigenous zebu cattle under pastoral and nomadic management systems in the lower plain of Southern highlands of Tanzania. Vet. Res. Commun., 3(5): 371-380.
41. Ghanem, Y.M., M.H. Naser, A.H. Abdelkader and A. Heybe, 2009. An epidemio coprological study of protozoan and nematode parasites of ruminants in tropical semi-arid district of SomalilanD (Northern Of Somalia). Vet. Med. J. 3rd Sci. Congress, 10-12: 768-787.
42. Gauly, M., M. Schackert, B. Hoffmann and G. Erhardt, 2006. Influence of sex on the resistance of sheep lambs to an experimental Haemonchus contortus infection. Dtsch. Tierarztl. Wochenschr, 113: 178-181.
43. Sisay, M.M., A. Uggla and P.J. Waller, 2007. Prevalence and seasonal incidence of nematode parasites and fluke infections of sheep and goats in eastern Ethiopia. Trop. Anim. Health Prod., 39: 521-531.
44. Hailelul, N., 2002. Study on prevalence of GIT helminthes of small ruminants in and around Wolayta Soddo, southern Ethiopia. DVM Thesis, Faculty of veterinary medicine, Addis Ababa university, Debre-Zeit. Ethiopia, pp: 353.
45. Maingi, N., E.J. Gichanga and V.M. Gichohi, 1993. Prevalence of gastrointestinal helminths and coccidian parasites and frequency distribution of some nematode genera of goats on some farms in four districts of Kenya. Bulletin of Animal Health and Production in Africa, 41: 285-290.
46. Nginyi, J.M., J.L. Duncan, D.J. Mellor, M.J. Stear, S.W. Wanyangu, R.K. Bain and P.M. Gatongi, 2001. Epidemiology of parasitic gastro-intestinal nematode infections of ruminants on smallholder farms in central Kenya. Research in Veterinary Science, 70: 33-39.
47. Genene, R., 1994. A study of prevalence of ovine GIT helminthes in and around kombolcha. DVM Thesis, faculty of veterinary medicine, Addis Ababa University, Debre Zeit. Ethiopia, pp: 24-25.
48. Wang, C.R., J.H. Qui, X.Q. Zhu X.H. Han, H.B. Ni, J.P. Zhao, Q.M. Zhou, H.W. Zhang and Z.R. Lun, 2006. Survey of helminths in adult sheep in Heilogjiang Province, People Republic of China. Vet. Parasitol., 140: 378-382.