

Study On The Prevalence Of Git Nematodes On Small Ruminants In And Around Kombolcha Town, North Eastern, Ethiopia

¹Desalegn Sisay, ²Hailehizeb Cheru, and ³Belsity Shumet, and ⁴Bewuketu Anteneh

¹Sinor clinical expert at Lumame Veterinary clinic, Lumame, Ethiopia. ²Lecturer at burie poly technic college department of animal health P.o.box. 75, Burie, Ethiopia, ³ Sinor clinical expert at Kuy Veterinary clinic, Kuy, Ethiopia. ⁴Sinor clinical expert at Lumame Veterinary clinic, Lumame, Ethiopia
haile12cheru12@gmail.com; Telephone: +251921165854

Abstract:-A cross sectional study was carried out to determine the prevalence and risk factors associated with small ruminant gastrointestinal nematode infestation by fecal examination and fecal culture of 384 small ruminants in and around kombolcha. Out of the total sampled, 162 (42.2%) small ruminants which were 111 (47.2%) sheep and 51 (34.2%) goats were positive for 5 genuses of nematodes. The most prevalent were *Haemonchus*, which known to be the most pathogenic among small ruminant nematodes and occurred in 15.9% (OR=3.57, CI=2.46-5.16) and 17.2% (OR=2.14, CI=1.38-3.32) with mixed infections with *Trichostrongylus* followed by *Trichuris* (19.7%) with OR=1.92, CI=1.20-3.07, *Trichostrongylus* (12.9%) with OR=1.93, CI=1.31-2.86 and *Oesophagostomum* (13.5%) with OR=4.04, CI=2.89-5.55. The prevalence of gastrointestinal nematode infection showed a significant difference ($p < 0.05$) between young and adult age groups, poor, medium and good body conditions, male and female sexes, ovine and Caprine species, and history of treatment. There was significant association between the gastrointestinal nematode infection and animals with different age group, and body condition. Due to its important health problem and impact on production in the study area, emphasis should be given for the control and prevention of gastrointestinal nematode infection with further studies on species identification.

[Desalegn S, Hailehizeb C, Belisty S. **Study On The Prevalence Of Git Nematodes On Small Ruminants In And Around Kombolcha Town, North Eastern, Ethiopia.** *Researcher* 2017;9(10):57-64]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). <http://www.sciencepub.net/researcher>. 10. doi:10.7537/marsrsj091017.10.

Key words: *Gastrointestinal nematode, goat, kombolcha, prevalence, sheep, small ruminant*

1. Introduction

Ethiopia is endowed with abundant livestock resources of varied and diversified genetic roles with specific adaption to its wide range of agro ecologies. The country is claimed to have the largest livestock population of 47.5 million cattle, 26.1 million sheep 21.7 million goat, 7.8 million equines, 1 million camel, 39.6 million chickens (CSA, 2009). The small ruminants which are well adapted to local climatic and nutritional conditions and contribute greatly to national economy which provides a vast range of products and services such as meat, milk, skin, hair, horns, bones, manure and urine, security, gifts, religious rituals and medicine (Alemayehu and Fletcher, 1995). However, poor animal production and management (Ademosun, 1992) coupled with infectious and parasitic disease had lead to reduce productivity of small ruminants (Hailelell, 2002). By and large parasitic infections pose a serious health threat and limit the productivity of livestock due to the associated morbidity and mortality (Tibbo *et al.*, 2006; Nwosu *et al.*, 2007). More specifically, plethora of parasitic diseases plays detrimental role in hampering small ruminant production leading to serious economic loss (Teklay, 1991). Small ruminants managed under extensive and intensive production systems are extremely susceptible to the effect of

endoparasites (Abebe and Esayasu, 2001). GIT nematodes of sheep and goats are among the endoparasite infections that are responsible for economic loss through reduce productivity and increased mortality (perry *et al.*, 2002). The loss through reduced productivity is related to reduction of food intake, stunted growth, reduced work capacity, cost of treatment and control of GIT nematodes (Pedreira *et al.*, 2006; Odoi *et al.*, 2007; Chaudhary *et al.*, 2007). The effect of infection by gastrointestinal parasites various according to the parasite concerned, the degree of infestation and other risk factors such as species, age, season and intensity of warm burden (perry *et al.*, 2002). Although considerable work has been done on endo parasites of sheep and goats in many parts of Ethiopia (jobre & Ali, 2000; Abebe & Esayasu 2001; Regassa *et al.*, 2006; Kumsa *et a.*, 2010; Dagnachew *et al.*, 2011) and losses from clinical and sub clinical level including losses due to inferior weight gains, lower milky yields, condemnation of carcasses at slaughter and mortality in massively parasitized due to parasitic diseases were documented (Tilahun, 1995; Regassa *et al.*, 2006). However, no reports so far have been published on the prevalence of small ruminant GIT nematodes in the present study areas, where sheep and goats are important assets to local farmers. Hence, it is

imperative to investigate the level of the parasitism; the type of GIT nematodes and the associated risk factors that make small ruminants susceptible to the wide range of gastrointestinal nematodes in an area, in order to devise effective control measure and monitor their outcome properly.

Therefore the objective of this study is to determine the prevalence and to establish the relationship between risk factors of GIT nematodes and their prevalence and identify the most prevalent nematode in small ruminants in and around Kombolcha, North eastern, Ethiopia.

2. Materials And Methods

2.1 Study area

The study was conducted starting from November 2013 to April 2014 in and around kombolcha town which is found in Amhara region south wollo zone, Northern Ethiopia. It is found 380 Km away from Addis Ababa and 24 Km from Dessie. It has latitude and longitude of $11^{\circ}4' N$ $39^{\circ}44' E$ and $11.06^{\circ} N$ $39.733^{\circ} E$ and its elevation is between 1500-1847 above sea level. The area is characterized by bimodal rain fall with the average rain fall of 6000mm and the minimum and maximum temperature varies $11.7^{\circ} C$ to $24^{\circ} C$ and the soil type of the area consists of vertisil and sandy type of soil with vegetation type which varies from larger tree to bushes (CSA, 2009).

2.2. Study population

Indigenous sheep and goats are reared under small holder farming system and extensive management system in and around kombolcha were used during the study period with different age and sex groups. A total of 384 fecal samples was collected and examined for GIT nematodes. Examined animal can be categorized into two age's groups as adult above one year and young less than one year (Kumsa, 2010). Which was determined by asking the owner of animal orally and also the animal was categorized into their body condition (good, medium and poor).

2.3. Study design

A cross-sectional study was carried out from November 2013 to April 2014 to determine the prevalence of small ruminant nematodes. All sheep and goats selected at random and the address, species, age, sex, body condition scores and history of treatment were recorded. It was designed to fulfill the objectives of the study.

2.4. Sample Size and Sampling Methods

Simple random sampling strategy was followed to collect feces from the individual animals. To calculate the total size, the sample size was decided based on the formula described by Thrusfield (2007) with 95% confidence interval at 5% desired absolute precision and assumption of the expected prevalence 50% since no previous report in this area.

$$N = 1.96^2 \times p(1-p)/d^2$$

Where N= Sample size

P= expected value

d= desired absolute precision

Then by taking $p=50\%$ and $d=5\%$

$$N = 1.96^2 \times 0.5(1-0.5)/0.05$$

$$N = 384$$

2.5. Study methodology

2.5.1. Study type

Cross sectional study method was followed in this study.

Fecal sample was collected directly from the rectum of each animal and placed in a sample collecting bottle (screw capped bottle) and transport to laboratory.

During every sampling of study animal information on sex, breed, and approximate age of individual animals, body condition, health status, owners name and origin was recorded.

For coproscopic examination of the fecal samples, a simple test tube flotation technique described by Hansen and Perry (1994) was employed and the slides prepared were examined under microscope ($\times 10$). Eggs of the different nematodes were identified on the base of morphological appearance and size of eggs (Foreit, 1999).

2.5.2. Faecal cultures

Faecal samples from animals of the same species and flock whenever positive for nematode eggs was pooled and cultured for harvesting third stage larvae and identification of the most important genera of non-distinguishable nematode eggs in sheep and goats according to Hansen and Perry (1994). Pooled faecal samples was broken up using stirring device, kept moist and crumbly; the mixtures transferred to Petri dishes and placed at $27^{\circ} C$ for 7 to 10 days. The samples was kept humid, mixed occasionally and be aerated every 1-2 days. During this period the larvae was hatched from the eggs and developed into L_3 . Finally larvae were recovered using the Baermann technique (Hansen and Perry, 1994). From each culture, the third-stage larvae (L_3) was morphologically differentiated and identified according to keys provided (Hansen and Perry, 1994).

2.6. Data analysis and management

All the data that was collected (age, species, sex, BCS and history of treatment entered to Ms excel sheet and analyzed by using SPSS 16.0 version software. Descriptive statistics' was used to determine the prevalence of parasites, chi-square test (χ^2) was used to look the significance difference between ages, species, sex, BCS and history of treatment of the host with parasites, and factors with $P < 0.2$ were analyzed with binary logistic regression to determine strength of association by their odd ratio. In all the analysis,

confidence level held at 95% and $P < 0.05$ was considered as statistically significant factor.

3. Results

A total of 384 small ruminants were examined for investigation of the prevalence of GIT nematodes in and around kombolcha town November 2013 to

April 2014. Out of this 47.2% and 34.2% are with GIT nematodes in sheep and goats respectively.

The total prevalence of GIT nematode infestation in the study area is 42.2% for 5 genera of nematodes. For the occurrence of GIT nematodes different risk factors were under taken. These are age, sex, body condition score, history of treatment and species.

Table 1: The prevalence of GIT nematodes in relation to sex of the animals

Sex	No of animal examined	No of positive with %	$X^2(P)$	OR (CI)
Male*	188	68(36.2%)		
Female	196	94(48.0%)	5.5(0.02)	1.63(1.2-3.54)
Total	384	162 (42.2%)		

Male* determinant

From the above table There was association on the prevalence of small ruminant nematode and sex of the animal ($x^2 = 5.5$, $p < 0.05$). The prevalence is high in female animals (48.0%) as compared with male animals (36.2%). Female animals was 1.63 times at risk (OR=1.63, CI=1.2-3.54) than those Males (Table 1).

Table 2: The prevalence of GIT nematodes in relation to age of the animals

Age	No of animal examined	No of positive with %	$X^2(P)$	OR (CI)
Adult*	212	70(33.0%)		
Young	172	92(53.5%)	16.3(0.000)	2.28(1.51-3.45)
Total	384	162 (42.2%)		

Adult* determinant

There was strong association on the prevalence of small ruminant nematode and age of the animal ($x^2 = 16.0$, $p < 0.05$). The prevalence is high in young animals (53.5%) as compared with adult animals (33.0%). Young animals was 2.28 times at risk (OR=2.28, CI=1.51-3.45) than those adults (Table 2).

Table 3: The prevalence of GIT nematodes in relation to BCS of the animals

BCS	No of animal examined	No of positive with %	$X^2(P)$	OR (CI)
Good*	51	16(31.4%)		
Medium	259	96 (37.1%)	13.6(0.000)	3.54(2.1-6.12)
Poor	74	50(67.6%)	24.8(0.004)	4.17(1.95-8.90)
Total	384	162 (42.2%)		

Good* determinant

There was very strong association on the prevalence of small ruminant nematode and BCS of the animal ($x^2 = 24.8$, $p < 0.05$). The prevalence is high in poor animals (67.6%) as compared with medium (37.1%) and good (31.4%). Poor BCS animals was 4.17 times at risk (OR=4.17, CI=1.95-8.90) than good BCS animal and likely medium BCS animals was 3.54 times at risk (OR=3.54, CI=2.1-6.12) than good BCS animals (Table 3).

Table 4: The prevalence of GIT nematodes in relation to history of treatment of the animals

History of treatment	No of animal examined	No of positive with %	$X^2(P)$	OR (CI)
Treated*	81	18 (22.2%)		
Not treated	303	144 (47.5%)	16.8(0.000)	3.21(1.82-5.68)
Total	384	162 (42.2%)		

Treated* determinant

There was strong association on the prevalence of small ruminant nematode and history of treatment of the animal ($\chi^2= 16.8$, $p<0.05$). The prevalence is high in treated animals (47.5%) as compared with animals not treated (22.2%). Non treated animals was 3.21 times at risk (OR=43.21, CI=1.82-5.68) than treated animals (Table 4).

Table 5: Fresh fecal examination result in relation with animal species

Species	No of animal examined	No of positive with %	χ^2 (P)	OR (CI)
Caprine*	149	51(34.2%)		
Ovine	235	111(47.2%)	6.3(0.012)	1.72(1.32-4.21)
Total	384	162 (42.2%)		

Caprine* determinant

There was association on the prevalence of small ruminant nematode and species of the animal ($\chi^2= 6.3$, $p<0.05$). The prevalence is high in ovine animals (47.2%) as compared with Caprine animals (34.2%). Ovine was 1.72 times at risk (OR=1.72, CI=1.32-4.21) than Caprine with the infestations of GIT nematodes (Table 5).

Table 6: Prevalence on nematode based on odds ratio

	Count	%	P (χ^2)	OR (CI)
Haemonchus Goat* Sheep	25	15.9	(0.00)19.34	3.57(2.46-5.16)
Trichostrongylus Goat* Sheep	21	12.9	(0.00)19.63	1.93(1.31-2.86)
Trichuris Goat* Sheep	32	19.7	(0.00)20.12	1.92(1.20-3.07)
Oesophagostomum Goat* Sheep	22	13.5	(0.00)19.16	4.04(2.89-5.55)
Bunostomum Goat* Sheep	11	6.7	(0.00)18.65	3.17(2.71-3.68)
Haemonchus & Trichostrongylus Goat* Sheep	28	17.2	(0.00)19.86	2.14(1.38-3.32)
Trichostrongylus & Oesophagostomum Goat* Sheep	4	2.5	(0.00)18.65	3.96(2.34-6.71)
Haemonchus & Oesophagostomum Goat* Sheep	6	3.7	(0.00)17.55	1.91(1.71-8.27)
Haemonchus & Bunostomum Goat* Sheep	11	6.7	(0.00)18.25	2.37(2.37-2.38)
Trichostrongylus & Bunostomum Goat* Sheep	2	1.2	(0.00)16.75	1.28(1.01-2.24)
Total	162	100		

Goat* determinant

Ovine were 3.57 times at risk (OR=3.57, CI=2.46-5.16) with *Haemonchus* infection compared with Caprine, likely those infected with *Trichostrongylus* & *Oesophagostomum* 3.96 times at risk (OR=3.96, CI=2.34-6.71) compared with Caprine (Table 6).

4. Discussion

Out of 384 small ruminants constituted under the study, 235 sheep and 149 goats were examined for GIT nematode infections. Out of these, the overall prevalence was 42.2% has been obtained. The overall prevalence in sheep and goat was 111 (47.2%) and 51 (34.2%) respectively which is in agreement with the study conducted by (Walemehret *et al.*, 2012) in sheep (56.25%) and in goat (35.33%) at Mekelle town in northern Ethiopia.

In this study, a higher prevalence of GIT nematode parasites were observed in sheep than in goats which is in agreement with the work of Teklay, (1991) in Ethiopia and outside Ethiopia (Waruiru *et al.*, 2005, Asif *et al.*, 2008). This is assumed to be due to the grazing habit of sheep where they graze closer to the ground fostering opportunity of exposure to parasites. However, it is in contrary to other reports (Abebe and Esayasu, 2001, Regassa *et al.*, 2006) in western and eastern parts of Ethiopia and abroad (Keyyu *et al.*, 2006). In this regard, beside the grazing habit of the sheep, the grazing area of small ruminant practiced in the study area could put the goats in a risk of acquiring the infection from sheep (Dagnachew *et al.*, 2011). Furthermore, it is assumed that sheep do have a considerably poor immunological response to gastrointestinal parasites compared with that of goats (Urquhart *et al.*, 1996).

In this study, a significant difference was observed in GIT nematode infection in relation to body condition where a higher prevalence of nematodosis was recorded in poor body condition animals compared to medium and good body condition of animals. This agrees with (Keyyu *et al.*, 2006 and Regassa *et al.*, 2006). This poor body condition might be due to malnutrition, other concurrent disease or the current parasitic infection which lead to poor immunological response to infective stage of the parasite.

In the present study, an animal with young age have higher prevalence of nematodosis, which could be related to their higher susceptibility to infection than adults which is statically significant. This is in agreement with reports in Ethiopia (Regassa *et al.*, 2006, Dagnachew *et al.*, 2011) and elsewhere in the world (Keyyu *et al.*, 2006, Nganga *et al.*, 2004, Githigia *et al.*, 2005). Asanji and Williams (Taswar *et al.*, 2010) also stated that young animals are highly susceptible due to immunological immaturity and

immunological unresponsiveness. Urquhart *et al.*, (1996) and Dagnachew *et al.*, (2011) have documented that adult and old animals develop acquired immunity against nematode infections as they get mature due to repeated exposure and this will help expel the parasite before it establishes itself in the GIT. On the contrary, there are instances where younger animals were reported to be resistant to parasitic infection (Taswar *et al.*, 2010).

Small ruminant which was not treated showed a higher nematode infection than those small ruminants which were treated which is statically significant. This is in agreement with reports in of (Regassa *et al.*, 2006, Dagnachew *et al.*, 2011). This assumed due to inhibition to the growth of nematode parasite in treated small ruminant and multiplication of the nematode parasites in not treated sheep and goats which leads compromization of immune system. Wang *et al.*, (2006) documented the presence of interaction and compromization of the immune system of the host by mixed infections described increase in their susceptibility to other diseases or parasites.

Female animals showed a higher infection rates than males with a significant difference between them. It is assumed that sex is a determinant factor influencing prevalence of parasitism (Maqsood *et al.*, 1996) and females are more prone to parasitism during pregnancy and per-parturient period due to stress and decreased immune status (Urquhart *et al.*, 1996). Dagnachew *et al.*, (2011) reported a higher prevalence of nematode infection in females.

The current study has shown the presence of mixed infection characterized by the presence of two or more nematode parasites both in sheep and goats which agrees with the findings of other researchers in the country (Abebe and Esayasu, 2001, Regassa *et al.*, 2006, Tefera *et al.*, 2011, Kumsa *et al.*, 2011) and elsewhere (Waruiru *et al.*, 2005, Asif *et al.*, 2008, Ageyi, 2003, Githigia *et al.*, 2005). These Mixed infections have been suggested to be an important cause of morbidity and loss of production in sheep and goats (Kumsa *et al.*, 2011). Moreover, the presence of interaction and compromization of the immune system of the host by mixed infections described increase in their susceptibility to other diseases or parasites (Wang *et al.*, 2006).

5. Conclusion And Recommendation

The present study was based solely on coproscopic examination and fecal culture for detection of gastrointestinal nematode eggs and larvae; it has provided an insight to the current prevalence and associated risk factors. It suggested that small ruminant gastrointestinal nematodes are of the major helminthosis in and around Kombolcha. Age, body condition sex and history of treatment are the most

prominent risk factors associated with gastrointestinal nematode infection. In addition, weak status of animal health services and lack of proper management, especially in the study area, crop-livestock mixed farming is highly practiced, and most land is cultivated so that many species of animals are kept together on marginal and a piece of land. However, they give low priority to small ruminant in respect to the value they obtained from them. They give the first line to draught and dairy animals and forced sheep to graze behind on overstocked areas which lead them to graze close to the ground and on fecal Materials, resulting in the uptake of higher numbers of infective larvae.

On the basis of the above conclusion and the present findings, the following recommendations are forwarded:

✚ Detailed study should be conducted to clearly identify parasitic fauna using fecal culture and postmortem examination in the study area. .

✚ Treat small ruminant with broad spectrum anthelmintic to reduce the worm burden and minimize pasture contamination with larvae.

✚ Separating the most susceptible young animals from adults, this is a possible source of contamination. .

✚ Education of farmers on the effects of parasites.

Acknowledgements

First and foremost, I would like to praise my almighty of God for his forgiveness and endless mercy as well as help me to pass the bad challenge of my life. I am greatly express my heartfelt gratitude to my advisor Dr. Andualem Yimer, he has been with me through the course of this seminar paper preparation by providing materials, counseling and editing the paper in expense of his golden time. I am also grateful to my friends: Girma, Adnew, Seada, and Sinke for their unreserved and friendly support.

References

1. Abebe W, Esayas G (2001). Survey on ovine and Caprine gastro- intestinal helminthosis in eastern part of Ethiopia during the dry season of the year. *Revue Vet. Med.*, 152(5):379-384.
2. Ademosun A A (1992). Constraints and prospects for small ruminant's research and development in *Africa. Small Rum. Dev. Afr.*, Pp.1-5.
3. Ageyi, A. D., 2003. Epidemiological studies on gastrointestinal parasitic infection of lambs in the costal savanna regions of Ghana. *Trop. Anim. Health Prod.*, 35: 207-217.
4. Alemayehu Z, and Fletcher I (1995). Small ruminant productivity in the central Ethiopian mixed farming system. Institute of Agricultural Proceeding, 4: 1941-1947.
5. Anene, B. M., onyekwo: dir: E. O; Chime, A. B; Anika, S. M (1994): Gastrointestinal tract parasites in sheep and goats of southern Nigeria, small ruminant Research, 13, 187-192.
6. Asif, M., S. Azeem, S. Asif 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.
7. Belschner, H. G. (1976): Sheep management and diseases. 10th ed. Australia: Angus and Robertson publisher. Pp. 580-610.
8. Bowman, D. D. (1999): Georgis parasitology for Veterinarian's 7th ed. USA: W. B. Saunders company, Pp. 144-220.
9. Chaudhary FR, Khan MFU, Qayyum M (2007). Prevalence of *Haemonchus contortus* in naturally infected small ruminants grazing in the Photohar area of Pakistan. *Pakistan Vet. J.*, 27 (2): 73-79.
10. Chiejna, S. N; Fake, B. B; Eze, PI. (1989). Development and survival of free living stages of gastrointestinal nematodes of sheep and goats on pasture in the Nigerian derived savannah. *Veterinary Research Communications*, Netherlands: Kluwer Academic, 13, 103-112.
11. Craig, T. M. (1998): Epidemiology of internal parasites. In veterinary conference, Las- vegas, Feb.1-5/1998, WBC 986, Pp. 29-37.
12. CSA (2009). Central Statistical Authority Federal Democratic Republic of Ethiopia Agricultural Sample Enumeration Abstract.
13. Dagnachew S, Amamute A, Temegen W (2011). Epidemiology of gastrointestinal helminthiasis of small ruminants in selected sites of North Gondar zone, Northwest Ethiopia. *Ethiop. Vet. J.*, 15 (2): 57-68.
14. Demelash, B; Etana, D., Sintayehu, Y. (2004): Effects of compressed piling and microclimate conditions of faces on developments of free-living stages of gastro intestinal nematodes of cattle. *Ethio Vet j.*, 8 (2), 75-84.
15. Douch, P. G. C Morum, P. E (1993): The effect on the response of Romney sheep to GI Nematodes during grazing. *Int. J. Parasitol.*, 23 (5), 651-655.
16. Drug Administration Control Authority of Ethiopia (DACA). (2006): Standard Treatment Guidelines for Veterinary Practice. 1st Edition, chamber printing house, Ethiopia. P: 77.
17. Dunn, A. M. (1978); *Veterinary Helmenthology* 2nd ed. London: William Heinemann Medical books Ltd, Pp 19-35, 173-191.
18. Eysker, M. (1997): Some aspects inhibited development of Trichostrongyles in ruminants. *Vet. Parasitol.*, 72 (3 & 4), 265-283.

19. Eysker, M., Ploeger, H. W. (2000): Value of present diagnostic methods for gastrointestinal nematode infections in ruminants, symposia of the British society for parasitology, Uk, Cambridge University Press, 2000, 37, 109-119.
20. Foriet W (1999). In: Reference Manual of *Vet. Parasitol.*, 5th (ed). Wiley Blackwell, New York, USA, Pp. 22-26.
21. Fritsiche, T., Kaufmann, J., Pfister, K. (1993): Parasite spectrum and seasonal epidemiology of gastro intestinal nematodes of small ruminants in the Gambia. *Vet. Parasitol.*, 49 (3 & 4), 271-283.
22. Gatong, P. M; Pichard; R. K., Ranjan, S., Gathuma, J. M., Munyum, W. K., Cheruiyot, H., Scott, M. E (1998): Hypobiosis of *Haemonchus contortus* in natural infections of sheep and goats in semi arid areas of Kenya. *Vet. Parasitol.*, 77 (1), 49-61.
23. Githigia, S. M., S. M. Thamsborg, N. Maingi and W. K. Munyua, 2005. The epidemiology of gastrointestinal nematodes in Goats in the low potential areas of Thika District, Kenya. *Bull. Anim. Health Prod. Afr.*, 53: 5-12.
24. Gray, G. D. (1997): The use of genetically resistant sheep to control nematode parasitism. *Vet. Parasitol.*, 72 (3 & 4), 345-366.
25. 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, p. 353.
26. Hansen J, Perry B (1994). The Epidemiology, Diagnosis and Control of Helminth Parasites of Ruminants. 2nd edition. Nairobi, Kenya.
27. Hendrix, C. M. (1998): Diagnostic veterinary parasitology 2nd ed. USA: Mosby, Inc., Pp 108-116, 136.
28. Jobre Y, Ali M (2000). Dry season bovine fasciolosis in northwestern part of Ethiopia. *Revue Med. Vet.*, 151(6): 493-500.
29. Kaufmann, J. (1996): Parasitic infections of domestic animals: A diagnostic manual. Germany: Birkauserverlag; Pp. 152-166.
30. Kelly, J. D. (1973): Immunity and epidemiology of Helmenthosis in grazing animals. *Newzeland Vet. J.*, 21 (9), 183-191.
31. Keyyu, J. D., A. A. Kassuku, L. P. Msalilwa, J. Monrad and N. C. Kyusgaard, 2006. Cross sectional prevalence of helminth infections in cattle on traditional, small scale and large-scale dairy farms in Iringa district, Tanzania. *Veterinary Research Communications*, 30: 45-55.
32. Kumsa B, Tolera A, Nurfeta A (2010). Comparative efficacy of seven brands of albendazole against naturally acquired gastrointestinal nematodes in sheep in Hawassa, Southern Ethiopia, and Turk. *J. Vet. Anim. Sci.*, 34: 417-425.
33. Kumsa, B., T. Tadesse, T. Sori, R. Dugum and B. Hussen, 2011. Helminths of sheep and goats in Central Oromia (Ethiopia) during the dry season. *J. Anim. Vet. Adv.*, 10: 1845-1849.
34. Maqsood, M., Z. Igbai and A. H. Chaudhry, 1996. Prevalence and intensity of haemonchosis with reference to breed, sex and age of sheep and goats Pakistan. *Vet. J.*, 16: 41-43.
35. Ndamukong, K. J. N, mbom: S. E; killanga, s. (1994): stocking rate of sheep and survival of helminth infective larvae on brachiaria pastures. Small ruminant research and development in Africa, Proceeding of the second Biennial conference of African small ruminant research network. AICC, ARUSHA, Tanzania, 7-11 December 1992. ILCA/TCTA, September, 1994. Addis Ababa, Ethiopia, Pp 127-131.
36. Nganga, C. J., N. Maingi, W. K. Munyua and P. W. Kanyari, 2004. Epidemiology of gastrointestinal, helminthes infection in dorper sheep in semi-arid area of Kenya. *Ondestepool J. Vet. Res.*, 71: 219-226.
37. Nwosu CO, Madu PP, Richards WS (2007). Prevalence and seasonal changes in the population of gastrointestinal nematodes of small ruminants in the semi-arid zone of north-eastern Nigeria. *Vet. Parasitol.* 144: 118-124.
38. Odoi A, Gathuma JM, Gachuri CK, Omore A (2007). Risk factors of gastrointestinal nematode parasite infections in small ruminants kept in smallholder mixed farms in Kenya. *BMC Vet. Res.*, 3 (6): 1186-1746.
39. Pedreira J, Silva AP, Andrade RS, Suarez JL, Arias M, Lomba C, Diaz P, Lopez C, Banos PD, Morrondo P (2006). Prevalence of gastrointestinal parasites in sheep and parasite control practices in North-West Spain. *Prev. Vet. Med.*, 75: 56-62.
40. Perry BD, Randolph TF, McDermott JJ, Sones KR, Thornton PK (2002). Investing in animal health research to alleviate poverty. International Livestock Research Institute (ILRI), Nairobi, Kenya, p. 148.
41. Radostitis, O. M., Gay, C. C., Blood, D. C; Hinchliff, K. W. (2000): Veterinary Medicine. A text book of disease of cattle, sheep, pig, goat and horse. 9th ed. USA, W. B. Saunders Company Ltd, Pp 1339-1352.
42. Rahman, W. A, Collins, G. H. (1991): Challenges in live weight gain and blood constituents in experimental infections of goat with a goat derived compared with a sheep derived strain of *Haemonchus contortus*. *Vet. Parasitol.*, 38 (283), 145-153.

43. Regassa F, Teshale S, Reta D, Yosef K (2006). Epidemiology of gastrointestinal parasites of ruminants in Western Oromyia, Ethiopia. *Int. J. Appl. Res. Vet. Med.*, 4 (1): 51-57.
44. Silva, W. W., Bevilaqua, C. M. L., Costa, A. L. (1998): Natural evolution of international nematodes in goats in the semi- arid ecosystem of the paraibaback woods, north- eastern Brazil. *Vet. Parasitol.*, 80 (1), 47-52.
45. Smith, M. C; Sherman, D. M. (1994): Goat Medicine. USA: Williams and Wilkins, Pp 321-350.
46. Souisby, E. J. L. (1982): Helminths, Arthropods and Protozoa of domestic animal. 7th ed. London: Bailliere, Tindall and Cassell. Pp 136-228.
47. Soulsby E J W (1982). Helminths, Arthropods and Protozoa of Domesticated Animals, Seventh Edition. Bailliere Tindall, London: Lea and Febiger, Philadelphia, Pp. 212-258.
48. Stronburg, B. E (1997): Enviromental factors influencing transmission. *Vet. Parasitol*, 72 (3 & 4), 247- 264.
49. Taswar, Z., S. Ahmad, M. H. Lashari and C. S. Hayat, 2010. Prevalence of *Haemonchus contortus* in sheep at Research Centre for Conservation of Sahiwal Cattle (RCCSC) Jehangirabad, District Khanewal Punjab, Pakistan. *Pakistan J. Zool.*, 42: 735-739.
50. Tefera, M., G. Batu and M. Bitew, 2011. Prevalence of Gastrointestinal Parasites of Sheep and Goats in and Around Bedelle, South-Western Ethiopia. *Int. J. Vet. Med.*, 8: 2-5.
51. Teklay B (1991). Epidemiology of endoparasites of small ruminants in sub- saharan Africa. Proceedings of Fourth National Livestock Improvement Conference. Addis Ababa, Ethiopia, pp. 13-15. November 7-11.
52. Tembly, s; Lahlou, K. A; Rege, G. E. O; Sovani, S, Diedhiou, M. L, Baker, R. L. (1997): The epidemiology of nematode infections in sheep in cool tropical environment. *Vet. Parasitol.*, 70 (1-3), 129-141.
53. Thrusfield M (2007). Veterinary Epidemiology. Blackwell Science Limited, USA, Pp. 180-181, 224-225.
54. Tibbo M, Aragaw K, Philipsson J, Malmfors B, Nasholm A, Ayalew W, Rege JEO (2006). Economics of sub-clinical helminthosis control through anthelmintics and nutrition in indigenous Menz and Awassi-Menz crossbred sheep in Ethiopia. Unpublished.
55. Tilahun G (1995). Epidemiology of helminth parasites of small ruminants in mid lowland 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.
56. Troncy, P. M. (1989): Helminthes of livestock and poultry in tropical veterinary parasitology. UK: CAB International, TCTA, Pp.11-15, 24-54.
57. Upadhayay, A. K. (2005): Text book of preventive veterinary medicine as per VCL syllables International book distribution Co, India, Pp: 387-390.
58. Urquhart GM, Aremour J, Dunchan JL, Dunn AM, Jeninis FW (1996). Veterinary Parasitology 2nd ed. The University of Glasgow, Blackwell Sciences, Scotland, Pp. 3-137.
59. Walemeheret N, Basaznew B, Mersha C (2012). Helminth parasites in small ruminants: Prevalence, species composition and associated risk factors in and around Mekelle town, Northern Ethiopia, p. 92.
60. 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.
61. Waruiru, R. M., M. N. Mutune and R. O. Oteino, 2005. Gastrointestinal Parasite Infections of Sheep and Goats in a semi - arid area of Machakos District, Kenya. *Int. J App. Res. Vet. Med.*, 4: 51-57.