Review Article
Volume 12:7, 2021

Journal of Veterinary Science & Technology

ISSN: 2157-7579 Open Access

Small Intestinal Helminthes of Sheep and Goats Slaughtered at Bishoftu Elfora Export Abattoir, Ethiopia

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Abstract

Helminthes have been recognized as a major constraint to both small and large-scale small ruminant production in developing countries. A cross- sectional study was carried out in sheep and goats from November 2016 to April 2017 to identify the species and to estimate the burden of small intestinal helminthes parasites of sheep and goats in Bishoftu ELFORA export abattoir, with the objectives of evaluating the current status of helminthes. The study animals were 230 small ruminants in which 105 sheep's and 125 goats slaughtered in Bishoftu ELFORA export abattoir. The study revealed that an overall infection was 83.5% and among the samples from sheep 105 (87.6%) and 100 (80%) from goats were detected positive for helminthes parasite with a no statistical significance ($p > 0.05$) between the sheep and goat. It also statistically significant differences ($P<0.05$) among the risk factors of age and origin considered in relation to the prevalence of Intestinal helminthes. Three species of parasites namely Trichostrongylus colubriformis, Bunostomum trigonocephalum and Moniezia expansa were found infecting intestines of both sheep and goats. In the current study, a high infection with helminthes parasite was observed in small ruminants during the study period affecting health of those animals and appropriate control measure should be instituted.

Keywords: Cestode • Ethiopia • Goat • Helminthes • Nematode • Parasite • Sheep

Introduction

Ethiopia with its great variation in climate and topography possesses one of the largest small ruminant populations in Africa. The latest estimate of small ruminant population gives 23.6 million sheep and 23.3 million goats [1]. Small ruminants provide about 46%of the national meat consumption and 58% of the value of hide and skin production. They have many advantages over large ruminants for most smallholder farmers, including among others: less feed costs, quicker turnover, easy management and appropriate size at slaughter [2,3].

Despite the large small ruminant's population of Ethiopia, the economic benefits remain marginal due to prevailing diseases, poor nutrition, poor animal production systems, reproductive inefficiency, management constraints and general lack of veterinary care [4]. Parasitic diseases represent a major problem for the health of small ruminants and hamper the poverty alleviation programs in livestock farming system in the developing countries [5].

Intestinal helminthosis is among the main constraints to small ruminant productions in Ethiopia. These parasites pose subtle economic losses and are the major factors responsible for lowered levels of production in many parts of the country. It also 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 [6].

Helminthosis in particular nematodiasis of domestic ruminants are of major importance in many agro-ecological zones in Africa, but their impact is greater in Sub-Saharan Africa in general and Ethiopia in particular due to availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species [7]. Trichostronglus colubriformis and Bunostemam trigonocephalum most common small intestine worms of sheep and goats in most part of the world including tropical areas resulting in significant loss of production [2].

Although the causes of helminthes parasitism in ruminant livestock are multiple and often interactive, the vast majority of cases are due to any of the following basic reasons: an increase in the number of infective stages on pasture, an alteration in host susceptibility, the introduction of susceptible stock into an infected environment, the introduction of infections into an environment and ineffective parasite removal from the host animals due to poor administration techniques, the use of sub-standard anthelmintic drugs and/or the development of anthelmintic resistance [3].

About 95% of sheep and goats are reported to be infected with helminthes with Haemonchus and Trichostrongylus being the key species involved. Production losses through mortality and reduced

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Received: 29 July, 2021; **Accepted:** 12 August, 2021; **Published:** 19 August, 2021.

weight gain have been reported by several authors [4]. Studies conducted on ruminant helminthosis of various regions of Ethiopia have revealed a prevalence range from 47.67 to 84.1% [5,6]. Even though several previous studies were conducted on small intestinal helminthes in various regions of Ethiopia, no study has conducted in the current study area.

Therefore, the objectives of this study were:-

- To estimate the species composition and worm load (burden) of small intestinal parasites in sheep and goats slaughtered in the study area.

Literature Review

Description of helminthes

It is multicellular eukaryotic animals that generally possess digestive, circulatory, nervous, excretory, and reproductive systems. Some are free-living in soil and water. Helminthes are studied in microbiology because they cause infectious diseases and most are diagnosed by microscopic examination of eggs or larvae. Eggs may have striations (lines), a spine, or an operculum (hatch by which the larva leaves). Helminthes infect more than one-third of the world population. Helminthes infections differ from bacterial or protozoan infections because the worms do not usually increase in number in the host. Symptoms are usually due to mechanical damage, eating host tissues, or completing for vitamins [7].

Type of helminthes

Platy helminthes: It is flattened from the dorsal to ventral surfaces. The classes of this phylum include trematodes and cestodes. Trematodes (flukes) often have flat, leaf shaped bodies with ventral and oral suckers. The suckers hold the animal in place. Flukes obtain food by absorbing it through their outer covering, called the cuticle. Flukes are given common names according to the tissue of the definitive host in which the adults live (for example, lung fluke, liver fluke, and blood fluke). Cestodes (tapeworms) are intestinal parasites. The head, or scolex (plural: scoleces), has suckers for attaching to the intestinal mucosof the definitive host; some species also have small hooks for attachment [1].

Tapeworms do not ingest the tissues of their hosts; in fact, they completely lack a digestive system. To obtain nutrients from the small intestine, they absorb food through their cuticle. The body consists of segments called proglottids. Proglottids are continually produced by the neck region of the scolex, as long as the scolex is attached and alive. Each mature proglottid contains both male and female reproductive organs. Each proglottid matures as it is pushed away from the neck by new proglottids. Each proglottid contains both male and female reproductive systems and eggs are fertilized as the proglottid reaches the middle of the worm. The proglottids farthest away from the scolex are basically bags of fertilized eggs that will be shed in feces [1].

Roundworms (Nematodes): It is cylindrical and tapered at each end. Roundworms have a complete digestive system, consisting of a mouth, an intestine, and an anus. Most species are dioeciously. The reproductive system consists of long tubules that serve as ovaries or testes. In females, the reproductive tubule (ovary) is usually double. Males are smaller than females and have one or two hardened spicules on their pp;posterior ends that guide sperm to the female's genital pore. Species identification is often based on spicule structure [2].

Trichostrongylus, It is hairworms, a genus or parasitic roundworms belonging to the family called Strongylidae that affects cattle, sheep, goats and other ruminants, as well as pigs, horses and poultry. It also infects wildlife (deer, antelopes, camels, monkeys, wild boars, zebras, etc.). It is found worldwide. In ruminants Trichostrongylus worms are mostly found in mixed infections with other gastrointestinal roundworms (e.g. of the genera Cooperia, Haemonchus, Ostertagia, etc.) [2,1].

There are about 30 species worldwide. Trichostrongylus colubriformis bankrupt worms, black scours worms. Infects cattle, sheep, goats, pigs and horses and many wild mammals. Found worldwide. Other less frequent species are Trichostrongylusprobolurus and Trichostrongylus vitrinus. Neither dogs nor cats are affected by this species. Some Trichostrongylus worms can incidentally infect humans if they ingest water or vegetables contaminated with infective larvae, which happens more frequently in rural regions with poor sanitary conditions [9] (Figure 1).

Figure 1. A) Adult male of trichoustrongylus and B) Ovary of Adult female trichoustrongylus .

Bunostemum trigonocephalum is a hook worm belonging to the family Ancylostomidae and is found in the adult stage in the small intestine of sheep and goat. Nematodes belonging to the family Ancylostomidae have long been recognized as serious pathogens in man but it is only since the early part of this century that detailed studies have been made on Acylostomes of both animals and man. Hook worm in variably have direct life cycles. As adults they inhabit the small intestine of the host. The adult nematodes range from 5-15mm long in the male and 5-30mm long in the female [4].

Invariably they are equipped with a large buccal capsule which is usually armed with teeth and marginal cutting plates which may be smooth or toothed. This buccal apparatus is also ciated with an invariable habit of hook worms namely, the ingestion of blood. In some cases it is known that this habit is also facilitated by the secretion of anticoagules. Aneamia is the usual sequel to hook worm infection in both man and animals. It seems clear however, that the anaemia is not simply a post hemorrhagic one but is complicated by induced iron deficiency and perhaps by hypoproteinaemia [5] (Figure 2).

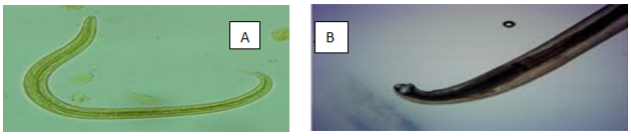

Figure 2. A) All body of Adult Bunostemem and B) Mouthe part of adult bunostemem.

Moniezia expansa: is commonly known as sheep tapeworm (double pored ruminant tapeworm) [6]. It is a large tapeworm inhabiting the small intestines of ruminants such as sheep and goat. It has been reported from Peru that pigs are also infected. There is an unusual report of human infection in an Egyptian [7]. It is characterized by unarmed scolex (i.e., hooks and rostellum are absent), presence of two sets of reproductive systems in each proglottid, and each proglottid being very short but very short but very broad [2].

Figure 3. Proglottid of adult Moniezia.

Etiology

Trichostrongylus in small ruminants are caused by Trichostrongylus colubriformis. *T. colubriformis* is a small intestinal helminthes parasitic, which infects small ruminants such as sheep and goats.

Bunostemum in small ruminants is caused by Bunostemum trigonocephalum. *B. trigonocephalum* is a small intestinal helminthes parasitic, which infects small ruminants such as sheep and goats. Moniezia in small ruminants is caused by Moniezia expansa. *M. expansa* is a small intestinal helminthes parasitic, which infects small ruminants such as sheep and goats [3].

Life cycle

Parasitic helminthes are highly modified compared to free living helminthes. They often lack sense organs such as eyes, and may even lack a digestive system. Their reproductive system, however, is often complex, which ensures infection of new hosts. Some flukes can produce 25,000 eggs per day.

Adult helminthes may be dioecious; male reproductive organs are in one individual, and female reproductive organs are in another. In those species, reproduction occurs only when two adults of the opposite sex are in the same host. Adult helminthes may also be monoecious, o hermaphroditic- one animal has both male and female reproductive organs [1].

Diagnosis of helminthes infections in small ruminants

The diagnosis of helminthes parasites of small ruminants is based on demonstrating the presence of helminth eggs, or larvae, in faecal samples, or the presence of parasites recovered from the digestive tracts or other viscera of the animals.

Although a great variety of methods and modifications have been described for such diagnosis, standardization of techniques, such as egg or larval counts, worm counts, pasture larval counts, etc., does not exist.

Therefore, in practice, most diagnostic laboratories as well as teaching and research establishments apply their own set and protocols of test procedures [3, 2].

The following diagnostic procedures for adult helminthes infections of small ruminants are relevant to African conditions. Post-mortem examinations and identification of adult worms and arrested larvae in animals are the definitive means of identifying the parasite infection status of animals.

Similar to faecal egg counts, there are many procedures that are described for post-mortem examination for nematode parasites [13].

Prevention and control

Since the susceptibility of animals varies with age, it is important, especially in the rainy season, to graze young stock in advance of older stock. Using cut and carry feeding systems can significantly limit worm infestation. Overstocking should be reduced. The farmers/pastoralists using the same pasture have to take control measures at the same time. Deworm all newly introduced animals and keep them separate for three days before allowing them to mix with the rest of the flock. Keep barns clean and dry. Deworm all goats at the end of the rainy season and at the end of the dry season. Always consider the possibility of acute parasitic gastroenteritis at any time from the start of the rains until shortly afterwards [3].

Materials and Methods

Study population and animal

The study involved 105 sheep and 125 goats at ELFORA export abattoir. The animals are presented to the abattoir from different local markets available in Ethiopia.

Borana: The study animals were also brought from Borana Zone which is situated about 600 kms South of Addis Ababa. The area is bordered by Kenya from the south, Somali regional state from east, highlands of Guji from the north and Southern Nation Nationalities and People Regional State from the west. The climate is generally semi-arid with annual average rainfall ranging from 300mm in the south to over 700mm in the north Annual mean daily temperature varies from 19°C to 24°C with moderate seasonal variation. Season affects herding patterns due to its effect on forage and water resources availability [3,4].

Jinka: The study animals were also come from South Omo Zone (Jinka) which is found in Southern Nation Nationalities and people Regional state (SNNP). The temperature of the area falls between 15.7°C and 38°C. The livestock resource of the zone is 2367712 cattle, 151499 sheep, 1881352 goats, 98545 equine, 1105053 poultry and 85,528 traditional beehives [5].

Somale: The study animals were also come from Somale, is located at 90 20 N in the eastern part of Ethiopia and is one of the semiarid parts of the country. During the study period Somale receives an average rainfall ranging from 250- 600mm and have a mean temperature ranging from 25-35oc with an average altitude of 1200 m above sea level [6].

Study design and sample size determination

A cross sectional study design was use to determine the prevalence, species composition and worm burden of small intestines helminthes in small ruminants at ELFORA export abattoir.

Samples collection and laboratory analysis

Worm recovery: A total of 105 and 125 respective small intestines of sheep and goats were collected from Elfora export abattoir during the study period. Classical procedure as described in MAFF and Hansen and Perry (Annex 2) was employed for small intestine worm recovery, counting and species identification.

Then, laboratory work was done at Parasitology laboratory of College of Veterinary Medicine and Agriculture, Addis Ababa University [7].

Species identification: The worms which are preserved in 10%formalin were poured in to Petri dishes and examined under a stereomicroscope. Identification and the degree of infection were made using keys developed by various researchers (Hansen and Perry) and MAFF (Annex 3).

Data management and analysis

All the data that are collected (age, species and parasitic infestation) entered to MS excel sheet and analyzed by using SPSS 20 version.

Descriptive statistics will be used to determine the prevalence of the disease and $\chi 2$-test will be used to look the significant difference between age and species of the host with parasites.

Results

Prevalence

Out of the 230 small ruminants (105 sheep and 125 goats) examined 192 (83.5%) were positive for at least 1 helminthes parasite (Table 1).

		T. colubriformis		*B. trigonocephalum*		*M. expansa*	
Species	Amount(N)	Positive	%	Positive	%	Positive	%
Sheep	105	69	65.7	34	43.6	51	52.6
Goat	125	78	61.2	44	56.4	46	47.4
Total	230	147	63.9	78	33.9	97	42.2

Table 1. Prevalence of intestinal helminthes parasites in sheep and goats.

The overall prevalence of helminthes in sheep and goats was 92(87.6%) and 100(80%) respectively, while the prevalence of Trichostrongylus colubriformis, Bunostomum trigonocephalum and Moniezia expansa in small ruminant was 147(63.9%), 78(33.9%) and 97(42.2%) respectively.

The prevalence of Trichostrongylus colubriformis, Bunostomum trigonocephalum and Moniezia expansa in sheep was 69(46.9%), 34(43.6%) and 51(52.6%) respectively, while the prevalence of Trichostrongylus colubriformis, Bunostomum trigonocephalum and Moniezia expansa in goat was 78(53.1%), 44(56.4%) and 46(47.4%) respectively.

Two species of nematodes (Bunostomu] m trigonocephalum) and one species of cestode (*M. expansa*) were recovered from the small intestines of both species of the study animals.

Infection with all the 3 species of parasites was recorded in 35 (15.2%) animals. Fifteen (12 %) goats were found infected with all the three parasites identified, while 53 (42.4 %) and 42 (33.6 %) were found infected with 2 and 1 species of parasite respectively.

Of which 78 (74.3 %) were harboring nematode parasitic worms. Twenty (19 %) sheep were infected with all the three species of parasites identified, while 23 (21.9 %) and 59 (56.2 %) were harboring 2 and 1 species of parasites respectively.

There was no significant difference in prevalence of all the three species of intestinal helminthes between the two species of hosts (P>0.05) (Table 2) (Figure 4).

Risk factors	**Sheep(N=105)**		**Goat(N=125)**	**x2**	**P-Value**	
Age	**No examined**	**No. positive (%)**	**No examined**	**No. positive (%)**		
6 month-1year	52	45(42.8%)	52	43(34.4%)	4.175	0.324
1year	36	34(32.4%)	43	33(26.4%)		
1-2year	17	13(12.4%)	30	24(19.2%)		

Body condition						
Good	48	41(39%)	61	53(42.4%)	2.496	0.287
Medium	57	51(48.6%)	64	47(37.6%)		
Origin						
Jinka	15	10(9.5%)	66	60(48%)	5.252	0.042
Borana	51	45(42.9%)	29	23(18.4%)		
Somale	39	37(35.2%)	30	17(13.6%)		
Total	105	92(87.6%)	125	100(80%)		

Table 2. Frequency of sheep and goats helminthes in relation to the risk factors.

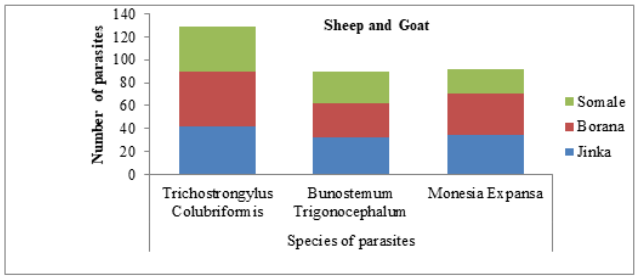

Figure 4. Prevalence of ovine and caprine helminthes based on origin.

Parasitic burden

Out of 105 sheep infected with *T. colubriformis* 15(14.3%), 49(46.6%) and 3(2.85%) were lightly, moderately and heavy infected respectively. Similarly 18(14.4%) goats were with light infection with *T. colubriformis*, while only 63(50.4 %) and 2(1.6%) had moderate and heavy infection respectively. Of those animals harboring *B. trigonocephalum* 22(56.4%) sheep and 17(43.6%) goats were with light degree of infection, 24(36.9%) sheep and 41(63%) goats were with moderate degree and the rest 100% sheep and no goats were with heavy degree of infection (Table 3). There was no significant difference (0.082 >0.05) in the burden of parasites among the two hosts for all the three parasites identified (Table 3).

	Ovine (n= 105)		**Caprine (n = 125)**		**Sheep +Goat**	
Intensity	T. c	B. t	T. c	B. t	T. c	B. t
Light	15	22	18	17	33	39
Moderate	49	24	63	41	112	65
Heavy	3	3	2	0	5	3
Negative	38	56	42	67	80	123
Total(n=230)	67	49	83	58	150	107

Table 3. Proportion and number of sheep and goats in relation to degree of infection by adult small intestines.

Discussion

The present study revealed an overall prevalence of helminthes infestation in small ruminants to be 83.5%. However, the overall prevalence of parasitic helminthes recorded in the current study was lower than that reported earlier 92% in sheep and goat by [1]. Ogaden region and 100% in sheep from Hawasa and 100% in sheep by Kumsa from Hawasa and its surroundings. The higher prevalence recorded in the current study during the period from November 2016 to April 2017 is might be attributed to unfavorable temperature and rainfall for the survival and development of the free living stages of helminthes on pasture during the study period [1].

The prevalence between species was 87.6% in sheep and 80% in goats. There was a higher prevalence of small intestinal helminthes both in Sheep (87.6%) and goat (80%). This is low when compared to the 97.4% (sheep) and 94.4% (goat) prevalence recorded in the Hawasa town. The difference might be attributed to the effect of year and site on helminthes prevalence [4].

There was no significant difference both in prevalence and burden of small intestinal helminthes parasites between sheep and goats. Even though the prevalence of *M. expansa* and *B. trigonocephalum* tended to be high in sheep (P =0.405) it failed to be statistically significant. This may show that goats, which naturally prefer to browse, were forced to graze because of shortage of browsing material possibly due to expansion of cultivated land. In contradiction to our observation [4] reported higher prevalence of intestinal nematodes in sheep than in goats from the same study area [2] also reported high prevalence of Monieziain sheep than in goats from central Ethiopia through coprological examination.

The prevalence of *T. colubriformis* in sheep (65.7%) and goats (61.1%) was lower compared to 83.5% and 77.5% prevalence reported for sheep and goats respectively by [40] from the Hawasa town. Much higher when compered within prevalence of 14.7% and 24.4% were recorded for *T. colubriformis*in sheep and goats respectively in the Sudan [3] and 16% for sheep in Iran [4]. The prevalence of *B. trigonocephalum* in sheep (43.6%) and goats (56.4%) was lower compared to 50.9% sheep but higher when compared 38% prevalence reported for sheep and goats by [4] from the Hawasa town. Much lower prevalence of 70% and 60% were recorded for *T. colubriformis*in sheep and goats respectively in the same area [39]. The prevalence of *M. expansa* in sheep (52.6%) and goats (47.4%) was agreement compared to 69% and 54.9% prevalence reported for sheep and goats respectively by [4] from the Hawasa town. Much higher prevalence when compare within 13% and 29.2% recorded for *T. colubriformis* in sheep and goats respectively in the same area [3].

The degree infection of T. columbriformis between species was 63.8% and 68% in sheep and goats respective. There was agreement when compare within 64.6% and 67.6% in sheep and goats study by Aragaw and Gebreegziabher and Bitew at hawasa town. The degree infection of *B.trigonocephalum* between species was 46.7% and 46.4% in sheep and goats respective. It is disagreement when compared degree of infection (0%) in both sheep and goats study at hawasa town by Aragaw and Gebreegziabher and Bitew in which the majority of *T. colubriformis* infections were light and all of the *B. trigonocephalum* infections were moderate.

This may suggest the parasites incur insidious loss in the productivity of small ruminants in the study area. This may suggest the parasites incur insidious loss in the productivity of small ruminants in the study, area. However, concurrent occurrence of these parasites even with this light to moderate level, with others may lead to morbidity and even mortality.

Asignificant difference ($p>0.05$) was not observed in prevalence of the parasite on different age groups. Sheep and goats on the age of 6monthe-1years had higher prevalence than those with age 1-2 years (Table 2). The study found that the prevalence decreased as age increased. This is in agreement with the research done by [4]. Even though the reasons underlying age resistance are not well known, the possible explanation of this may be the development of acquired immunity and immune-competence increase as the age increases due to high rate of exposure to parasitic infestations [3,4] stated that young animals are highly susceptible due to immunological immaturity and immunological unresponsiveness.

Conclusion and Recommendations

The present study was based solely on post mortem examination for detection of adult helminthes. The post mortem examination evidenced the presence of small intestine helminthes infection in the study areas. Observation on the present study conducted on sheep and goats of small intestinal helminthes for six months in ELFORA export abattoir showed that helminthes of sheep and goats is the most prevalent disease in the area affecting the health of the animals in both species of animals examined; the species of parasites identified were the same for small intestines. The parasites identified were *T.columbriformis*, *B.trigonocephalum* and M.expansa form small intestine species and age were considered as possible risk factors included in the present study. There was significant difference on age and species. The study indicated that sheep were infected than goats. This may be due to the grazing habit of sheep. In addition to these 6months-1 years animals were affected than > 1year this may be due to immunological immaturity and most of the animals in the study area are affected with light to moderated degree of infestation.

Based on the above conclusive remarks the following recommendations were forwarded:

- Education and awareness creation of farmers with regards of epidemiology of parasitic diseases and choosing of the best parasitic control strategy and possible management systems should be given through strong extension.
- More detailed studies should be conducted to determine the losses associated with helminthes infections in sheep and goat and to pin point appropriate parasitic control strategy.

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How to cite this article: Hurisa, Getu and Yimer Lama. "Small Intestinal Helminthes of Sheep and Goats Slaughtered at Bishoftu Elfora Export Abattoir, Ethiopia." *J Vet Sci Techno*12 (2021) : 14013