ISSN 2475-1286

VETERINARY MEDICINE
OpenJournal

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Original Research

Study on Prevalence of Major Gastrointestinal Nematodes of Sheep in Wayu Tuka and Diga District, Oromia Regional State

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Article information
Received: January 28th, 2021; **Revised:** March 3rd, 2021; **Accepted:** March 8th, 2021; **Published:** March 24th, 2021

Cite this article
Chali AR, Hunde FT. Study on prevalence of major gastrointestinal nematodes of sheep in Wayu Tuka and Diga District, Oromia Regional State. *Vet Med Open J*. 2021; 6(1): 13-21. doi: 10.17140/VMOJ-6-154

ABSTRACT

Aim
This study was devised to be conducted to determine the prevalence and identify the major gastrointestinal nematode parasites based on fecal examination.

Methods
A cross-sectional study was carried out to determine the prevalence and associated factors with ovine gastrointestinal nematode infestation by fecal examination of 384 sheep from Wayu Tuka and Diga district, Eastern Oromia regional state.

Results
Out of the total 384 sampled sheep, 169 (44.0%) had been infected with gastrointestinal nematode parasite. Haemonchus species were the most frequently (20.8%) recovered nematode eggs followed by Trichostrongylus (13.0%) and Nematodirus (10.2%). There was no significant difference ($p>0.05$) in prevalence between age groups and sex. Sheep with poor body condition had a significantly higher prevalence of gastrointestinal nematode parasite ($p<0.05$) than those sheep in moderate or good body condition. There was no significant association between the gastrointestinal nematode infection in animals of different ages and sex groups.

Conclusion
The study shows that the gastrointestinal nematode parasite was a major important health problem and impact on the production of sheep in the study area. Therefore, a detailed study should be conducted to identify the parasite at the species level and special consideration should be taken on the management of sheep in poor body condition to reduce the burden of gastrointestinal nematodes.

Keywords
Diga; Eastern Wollega; Gastrointestinal nematodes; Prevalence; Sheep; Wayu Tuka.

INTRODUCTION

Small ruminants are the most numerous of man's domesticated livestock and are especially important in more extreme climates of the world. Over two-thirds of the total populations of small ruminant occur in developing countries where they often provide a major contribution to farming enterprises.[1] Historically, the livestock sector was subsistence-oriented and dominated by smallholders, and even today livestock isconsidered a more secure source of income generation for poor and landless farmers, particularly true for sheep and goats.[2] Because of relatively low inputs needed such as startup capital, feedstuffs, and maintenance expenditures as compared to large ruminants.[3]

Sheep and goats are under sober coercion of clinical and sub-clinical gastrointestinal helminths infestation in undeveloped countries, which reduces the productive and reproductive potential of animals due to reducing voluntary feed intake and feed conversion efficiency of the animals, especially the ineffective use of absorbed nutrients leads to retarded growth.[4] When comparing the population size and importance of small ruminants, the country has little benefited from this enormous resource owning to a multitude of problems, the disease is the most important. Disease alone accounts for mortality of 30% in lambs and 20% in adults.[5]

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Globally, parasitic diseases of animals continue to be a major constraint for undeveloped countries. Parasitic diseases remain the main constraint to animal production systems all over agro-ecological zones throughout the world. The productive and reproductive potential of domesticated livestock is adversely impaired by clinical and sub-clinical helminths diseases. It has well-recognized that in resource-poor regions of the world, helminth infections of sheep and goats are major factors responsible for economic losses through the reduction in productivity and increased mortality of animals. They are responsible for suppressing the immune system of animals, enhancing the susceptibility of the animals to other diseases.[6] Among helminths, gastrointestinal nematodes significantly affect the production of sheep and goats due to reduce appetite of animals, loss of body condition, anemia, hypoproteinemia, Impaired digestive absorptive efficiency, other pathogenic complications, and even death of animals.[7]

Several factors influence the diseases of gastrointestinal nematode parasites in small ruminants. These include weather conditions, husbandry practices, and the physiological status of the animals and for sustainable and normal control of gastrointestinal nematodes of sheep, comprehensive knowledge of epidemiology is a prerequisite.[8] In a developed country, the greatest component of impact by the gastrointestinal nematode parasites is probably found in the cost of control. But their impact is greater in sub-Saharan Africa in general and Ethiopia inparticular because of suitable ecological factors for diversified hosts and parasite species.[9]

Ethiopia has the highest livestock population in Africa. Small ruminants are among the major economically important livestock in Ethiopia; sheep and goats are of great importance as major sources of livelihood and contribute to the sustenance of landless, smallholder, and marginal farmers especially to the poor in the rural areas throughout the developing countries in which they are playing an important role in the livelihood of resource for poor farmers and provide a vast range of products and services such as meat, milk, skin, hair, horns, bones, manure, security, gifts and for many purposes.[10]

Shoats are very important in rural areas of Ethiopia due to their ease of management, short generation cycles, and high reproductive rates which lead to high production efficiency and a significant role in the provision of food and cash income generation for the farmers. These animals serve as a living bank for many farmers, closely linked to the social and cultural life of resource-poor farmers, and provide security during the cultivation of crops became difficult.[11] Therefore, they form an important economic and ecological niche in all agricultural systems throughout the country.[12]

The livestock population of Ethiopia is estimated to be 56.71 million cattle, 29.33 million sheep, and 29.11 million goats.[13] When the large livestock population of Ethiopia is compared with its economic benefits, it remains less because of prevailing diseases, poor nutrition, poor animal production systems, reproductive inefficiency, management constraints, and awareness of owners.[12]

Gastrointestinal nematode parasite infection is one of the major important health problems of animals in the world. These nematode infections affect the health of millions of animals, causing a huge economic loss in livestock farming.[14] In Ethiopia, gastrointestinal nematode parasite infections have a greater impact on livestock due to the availability of a wide range of agro-ecological-factors suitable for diversified hosts and parasite species.[15] Nematode parasites of small ruminants are primarily parasites of the gastrointestinal tract. The most important species are those found in the abomasum and small intestine. This includes; *Haemonchus*, *Trichostrongylus*, *Nematodirus*, *Cooperia*, *Bunostomum*, *Ostertagia*, and *Oesophagostomum*.[16]

In many parts of the Eastern Wollega Zone, the gastrointestinal nematodes parasite remains an important disease problem of sheep in the area. Hence, this study was devised to be conducted in WayuTuka and Diga district of Eastern Wollega Zone, Oromia regional state, to determine the prevalence and identify the major gastrointestinal nematode parasites based on fecalexamination.

MATERIALS AND METHODS

Study Area

The present study was conducted from November 2016 to April 2017 in Wayu Tuka and Diga district which are found in East Wollega Zone Oromia Regional state. Wayu Tuka and Diga District are located at about 319 km and 343 km distance from Addis Ababa, altitude of the study area ranges from 1300-3140 and 2250 m.a.s.l. respectively. According to Wayu Tuka Agricultural Office, the district has various topographic features. The rainfall distribution of the area is unimodal. In general, the mean annual temperature and mean annual rainfall are 18.8 °C and 2,067 mm, respectively. Diga receives the average annual rainfall of approximately 1250 mm. The annual temperature varies from 14 °C to 32 °C with an average of 22.6 °C.[17]

Study Animals

The study animals include all grazing sheep of different age groups and both sexes in Wayu Tuka and Diga district of Eastern Wollega Zone, Oromia that are kept under traditional extensive production management system. A total of 384 sheep were randomly selected and examined for gastrointestinal tract nematodes considering different age groups (<1, 1-2 and >2-years), sex group (male and female), and body condition groups (poor, medium, and good) as described by Gatenby et al[18] and Russel.[19] Natural pastures from communal grazing lands were the principal sources of feed for sheep and other livestock throughout the year. Mostly, a large number of different livestock including sheep are grazed together on communal grazing pasture.

Study Design

A cross-sectional study was undertaken to determine the prevalence of sheep gastrointestinal nematodes by qualitative fecal examination. Individual animals were carefully identified and sex, age, and body condition score were recorded. These risk factors were assessed for the presence of possible association with the

presence of gastrointestinal nematode.

Sampling Method and Sample Size

A random sampling strategy was followed to collect feces from the individual animals. The sample size was determined based on the formula described by Tsedeke.[11] The sample size was calculated using 50% expected prevalence, 5% absolute precision, and 95% confidence interval and the calculated total sample size was 384.

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

Where n=number of sample size
P exp=expected prevalence and d=desired absolute precision
1.96=constant from normal distribution at a given confidence level.

Laboratory Procedure

Fecal samples were collected directly from the rectum of each animal and placed in universal bottles and then transported to Wollega University Laboratory. In the laboratory, the samples were subjected to floatation techniques for screening of study animals for nematodes parasite presence. A simple test tube floatation technique is performed with the purpose of a qualitative test for detection of nematodes eggs. Eggs of different nematodes were identified on the basis of morphological appearance and size of eggs.[20]

Equipment required; fecal sample, tea strainer, measuring cylinder, test tube and test tube rack, pistol, and mortar, stirring rod, beaker, digital balance, floatation fluid, microscope, slide, and coverslip. Procedures; 3 gram of feces was measured and placed in a mortar and crushed by pistol, 50 ml of floatation fluid was added and mixed thoroughly, the suspension was poured into beaker through a tea strainer, from beaker the fecal suspension was poured into test tube supported by test tube rack, the coverslip was placed on the top of the test tube, the test tube was left for 20-minutes, the cover slip was lifted off after 20-minutes and placed on the slide then examined under microscope 10x magnification.[21]

Data Managemnt and Statistical Analysis

All collected data were entered into a Microsoft Excel spreadsheet. Data were analyzed using STATA 13 statistical software.[22] Pearson's chi-square test was employed as a test of the association if there is the relationship between the factors and the prevalence of gastrointestinal nematodes. A statistically significant association was said to exist when the calculated *p*-value is less than 0.05 ($p<0.05$) at a 95% confidence level.

RESULTS

In this study, the overall prevalence of gastrointestinal nematodes in the study area was 44.0% from two districts. During the study period, some factors were taken to identify the association of gastrointestinal nematodes parasite in sheep. The overall demographic study animals are summarized in the following table (Table1).

Prevalence of Gastrointestinal Nematodes in Male and Female Sheep

During the, a higher prevalence of major gastrointestinal nematode infection was observed in female animals as compared to male while the overall prevalence was 44.0%.

However, the difference in prevalence between the two sexes was not statically significant ($p>0.05$) (Table2).

Table 1. *Distribution of Study Animals by Demographic Data*

Districts	Factors	Wayu		Tuka	
		Frequency	Percent	Frequency	Percent
Sex	Male	83	43.2	61	31.8
	Female	109	56.8	131	68.2
Age	<1-year	49	25.5	50	26.0
	1-2-year	68	35.4	53	27.6
	>2-year	75	39.1	89	46.4
Body condition	Poor	69	35.9	65	33.9
	Medium	65	33.9	62	32.3
	Good	58	30.2	65	33.9
Agroecology	Midland	192	100.0	0	0.0
	Highland	0	0.0	192	100.0
Kebele	Gute	96	50.0	0	0.0
	Warababo	96	50.0	0	0.0
	Haro	0	0.0	96	50.0
	Soyama	0	0.0	96	50.0
Genus	*Haemonchus*	34	17.7	46	24.0
	Nematodirus	18	9.4	21	10.9
	Trichostrongylus	26	13.5	24	47.4

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Table 2. *Prevalence of Gastrointestinal Nematodes in Male and Female Sheep*

Sex	No. of Examined	No. of Positive	Prevalence	χ^2	*p*-value
Male	144	61	42.4%	0.2543	0.614
Female	240	108	45.0%		

Prevalence of Gastrointestinal Nematodes in Sheep Based on their Age

The study revealed that the proportion of the prevalence was greater than in less than one year, followed by between one up to two years and two years respectively. There was no statistically significant difference (p>0.05) in the prevalence of gastrointestinal nematode between the ages (Table 3).

Table 3. *Prevalence of Gastrointestinal Nematodes in Sheep Based on their Age*

Age	No. of Examined	No. of Positive	Prevalence	χ^2	*p*-value
<1-year	99	46	46.5%	0.5105	0.775
1-2-year	121	54	44.6%		
>2-year	164	69	42.1%		

Prevalence of Gastrointestinal Nematodes of Sheep Encountered in the Study Area

The dominant gastrointestinal nematodes parasite genus found during the study period were *Haemonchus*, *Trichostrongylus*, and *Nematodirus*. There was statically significant between genes of the parasite (p<0.05) (Table 4).

Table 4. *Prevalence of Gastrointestinal Nematodes of Sheep Encountered in the Study Area*

Genus of Parasite	No. of Examined	No. of Positive	Prevalence	χ^2	*p*-value
Haemonchus	384	80	20.8%	0.001	0.001
Trichostrongylus	384	50	13.0%		
Nematodirus	384	39	10.2%		

Prevalence of Gastrointestinal Nematodes in Sheep Based on Body Condition

Prevalence was significantly higher in animal with poor body condition when compared to that of medium and good body condition animals. There was statically significant difference in prevalence of gastrointestinal nematode parasite between body conditions of animals (p<0.05) (Table5).

Table 5. *Prevalence of Gastrointestinal Nematodes of Sheep based on Body Condition*

Body Condition	No. of Examined	No. of Positive	Prevalence	χ^2	*p*-value
Poor	134	96	71.6%	70.159	0.001
Medium	127	47	37.0%		
Good	123	26	21.0%		

Prevalence of Gastrointestinal Nematodes in Sheep Based on Agroecology

Out of all the sheep examined in different agroecology, samples from high land were a relatively high prevalence of gastrointestinal nematode. But the distribution of the parasite was not significantly different between midland and highland (Table 6).

Table 6. *Prevalence of Gastrointestinal Nematodes in Sheep Based on Agroecology*

Agroecology	No. of Examined	No. of Positive	Prevalence	χ^2	*p*-value
Midland	192	78	40.6%	1.7860	0.181
Highland	192	91	47.4%		

Prevalence of Gastrointestinal Nematodes Sheep on Different Site of the Study Area

During the study period, samples from Haro and Soyama revealed higher gastrointestinal nematode prevalence, and lower prevalence nematode were recorded in samples from Gute and Warababo. The chi-square (χ^2) test value indicated that there was no statistically significant difference (p>0.05) in prevalence of gastrointestinal nematode infection of sheep between these sites (Table 7).

Table 7. *Prevalence of Gastrointestinal Nematodes in Sheep on Different Site of Study Area*

Study Site	No. of Examined	No. of Positive	Prevalence	χ^2	*p*-value
Gute	96	40	41.7%	2.3990	0.494
Warababo	96	38	39.6%		
Haro	96	48	50.0%		
Soyama	96	43	44.8%		

DISCUSSION

The gastrointestinal nematodes of sheep are one of the major important parasitic diseases that reduced the productivity of sheep raised by farmers using traditional husbandry management system in Wayu Tuka and Diga district. The result of the present study which was conducted based on qualitative fecal examination during the study using fecal floatation method revealed an overall prevalence of gastrointestinal nematodes parasitic infection in sheep was (44.0%). This finding was found to be higher than that reported by Aga et al[23] who reported (24.7%) prevalence of gastrointestinal nematodes in sheep which was conducted in Western Oromia, Ethiopia.

The overall prevalence of present study findings are in agreement with Khan et al[24] who observed the overall prevalence of gastrointestinal helminthiasis, prevalence, and associated determinants in domestic ruminants of district Toba Tek Singh, Punjab, Pakistan as (44.2%).[25] Reported nematodes prevalence (47.7%) in North Gondar zone of Northwest Ethiopia, which is almost close to the present study. However, Kenea et al[26] who showed a higher prevalence of (73.1%) of gastrointestinal nematodes of sheep in three districts of Kaffa and Bench Manji

zones,[27] reported a higher prevalence (65.0%) of gastrointestinal nematode than the present study.[28] Reported (83.6%) and even higher (91.3%) by Tefera et al[29] in South-Western Ethiopia, respectively. This difference could be due to the sample size considered, the climatic condition of the study area and types of techniques utilized, and lack of intervention with anthelmintic.

In the present study, the prevalence of gastrointestinal nematodes was higher in females (45.0%) as compared to males (42.4%). In this study, no significant variation was observed in males and females despite slightly higher infection noticed in female sheep. The absence of statistical association between sex and prevalence of gastrointestinal nematode is in agreement with that of Regassa et al[9]; Assefa et al[30]; Keyyu et al[31]; yet, it is in disagreement with other reports including Maqsood et al[32] and Urquhart et al[33] who found higher infections in female animals than males with a significant difference between them. It is assumed that sex is a determinant factor influencing the prevalence of parasitism[32] and females are more prone to parasitism during pregnancy and per-parturient period due to stress and decreased immune status.[9,31,33]

The present study revealed that higher prevalence of gastrointestinal nematode parasites in sheep of less than 1-year age (46.5%) followed by 1-2-years (44.6%) and greater than two years age (42.1%) groups. These findings were in line with the study of Shimelis et al[25] who recorded a higher prevalence of gastrointestinal nematodes in sheep of less than one-year <1 (69.2%), followed by 1-2-years (50.8%) and >2-years (37.0%) animals. This might be due to low immunity in younger than the older ones. These findings were also similar to other researchers[24,27,33,34] also stated that a significant immunity develops with age against a few parasites in adult stock. Pointed out the two age groups of sheep most commonly affected are weaned lambs and yearlings. These were agreed with the report of Hamdullah et al,[35] who recorded a higher prevalence of gastrointestinal nematodes parasites in sheep of less than one year age (60.8%) followed by >2-years (43.3%) and 1-2-years (41.3%) age groups.

It disagrees with the report of Tasawar et al[36] who reported a higher prevalence of gastrointestinal nematodes in older age animals than younger. The low nematode prevalence in younger sheep might bedue to grazing on (nearby home) low contaminated pastures and supplemental feeding (barley grain, green wheat, etc.). While higher nematode prevalence in adult sheep might be due to grazing on the larger areas of pastures being contaminated with various flocks and different stress conditions like climate, long daily traveling, and gestation, etc. They added that the sheep over 18-months of age are less commonly affected because of immunity, resulting from the previous infection. In contrast,[28] stated that there was no significant difference in sheep nematodes prevalence between age and month. Young animals also get infected with internal parasitic ova from the contaminated pastures being spread for the female animals during the gestation period because of the higher parasitic load at thisstage.

Three genus of gastrointestinal nematode parasites were recovered from the gastrointestinal tract during the study period. Among these, *Haemonchus* was highest (20.8%) Inprevalence followed by *Trichostrongylus* (13.0%) and *Nematodirus* (10.2%) respectively. These findings are in agreement with Lateef et al[27] who recorded the highest prevalence of *Haemonchus* (61.5%) followed by *Trichostrongylus* (46.1%) and *Ostertagia* (33.0%). Similarly, Asif et al[37] reported that *Haemonchus* was higher inprevalence (80.6%) followed by *Trichuris* (32.3%) and *Nematodirus* (29.0%), respectively.[38] Recorded the prevalence of *Haemonchus* (28.9%), *Trichuris* (40.0%), and *Nematodirus* (11.1%) in sheep.[39] Recorded the genera of nematodes *Haemonchus* and *Trichostrongylus* as (33.0%) and (29.0%), respectively Abunna et al[28] observed the prevalence of *Haemonchus* (78.1%) and *Trichostrongylus* species (90.4%) in sheep.[40] Recorded genera-wise prevalence in sheep for strongly type eggs, Strongyloides, *Trichuris* as (39.8%), (17.5%) and (7.8%), respectively. Kantzoura et al[41] Reported prevalence in sheep for *Nematodirus* as (1.1%) and *Trichuris* as (2.9%).[42] Recorded prevalence of *Haemonchus* and *Trichuris* (6.5%) and (5.7%), respectively. While Al-Shaibani et al[34] recorded a higher prevalence of *Haemonchus* (24.6%) which was found to be predominant of gastrointestinal nematode parasites while *Trichostrongylus* (18.0%) was the next most prevalent species. while Khan et al[43] reported the same parasites in upland districts of Baluchistan.

Differences in the occurrence of different gastrointestinal nematode parasites in the present and other studies carried out in different locations might be due to different ecologies, temperatures and pastures.[44] Reported that the occurrence of gastrointestinal nematodes was higher and lower in arid conditions of upland Baluchistan as compared to the semi-humid, subtropical climate of Punjab province.[45] Pointed out that warm, wet weather provides favorable conditions for the translation of eggs to larvae in the majority of helminths. The areas having severe summer and dry winter reduced the parasitic burden on the local livestock. It was observed in the present study that most of the flocks were sedentary and they were under strict confinement during grazing which leads to a high-risk of helminths infection.[46] In thepresent study among three genus of gastrointestinal nematodes. *Haemonchus* was the most prevalent nematode. It might be due to its biotic potential which justified the percentage of infection.[39]

Trichostrongylus was the next most prevalent nematode parasite in the present study. These findings are in contrast to those of Busetti et al[47] mentioned that *Trichostrongylus* populations were high in autumn and reached their peaks in June to July, while the highest larval availability was in autumn. *Trichostrongylus* species has the capability to developed and survive at a lower temperature.[48]

The prevalence of *Nematodirus* was (10.5%) in the present study. These findings are close to the findings of Asif et al[37] who reported prevalence in sheep for *Nematodirus* as (11.1%) and Kantzoura et al[41] reported lower prevalence (1.1%). Some particular parasites, *Nematodirus*, have no obvious seasonal pattern of occurrence, and chill temperature requirement for larval development are important factors for their prevalence during a different period of year. Similarly, some climatic factors like warmness and moisture favor development and allow the accumulation of large numbers of infective stages on the rangelands.[33]

In this study, a significant difference was observed in prevalence of nematode infection in relation to body condition where a higher prevalence of gastrointestinal nematodes parasites were recorded in poor and moderate body as compared to animals with good body condition. Difference in body condition score is statistically significant ($p<0.05$) with gastrointestinal nematode prevalence such that shedding of nematodes eggs increased with poor body condition (71.6%) than in medium (37.0%) and good body condition (21.0%). This finding was agrees with Gonfa et al[49]; Radostits et al.[50]

CONCLUSION AND RECOMMENDATIONS

Gastrointestinal nematode parasites are the major health constraints in sheep production and contributing loss in productivity and economy. The present study was based on fecal examination for detection of gastrointestinal nematode eggs; it has provided the current prevalence and associated factors. It suggested that ovine gastrointestinal nematodes are of the major problem in the study area. There was significant difference within body condition of animals and genus of the parasite. However, significant difference was not recorded within age, sex and agro-ecology.

Based on the above conclusion the following recommendations are forwarded:

- Detailed study should be conducted to identify the parasite at species level.
- Special consideration should be taken on the management of sheep in poor body condition to reduce burden of gastrointestinal nematodes.
- Further investigation is needed to study on the association of prevalence of gastrointestinal nematodes within age, sex and agro-ecology in the area.

ETHICAL CONSIDERATION

The case report was done under super vision of Mekelle University, College of Veterinary Medicine ethical review committee and had critically reviewed and concludes that there was no ethical misconduct. The approval of ethical committee was taken for conducting this study and followed all the animal ethics and welfare guidelines.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. Tony W. The veterinary epidemiology and economics research unit (VEERU), School of agriculture, policy and development. United Kingdom: The University of reading; 2007.

2. Khajuria K, Katoch A, Yadav R, Godara S, Gupta K, Singh A. Seasonal prevalence of gastrointestinal helminths in sheep and goats of middle agro-climatic zone of Jammu province. *J Parasit Dis.* 2012; 37(1): 12-25. doi: 10.1007/s12639-012-0122-3

3. Terefe D, Demissie D, Beyene D, Haile S. A prevalence study of internal parasites infecting Boer goats at Adami Tulu agricultural research center, Ethiopia. *J Vet Med Anim Health.* 2012; 4: 12-16. doi: 10.5897/JVMAH11.046

4. Ayaz MM, Raza MS, Murtaza S, Akhtar S. Epidemiological survey of helminths of goats in southern Punjab, Pakistan. *Trop BioMed.* 2013; 30: 62-70.

5. Demelash B, Yilma J, Hassen. C. Ovine helminthosis, a major health constraints to productivity of sheep in Ethiopia. *Anim Health Res Rev.* 2006; 7(1-2): 107-118. doi: 10.1017/S1466252307001132

6. Tibbo M, Aragaw K, Philipssonn J, Malmfors B, Nasholw A, Ayelew W, et al. Economics of sub clinical helminthosis control through anthelminthics and nutritional in indigenous menz and Awassi-menz cross bread sheep in Ethiopia. Paper presented at: 56th Annual Meeting of the European Association for Animal Production (EAAP); 2006; Uppsala, Sweden.

7. Holmes Ph. Pathogenesis of trichostrongylosis. *Vet Parasitol.* 1986; 18: 89-101. doi: 10.1016/0304-4017(85)90059-7

8. Keyyu D, Kyvsaard N, Monrad J, Kassuku A. Epidemiology of gastrointestinal nematodes in cattle on traditional, small-scale dairy and large-scale dairy farms in Iringa district, Tanzania. *Vet Parasitol.* 2005; 127: 285-294. doi: 10.1016/j.vetpar.2004.10.014

9. Regassa F, Sori T, Dhuguma R, Kirros Y. Epidemiology of gastrointestinal parasites of ruminant in Western Oromia, Ethiopia. *Int J App Res Vet Med.* 2006; 4(1): 51-57.

10. Welemehret N, Basaznew B, Mersha C. Helminthes parasites in small ruminants, prevalence, species composition and associated risk factors in and around Mekelle Town, Northern Ethiopia. *Eur J BioSci.* 2012; 4(3): 91-95. doi: 10.5829/idosi.ejbs.2012.4.3.65149

11. Tsedeke K. *Production and Marketing systems of sheep and goats in Alaba, Southern Ethiopia.* [master's thesis]. Alaba, Southern Ethiopia: Hawassa University; 2007; 4.

12. Sissay MM. *Helminth Parasites of Sheep and Goats in Eastern Ethiopia.* [Doctoral thesis]. Acta Universitatis Agriculturae Sueciae; Uppsala: 2007.

13. Central Statistical Agency (CSA). Agricultural sample survey. Report on livestock and livestock characteristics, Statistical Bulletin Addis Ababa, Ethiopia. 2015.

14. Ahmed, M. *Gastrointestinal Nematode Infections in Small Ruminants: Epidemiology, Anthelmintic Efficacy and the Effect of Wattle Tannins.* [master's thesis]. Animal Science Discipline of Animal and Poultry Sciences, School of Agricultural Sciences and Agribusiness University of Kwazulu-Natal Pietermaritzburg. 2010; 1-6.

15. Fikru R, Reta TD, Yosef K, Teshale S. Epidemiology of gastrointestinal parasite of ruminant in Western Oromia. Addis Ababa University; Debre -Zeit, Ethiopia; 2006.

16. Hutchinson GW. Nematode Parasites of Small Ruminants, Camelids and Cattle Diagnosis with Emphasis on Anthelmintic Efficacy and Resistance Testing. Paper presented at: Formerly at Elizabeth Mcarthur agricultural Institute; 2009; New South Wales, USA.

17. Diga Agricultural Bureau (DAB). Annual Report. Nekemte, Oromia, Ethiopia. 2015.

18. Holness DM, Smith AJ. *The Tropical Agriculturalist Pigs (The tropical agriculturalist Macmillan/CTA).* Noida, UP: Macmillan Education; 1991: 32: 6-11.

19. Russel A. Body condition scoring of sheep. *Ann Sci.* 1984; (6): 91-93.

20. Foriet W. *In Reference Manual of Veterinary Parasitology.* 5th ed. New York, USA: Wiley Blackwell, 1999: 22-26.

21. Hendrix C, Robinson E. *Diagnostic Parasitology for Veterinary Technician's.* 3rd ed. Chain; Mosby inc and affilicateelseverianc; 2006: 12-13.

22. StataCorp. *State Statistical Software: Release 13.* College Station, TX, USA: State Corp LP. 2013

23. Aga T, Yacob H, Terefe G. Epidemiology of gastrointestinal nematodes of Horro sheep in Western Oromiya, Ethiopia. *Academic Journal.* 2013; 5(10): 296-304. doi: 10.5897/JVMAH2013.0234

24. Khan M, Sajid M, Iqbal Z, Hussain A. Gastrointestinal helminthiasis, prevalence and associated determinants in domestic ruminants of district Toba Tek Singh, Punjab. *Pak Parasitol Res.* 2010; 107: 787-794. doi: 10.1007/s00436-010-1931-x

25. Shimelis D, Asmare A, Wudu T. Epidemiology of gastrointestinal helminthiasis of small ruminants in selected sites of North Gondar zone, Northwest Ethiopia. Ethiopian *Vet J.* 2011; 15: 57-68. doi: 10.4314/evj.v15i2.67694

26. Kenea T, Bekele J, Sheferaw D. Gastro-intestinal nematodes of sheep and goats in three district of Kaffa and Bench Maji zones, Southwest Ethiopia. *Ethiopian Veterinary J.* 2015; 19(2): 67-76. doi: 10.4314/evj.v19i2.6

27. Lateef M, Iqbal Z, Jabbar A, Khan M, Akhtar M. Epidemiology of Trichostrongyloid nematode infections in sheep under traditional husbandry system in Pakistan. *Int. J. Agri. Biol.* 2005; 7(4): 596-600.

28. Abunna F, Tsedeke E, Kumsa B, Megersa B, Regassa A, Debela E. Abomasal nematodes: Prevalence in small ruminants slaughtered at Bishoftu Town, Ethiopia. *International Journal Veterinary Medicine.* 2009; 1: 1937-8165.

29. Tefera M, Batu G, Bitew M. Prevalence of gastrointestinal parasites of sheep and goats in and around Bedelle, South-Western Ethiopia. *Int J Vet Med.* 2011; 8: 60-65.

30. Assefa D, Sissay L. Preliminary investigation on the seasonal occurrence of parasites around Sheno. Paper presented at: 5th National conference of society of animal production; 1998; Addis Ababa Ethiopia.

31. Keyyu D, Kassuku A, Kyvsgaard C, Willingham W. Gastrointestinal nematodes in indigenous zebu cattle under pastoral and nomadic management systems in the lower plain of Southern highlands of Tanzania. *Vet Res Commun.* 2003; 27(5): 371-380. doi: 10.1023/a:1024706120270

32. Maqsood M, Igbai Z, Chaudhry H. Prevalence and intensity of haemonchosis with reference to breed, sex and age of sheep and goats. *Pakistan Vet J.* 1996; 16: 41-43.

33. Urquhart M, Armour J, Duncan L, Dunn M, Jennings W. Veterinary parasitology, 2nd ed. University of Glasgow Scotland; 1996; 4-137.

34. Al-Shaibani I, Phulan M, Arijo A, Qureshi T. Epidemiology of ovine gastrointestinal nematodes in Hyderabad District, Pakistan. *Pakistan Vet J.* 2008; 28: 125-130.

35. Hamdullah K., Mohammad L, Azhar M, Makhdoom A, Farhat A, Sadullah J, Haider Sh. Prevalence and intensity of ovine gastrointestinal nematod es in Balochista Pakistan. *Pakistan Journal Zoology.* 2013; 45(6): 1669-1677.

36. Tasawar Z, Naz F, Lashari H, Hayat C. Prevalence of ostertagia species in a sheep herd. *SarhadJournal of Agriculture.* 2011; 27: 275-278.

37. Asif A, Azeem S, Asif S, Nazir S. Prevalence of gastrointestinal parasites of sheep and goats in and around Rawalpindi and Islamabad, Pakistan. *Journal Veterinary Animal Scince.* 2008; 1: 14-17.

38. Gadahi A, Arshed Q, Ali S, Shah, S. Prevalence of gastrointestinal parasites of sheep and goats in and around Rawalpindi and Islamabad, Pakistan. *Vet World.* 2009; 2: 51-53.

39. Nginyi M, Duncan L, Mellor J, Stear J, Wanyangu W, Bain K, et al. Epidemiology of parasitic gastrointestinal nematode infections of ruminants on smallholder farms in central Kenya. *Res Vet Sci.* 2001; 70: 33-39. doi: 10.1053/rvsc.2000.0438

40. Zeryehun T. Helminthosis of sheep and goats in and around Haramaya, Southeastern Ethiopia. *J. Vet. Med. Anim. Health.* 2012; 4: 48-55. doi: 10.5897/JVMAH12.0014

41. Kantzoura V, Kouam M, Theodoropoulou H, Feidas H, Theodoropoulos G. Prevalence and risk factors of gastrointestinal parasitic infections in small ruminants in the Greek temperate Mediterranean environment. *Open J Vet Med.* 2012; 2: 25-33. doi: 10.4236/ojvm.2012.21005

42. Mushtaq H, Tasawar Z. Prevalence of some gastrointestinal parasites in sheep in southern Punjab, Pakistan. *Pakistan Veterinary Journal.* 2011; 31: 295-298.

43. Khan M, Rehman A, Munir M, Khan Br. Incidence of internal parasites of sheep in upland districts of Baluchistan. MART/AZR project: high elevation research in Pakistan: research report no. 18. 1988

44. Durrani MS, Chaudhry NI, Anwar AH. The incidence of gastrointestinal parasites in sheep and goats of Jhelum Valley (Azad Jammu Kashmir). *Pakistan Veterinary Journal.* 1981; 1: 164-165.

45. Radostits M, Blood C, Gay C. *Veterinary Medicine. A Textbook of Diseases of Cattle, Sheep, Pig, Goat and Horses.*7th ed. Great Britain, UK: Bath Press Avon; 1994: 1311-1367.

46. Anene, B., Onyekwodiri, E., Chime, A. and Anika, S. (1994): Gastrointestinal parasites in sheep and goats of Southern Nigeria. Small ruminant research, 13:187-192.

47. Busetti R, Suarez H. The Epidemiology of helminth infections of growing sheep in Argentina's Western Pampas. *Int J Parasitol.* 1995; 25: 489-494. doi: 10.1016/0020-7519(94)00122-5

48. Mallet S, Kerboeuf D. Winter survival of third stage Trichostrongylus Colubriform is larvae, effects on infectivity and fecundity of adult worms. *Res Vet Sci.* 1986; 41: 265-267.

49. Gonfa S, Basaznew B, Achenef M. An abattoir survey on gastrointestinal nematodes in sheep and goats in Hemex-export abattoir, Bishoftu (DebreZeit), Central Ethiopia. *J Adv Vet Res.* 2013; 3(2): 60-63.

50. Radostits M, Gay C, Hinchcliff W, Constable D. *Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats.* 10th ed. UK: Saunders Ltd; 2006: 1541-1553.

ANNEXES

ANNEX 1. *Estimation of Age of Sheep*[18]

Prominent Incisors	Age of Sheep
None	less than 1-year
One pair	1-year
2 pair	1-year to 10-months
Above 3 pair	more than 2-year

ANNEX 2. *Body Condition Score of Sheep*

Condition Score	Indications in Number	Body Condition
Starving	0	Extremely thin, nearly dead, no muscle between skin and bone
Very thin	1	Spinous process sharp sticks up. Thoracic processes are sharp and fingers easily pushed under thin end. There is hollow between the ends of each process, lion muscles are shallow.
Thin	2	Spinous process fell less sharp; fingers can be pushed under the thoracic process with the little pressure. lion muscles are moderate depth
Moderate	3	Spinous process only sticks up very slightly; they are smooth and rounded. Firm pressure is needed to detect each one separately. Thoracic processes are smooth and well covered, firm pressure is required to push, lion muscles are full.
Fat	4	Spinous process can just be felt with firm pressure as herd line and level with the flesh on either side. The ends of the thoracic process cannot be felt, lion muscles are full.
Very fat	5	Spinous process cannot be felt at all. Thoracic process cannot be felt lion muscles are very fully developed.
Body condition of animals was classified in to three as poor, medium and good BCS 1 and 2 poor; BCS 3 medium; BCS 4 and 5 good. Source[19]		