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Prevalence and Burden of Nematode Parasites of Small Ruminants in and Around Haramaya University

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Abstract: A cross-sectional study was conducted from November 2013 to April 2014 in Haramaya University farms and around Haramaya University, Eastern Hararghe, Oromiya region to determine the prevalence of nematode parasites of small ruminants and to identify the possible risk factors associated with the major genera of nematode larvae. During the study period faceal samples were randomly collected from a total of 383 of small ruminants (216 ovine and 167 caprine). Standard parasitological methods including floatation and ova culture were employed in the study. Out of these, 340 (88.8%) animals were found positive for nematode parasites of which, 89.2% in ovine and 88.4% in caprine were recorded. The dominant nematode genera recorded during the present study were *Haemonchus (*55%), *Trichostrongylus* (45%), *Oesophagostomum* (37.5%), *Bunostomum* and *Trichur*is (10%) and *Dictyocaulus* (7.5%) in descending order of prevalence in both species. In this study, maximum EPG counts were recorded in ovine species and females were severely infected than their counter part. In the present study, there was no association between different potential risk factors tested. However, slightly higher prevalence of nematode was observed at <2 years of age, male, poor body condition, wet season and pregnant (1sttrimester and 2ndtrimester) than, >3yeras, female, good, dry season and non pregnant animals. In conclusion, high prevalence of nematode parasites was observed in the study area and affecting wellbeing of the animals. Therefore, strategic de-worming of animals using broad spectrum anthelmintics could help in the control of the disease.

Key words: Nematode Parasite · Prevalence · Small Ruminates

INTRODUCTION

The livestock sector plays a vital role in the national economy of developing countries. Ethiopia lies within the tropical latitudes of Africa and has an extremely diverse topography, a wide range of climatic features and a multitude of agro-ecological zones, which makes the country suitable for different agricultural production systems. This in turn has contributed to the existence of a large diversity of farm-animal genetic resources in the country [1].

In Ethiopia the ruminant livestock populations were estimated at 91.2 millions and in spite of the large populations, production is very low. Small ruminants are important source of the country as they provide more than 30% of local meat consumption and generate cash income from the export of meat, live animals and skins [2-4]. These small ruminants were estimated at 24 millions sheep and 18 millions goats constitute a major part of livestock resource [2]. From this annual national mutton and goat meat production is 77 and 62 thousand metric ton, respectively. These animals contribute 13.9% and 11.2 of the total meat production [5].The share of small ruminants of the total milk output is estimated to 16.4% and Ethiopia exports 155,000 heads of livestock sheep and goats annually [5].

Studies have revealed that ruminants contribute 80 % of the total food production from livestock in tropical Africa, of which small ruminants account for about 30 %. However, the economic benefits remain marginal due to poor nutrition, poor animal production systems, reproductive inefficiency, management constraints and general lack of veterinary care [6, 7] coupled with infectious and parasitic disease that led to reduce productivity of small ruminants. All grazing sheep and goats are infected with a community of nematodes, whose combined clinical effect is the condition known as parasitic gastroenteritis [8]. It is well recognized that in

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resource-poor regions of the world, helminthes infections of sheep and goats have a major impact on morbidity and mortality rates, with annual losses as high as 30-50% of the total value of livestock products of Ethiopia [9,10].

Nematodes of small ruminants 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 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 [11].

In Ethiopia, parasitological investigation of small ruminants in the humid central high land regions of our country have demonstrated most species of nematodes associated with parasitic gastro-enteritis in small ruminants which are of the genera, *Haemonchus, Trichostrongylus, Oesophagostomum, Nematoddirus, Cooperia, Trichuris* and *Strongyloides* [12].

Although considerable work has been done on endoparasites of sheep and goats in many parts of Ethiopia [12-16] and losses from clinical and sub-clinical level including, inferior weight gains, lower milk yields, condemnation of organs and carcasses at slaughter and mortality in massively parasitized due to parasitic diseases were reported yet [14].

There is a limitation in scope and coverage of the studies conducted in Ethiopia on nematode parasites as well as on it is important to assess the type and level of parasitism, in order to determine the significance of parasite infections and to recommend the most beneficial and economically acceptable control measures. Therefore, the first step in the investigation of helminthes infections of ruminants is to establish what parasite species are present in an area, or region in small ruminants [1, 13] Therefore, the objectives of this study were: to determine the prevalence and burden of nematode parasites of small ruminants and identify the possible risk factors in and around Haramaya University.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2013 to March 2014 in the Haramaya university sheep and goat farm and around Haramaya town of Eastern Hararghe, Oromia Region. 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 041° 59' 58" N latitude and 09° 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 [17, 18].

Study Population: The Study conducted in HU farms and around Haramaya town on breeds of sheep and goat. In this study 383 (216 sheep and 167 goats) were randomly selected for coprological examination. The study animals included small holder, where farmers maintain one to three sheep and goats 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, these animals were normally grazing on the field with different animal population (herds). During the night there was separation of the animals in HU farms however no separation of ewes and lambs, dry and pregnant ewes outside area.

Study Design: Across-sectional study was conducted from November 2013 to April 2014 on both local and exotic breeds of sheep and goats that were found in the areas involving 383 small ruminates (216 ovine, 167caprine) of which 238 female and 145 male were included. The considered explanatory variables were origin, age, sex, species, body condition, season and physiological status of the study animals to estimate the prevalence of nematode parasites and its burden by collecting fecal samples from individualanimals. Animals in each area were categorized in to three age groups (<2 years, between 2-3 years and 3 years) and also grouped in to three body conditions score (poor, medium and good) as described before [19].

Sampling Method and Sample Size Determination: The sample size was determined according to Thrusfield [20] for simple random sampling.

$$N = \frac{1.96^2 \, p_{exp}(1-p_{exp})}{d^2}$$

Where N = required sample size
P_{exp}= expected prevalence
d = desired absolute precision,

The size of the sample is determined using 95% level of confidence, 60% expected prevalence of previous study in the area and 0.05 desired absolute precision. Therefore, 369 needed for the study. However, to increase the precision, the sample is increased by 383 (216 for sheep and 167 goat) was considered for the study.

Study Methodology

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

Coproscopic Examination and EPG Determination: For coproscopic examination of the fecal samples, a simple test tube flotation technique described by Hansen and Perry [19, 21] was employed and the slides were examined under microscope (x10and x40). The positive samples for nematode eggs were processed for coproculture and Baermann technique [22]. Eggs of the different nematode parasites were identified on the basis of morphological appearance and size of eggs as described by Van Wyk and Mayhew [23].

McMaster egg counting method was used to determine the number of eggs per gram (EPG) of feces in the positive fecal samples and the degree of severity was categorized based on previously described methods [21, 24, 25]. In general, the category of intensity of infection was made based on feacal EPG counts as light (50-800epg), moderate (800-1200epg) and heavily (>1200epg) of faeces as described by Soulsby [24].

Ova Culture and Larval Identification: For identification of certain genera of nematodes, ova culture was performed to obtain larval stages as described by Van Wyk and Mayhew [23]. 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 Baermann technique. L3 parasites were counted and identification of the hatched L3 was performed on the basis of key morphological differences described before [22, 26].

Data Management and Analysis: The data obtained were recorded in Microsoft excel spread sheet and analyzed by SPSS version 20. The presence of associations between risk factors and parasitism were compared using Chi-square ($\chi 2$) test and the level of significance was set at $p<0.05$.

RESULTS

Out of the total 383 small ruminate examined, 340 (88.8%) were positive for different nematode eggs in both species. In the present study, a total of 383 fecal samples from small ruminants (216ovine and167caprine) were examined with species prevalence of 210 (89.2%) and 130 (88.4%) in ovine and caprine, respectively, were found infected at least by one parasite species and these give an overall prevalence of 88.8% in both species. Taking origin, species, age, sex, body condition score, season and physiological status as predisposing risk factors, it was observed that there was no significant difference ($p>0.05$) in the occurrence of nematode parasites in all studied risk factors (Table 1).

The results of the ova cultural examination revealed six nematode parasites, namely *Haemonchus sp., Trichostrongylus sp., Oesophagostomun sp., Bunostomum,Trichuris* and *Dictyocaulus sp.,* in a decreasing order in both host species. Among which, *Haemonchus sp.*, was the most dominant genus in both species (55.0%) and *Dictyocaulus sp.,* was the least one among the identified nematode parasites (Table 2).

Fecal samples positive for nematode parasite were subjected to McMaster egg counting chamber for EPG count to determine the degree of severity of parasitic

Table 1: Prevalence of nematode parasite in small ruminants based on different risk factors

Category	Variable	No of examined	No of positive	(%)	x^2	p-value
Origin	HU farm Around HU	189	169	89.4%	0.156	0.693
		194	171	88.1%		
Age	<2 years	68	66	97.1%	5.707	0.58
	2-3 yaers	308	268	87%		
	>3 years	7	6	85.7%		
BCS	Poor	78	72	92.3 %	3.810	0.149
	Medium	118	108	91.5%		
	Good	187	160	85.6 %		
Season	Wet season	236	210	89 %	0.27	0.869
	Dry season	147	130	88.4%		
Sex	Male	145	131	90.3%	0.579	0.447
	Female	238	209	87.8%		
Species	Ovine	216	191	89.2 %	0.060	0.807
	Caprine	167	149	88.4%		
Physiological status	1st trimaster	5	5	100%	4.023	0.712
	2nd trimaster	15	15	100%		
	3rd trimaster	12	11	91.7%		
	Non pregnant	206	178	86.4%		

HU: Haramaya University; BCS: body condition score.

Table 2: Genera of nematodes recovered in coproculture in small ruminates

Genera of Nematode	No. sample	proportions
Haemonchus	22	55%
Trichostrongylus	18	45%
Oesophagostomum	15	37.5%
Bonostomum	4	10%
Trichuris	4	10%
Dictyocaulus	3	7.5%

Table 3: Degree of infection of nematodes with species

	Degree of infestation					
Risk factors	Categories	Light (%)	Moderate (%)	Heavy (%)	$\chi 2$	P- Value
Species	Ovine	61(40.94)	21(14.09)	67(44.96)	0.16	0.91
	Caprine	74 (38.74)	28 (14.65)	89 (46.59)		
Sex	Male	66 (50.38)	18 (13.74)	47 (35.87)	10.83	0.00*
	Female	69 (33.01)	31 (14.83)	109 (52.15)		
Body condition score	poor	23 (31.94)	6 (8.33)	43(59.72)	7.62	0.10**
	Medium	45 (41.66)	16 (14.81)	66 (43.51)		
	Good	67 (41.87)	27 (16.87)	66 (41.25)		
Season	Wet	78 (37.14)	32 (15.23)	100 (47.61)	1.53	0.46
	Dry	57 (43.84)	17 (13.07)	56 (43.07)		

*Statistically significant; ** Fisher's exact test

infection and compare the degree of severity with the various risk factors. In the present study, species, body condition score and season did not show significance association ($p>0.05$) however, sex showed significance association ($P<0.05$) with EPG counts (Table 3).

DISCUSSION

The results of the study clearly indicated a high prevalence rate of nematode parasites in small ruminants. The coprological examination showed that existence of nematode parasites with an overall prevalence rate of

88.8% in the examined small ruminants. The current finding, were comparable with the previous studies reported by Dereje [27] of 91% in wollayta Soddo, Dugasa [31] of 85.6% prevalence in Haramaya town and HU, Tekyle [28] of 80.75% prevalence in arid and semi-arid zones and Genene (2) of 92% in kombolcha, North Ethiopia.

On the other hand, the results were higher than that of Regassa *et al*. [14]; Terefe *et al.* [32]; Lemma and Abera [33] Shimelis *et al.* [16] and Tesfaheywet [12] who reported a prevalence of 50.2% in Western Oromia, 72% in Bedelle, 41.49% in Dembia, 46.07% in Gondar and 61.4% in Eastern Ethiopia, respectively. However, the current study was lower than the report of Amenu [34] with a prevalence of 96.5%, in central high land.

The difference in the nematode parasites in the present study compared with the previous studies in different country could be due to existence of different climatic or environmental factors that could support survival and development of infective larval stage of most nematodes [35, 36].

Similar prevalence of nematodes was observed, both in sheep and goats, with other works in Ethiopia [28]and elsewhere in the world [38, 39].This might be due to both species of animals were sharing the same environments and nearly equally susceptible to the nematodes. Even though statistically significant difference was not observed in the present study, higher prevalence and EPG count of nematode parasites were observed in ovine than caprine. These results agreed with the report of Kumsa and Wossene, [29] and could be due to the grazing habit of the sheep which graze closer to the ground fostering opportunity of exposure to parasites.

However, contrary reports from Western part of Ethiopia prevalence of nematode parasite was 56.6% in ovine and 60% in caprine Regassa *et al*. [14] and Eastern parts of Ethiopia 97.03% in ovine and 100 % in caprine [13] and in which high prevalence of nematode was observed in goat than sheep elsewhere [30]. It is assumed that sheep acquired a considerably higher imuunological response to nematode parasites compared with that of goats [21].

Prevalence of nematode with regard to species in the present study was 89.2% in ovine and 88.4% in caprine, this finding was comparable with previous observation reported by Dugasa [31] who reported 85.25% in ovine and 85.05% in caprine around Haramaya town.

Regarding, age groups 97.1%, 87% and 85.7% prevalence of nematodes was encountered in <2 years, 2-3 years and >3 years, respectively. According to this study, no statistically significant difference was observed in age groups of the sheep and goats in all identified gastrointestinal nematodes. 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 [16] and Similar other study done elsewhere [40]. This was due to gastrointestinal nematode parasites affected both ages equally and equal opportunity of both age groups to exposure and also they were from the same ecological area. Even though significant difference was not observed, high prevalence of gastrointestinal nematodes occurred in <2years and 2-3 years than in >3 years [11]. 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.* [41] Regassa *et al.* [14] Ghanem *et al*. [42] Tesfaheywet [12]. However, Shimelis *et al*. [16] reported a higher prevalence of helminth infection in females. In contrast, Gauly *et al.* [43] and Raza *et al.* [30] had documented higher prevalence of helminth infection in males.

Prevalence of nematode based on the origin of animals were 89% in HU farm and 88.1% around HU, did not show statistical significant difference, this might be attributed to similar of altitude and other ecological conditions, Similar findings were reported by Dereje [27] around Wollayta Soddo.

The body condition of animals was not significantly associated with the prevalence of nematode however, the results of the present study indicated that higher infection rate of nematode parasites were record in the study small ruminates with poor body condition than medium and good body condition animals. The explanation for this observation could be due to immune-suppression in sheep and goat with very poor body conditions, concurrent infection by other parasites including nematode parasite and/or malnutrition [44]. However this result was in contrary with Tesfaheywet [12] who revealed that body condition was strongly associated with the prevalence of nematode infection.

The present study did not show significant association with season, this result disagreed with the result of Tesfaheywet [12] who indicated that, parasitic load was higher in wet season than the dry season. Although the animals are expected to acquire high number of infective larvae during rainy season and harbor higher prevalence of nematodes [37,45], the animal do have an access to ample amount of pasture which would increase the plane of nutrition and consequently increase the

immunity of the animals, thereby reducing the fecundity which prevent the rise in nematode infection during the wet season.

Regarding, the physiological status of the animals studied; there was no significant association between pregnant and no pregnant animals. This might be due to the sample size of the study animals however; there were higher parasitic load were recorded in pregnant animals, 1st trimester and 2nd trimester, (100%) than non pregnant animals (86.4%).The explanation for this observation could be due to the immunity of pregnant animal were suppressed during the 1st trimester of their pregnancy.

The coprological investigation in the present study revealed that out of 383 small ruminants, 340 (88.8%) were infected, of which191 (89.2%) ovine and 149 (88.8%) caprine were positive for nematode parasites which could be classified as six genera of nematode parasites. *Haemonchus* was established as the predominant nematode, accounting for 55% of the total worm burden in both species during the study period. Next were 45% *Trichostrongylus*, 37.5% *Oesophagostomum,* 10% (*Bunostomum,* Trichuris) *and* 7.5% *Dictyocaulus* in both species in decreasing order. The nematode parasites found in this study had also been reported previously in other part of the country Sissay *et al.* [18]; Tesfaheywet [12], Regassa *et al.* [14]; Shimelis *et al.* [16]; Kumsa *et al*, [15]. However, it was contrary to the reports of other author Kumsa *et al*. [15] who documented a higher prevalence of *Trichostrongylus* sp. Higher prevalence of *Haemonchus* larvae in faecal cultures during this study were in accordance with studies in other countries [46]. This could 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 [30].

The study further revealed that season, species and body condition score of the animal did not show significant association with the load of the parasites and degree of EPG. The absences of association between those factors were consistent with previous reports of Tesfaheywet [12]. However, the present study had shown significantly association between the sexes of animal with the parasitic load in that female animals were highly infected than males. This might be due to the difference in the physiological status of animals. The result of EPG counts in this study showed a higher count in ovine >12000 than caprine species. This was assumed to be due to the grazing habit of the sheep, where they graze closer to the ground fostering opportunity of exposure to parasites [21].

CONCLUSION

In general, the present study showed that nematodes of small ruminants were prevalent in the study area affecting the wellbeing of the animals. Six genera of nematode parasites were recorded, *Haemonchus sp., Trichostrongylus sp., Oesophsgostomum sp., Bunostomum sp., Trichuris sp. and Dictyocaulus sp*., during study period among those species *Haemonchus* larvae was the predominant while *Dictyocaulus* sp., was lower in both species. Among the assumed risk factors tested, none of them showed significant association with the occurrence of the nematode parasites. Females were heavily infected with nematode parasites than male in EPG counts. However, nematode parasites in the study area showed high prevalence. Therefore, using broad spectrum anthelmintics with proper pasture and animal management should be practiced and further study should be recommended with species based identification and the impact of nematode parasites on small ruminant should also be studied.

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