Study On Lung Worm Infection In Small Ruminants: Prevalence And Associated Risk Factors In Some Selected District Of North Gondarzone

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Abstract: Across sectional study of lung worm infection was conducted in three districts of North Gondar Zone namely, Gondar, Maksegnit and Dabat from November 2014 to April 2015 with the objectives of determining the prevalence of lung worm infection, identifying the species of lung worms involved in the infection and assessing the risk factors associated to the disease. For this purpose fecal samples of 313 sheep and 119 goats of all age groups and both sexes were examined by modified Bermann technique for the extraction of L_1 larvae and 100 small ruminant lungs were examined for identification of adult parasites. The finding indicated that an overall prevalence of 32.2%. The specific prevalence was found to be 21.4% and 60.5% in sheep and goats respectively (χ^2=60.396, P=0.000). *Mulleriuscapillaries* was the most identified species (20.8%) followed by *Dictyocaulusfilaria (*6.21%*)* and *Protostrongylusrufescens* (2.78%). A prevalence of 35.5% and 27.7% lung worm infection was observed in female and male animals, respectively. However, the variation was not statistically significant (χ^2=1.198, P= 0.274). There was a significant difference (p <0.05) in the infection rate among the study sites, age and management systems. The prevalence of *Mullerius capillaries* was the highest identified species by both postmortem (18%) and coproscopic (20.8%) examinations. In conclusion, Coproscopic and postmortem examinations revealed that lungworms belong to the major parasites that impaired the health and productivity of small ruminants in the study area. Finally, possible control measures of the disease are forwarded.

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1. Introduction

Sheep and goats are the most numerous of man's domestic livestock and are especially important in the more extreme climates. Of the worlds' 1,614 million sheep and 475 million goats, 65 and 95%, respectively, are located in developing countries. Small ruminants in Africa are noted for their ability to convert low cost feed into high value products, namely: meat, milk, fiber, manure and hides (Wilsmore, 2006; (FAO), 1986).

Ethiopian's livestock population is often said to be the largest in Africa and 10th in the world. Excluding the Afar and Somali regions there were approximately 45.57 million cattle, 26.1 million sheep, 21.7 million goats, 2.1 million horses and mules, 5.6 million donkeys, 1 million camel and 39.6 million poultry. For the Afar and Somali regions, estimated numbers vary greatly between conventional and aerial censuses, but total less than 15 percent of the non nomadic regions. Ethiopia has great potential for increased livestock population, both for local use and for export. However, expansion was constrained by inadequate nutrition, diseases, lack of support services and inadequate information on how to improve animal breeding, marketing and processing (CSA, 2009).

Small ruminants are especially important in the more extreme climates of the world. Their small size, high productive capacity and rapid growth rate make small ruminants a more flexible short term form of investment than cattle (ILCA, 1990).

Small ruminants are important contributors to food production in Ethiopia, providing 33% of meat consumption and 14% of milk consumption. Sheep and goats contribute a quarter of the domestic meat consumption; about half of the domestic wool requirement; 40% of fresh skins and 92% of the value of semi - proceed skin and hide export trade. There is a growing export market for sheep and goats meat in the Middle Eastern Gulf States and some African countries. At optimum off take rates, Ethiopia can export 700, 000 sheep and 2 million goats annually and at the same time supply, 1, 078, 000 sheep and 1, 128, 000 goats for the domestic market consumption annually (Tewodros *et al*., 2012).

Owing to their high fertility, short generation interval and adaptation even in harsh environments, sheep and goats are considered as investments and insurance to provide income to purchase food during seasons of crop failure and to meet seasonal purchases such as improved seed, fertilizer and medicine for rural households. Even these small ruminants are important components of the Ethiopian farming system, their contribution to food production, rural income and export revenue are far below than their expected potential. This is because small ruminant production is constrained by the compound effects of disease, poor feeding and poor management (Yitagele *et al.*, 2013).

Helminthes parasites of ruminants are ubiquitous with many tropical and subtropical environments of the world providing nearly perfect conditions for their survival and development. Although these parasites are widely prevalent, they can be less obvious than signs of other livestock diseases. Partly for this reason, infection with helminthes parasites are among the most established that high prevalence rates of the infection with less obvious signs are associated with poor production (Hansen and Perry, 1994).

In Ethiopia, farm animals are kept on pasture throughout the year and climatic conditions are favorable for the development and survival of infective stages or vectors. Helminthes parasites are therefore a major cause of economic loss. Major factors that contribute to the multiplication and sustainability of parasites are climate, ecology and systems of animal production (Sileshi and Desalegn, 2007).

The production loss due to helminthosis is also associated with direct consequences of clinical and subclinical infections resulting in low productivity due to stunted growth, reduced weight gain, poor feed utilization or loss due to mortality or indirect loss associated with cost of treatment and control measures (Ayalew, 1995). Among helminthes parasites, lung worm infection causes one of the significant losses in productivity of ruminants (Soulsby, 1986). The incidence of parasitic diseases, including respiratory helminthes varies greatly from place to place depending on the relative importance of the factors. Verminous pneumonia due to various lung worm species has been reported to exist in sheep and goats particularly in the high land areas of Ethiopia (Alemu *et al*., 2006).

Verminous pneumonia is infection of the lower respiratory tract resulting in bronchitis or pneumonia or both, by any of several parasitic nematodes including *Dictyocaulus viviparous* in cattle, *Dictyocaulusarnfieldi in* horses and donkeys, *Dictyocaulusfilaria*, *Muelleriuscapillaris* and *Protostrongylusrufescens* in sheep and goats (Soulsby, 2006). Dictyocaulidaeand certain Metastrongylidae are known to exist in East Africa (Ethiopia, Kenya and Tanzania) and the South Africa (Tony, 2006). In highland area of Ethiopia respiratory lungworm parasites are the most common cause of high morbidity and mortality rates of sheep (FAO, 2006; Alemu *et al.,* 2006)**.** The three respiratory parasites that cause a significant damage in small ruminant production are *Dictyocaulusfilaria*, *Protostrongylusrufescent* and *Muelleriuscapillarius.* These lungworms particularly *Dictyocaulusfilaria* can suppress the immunity of the respiratory tract and causes death, poor weight gain or loss of body weight as well as greatly affects the potential productivity of sheep industry in the areas where it is prevalent (Ibrahim and Degefa, 2012).

Prevention and control of these parasites are, therefore, critical to enhance the economic benefit from these species of livestock. However, the incidence of parasitic diseases including respiratory helminthosis varies greatly from place to place depending on the relative importance of factors (Alemu *et al*., 2006).

Therefore, the objectives of this thesis were:

- To determine the prevalence of small ruminant's lungworm infection in some selected districts of North Gondar zone based on fecal and post mortem examination.
- To assess the risk factors associated with small ruminants' lungworm infection in the study area.
- To identify species of parasites involved in the study areas.

3. Materials And Methods

3.1. Study area

The study was conducted in three districts of northwest Amhara region including Dabat, Maksegnit and Gondar town districts from October 2014 to April 2015. Gondar town is 748 km north of the capital city Addis Ababa and is 2220m above sea level, with 1172mm mean annual rainfall and 19.7^{o}C average annual temperature. Dabat is 70 km away from Gondar town. Dabat is 2500-3200m above sea level with a mean temperature of 12.5°C. The area is located at latitude 12.4°N and longitude of 27.25°E. Maksegnit is located at longitude and altitude of 12.3-13.8°N, 35.3-35.7°E and 2220m above sea level respectively with 1172mm mean annual rain fall and 19.7°C average annual temperature. The livestock Population is registered as cattle200,135, sheep 70,000, goat 81,000 and equine 21,000 in North Gondar Zone. Numerous mountains, plateaus, sloped areas, rivers, streams and lakes mark the topography of the area. The region receives a bimodal rainfall pattern**.** The short rains occur during the months of

March to May while the long rains extend from June to September. The production system observed in the area combines cereal-based agriculture and livestock farming (North Gondar Zone agricultural and development office, 2012; CSA 2009).

3.2. Study Population

The study population recruited for this study were small ruminants having different sex, age group, body conditions and from different areas and kept under extensive and semi-intensive management systems. Animals from Gondar town were managed under a semi-intensive system while the rest were under an extensive production system.

3.3. Study Design and Sampling Method

The study was a cross sectional study design with simple random sampling technique which was conducted from November 2014 to April 2015 to establish the prevalence and its associated risk factors of lung worm infection in the study area. The desired sample size was calculated using the standard formula described by Thrusfield (2005) using the following formula:

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

Where,

n= required sample size

Pexp= expected prevalence

d= desired level of precision

1.96^2 = z-value for the 95% confidence level

The prevalence of lung worm infection in Gondar town was reported to be 33.83% (Mekonnen *et al.,* 2011). Therefore, an expected prevalence of 33.83 % was taken to estimate the sample size. Taking 95% confidence level, 5 % precision and 33.83% expected prevalence 344 animals were need to establish the prevalence. However, 188 small ruminants have been included in the study to increase the level of precision and randomness, and a total of 532 small ruminants (477sheep and 155 goats from study districts) were used in this study. Three representative districts were purposely selected; Dabat, Maksegnitand Gondar town. Sampling animals was conducted at random from study districts and small ruminants slaughtered in Gondar town (63 sheep) and Maksegnit (37goats) from the restaurants and hotels.

3.4. Study Methodology

3.4.1. Coprological examination

Fecal samples were collected directly from the rectum of all selected animals and stored in vials within the icebox and transported to the Gondar university veterinary laboratory for examination. During sample collection, the species of the animal, sex, age, date of sampling and the area were properly recorded. In the laboratory, the collected fecal samples were processed according to conventional methods for lungworm larvae (Baermanization). Brifely, 5 -10 g of faeceswere weighed from each sample for the extraction of larvae using modified Baermann technique (Hansen and Perry, 1994). The feces were enclosed in a double gauze layer and fixed on the string rod and submerged in a clean glass tube filled with luke warm water to facilitate the migration of L_1 larvae through the gauze and settle at the bottom of the glass. The whole apparatus were left for overnight. After siphoning off the supernatant, the sediment was examined under the low power of the microscope (Fraser, 1991; Urquhart et al., 1996). All the area under the cover slip was thoroughly and uniformly searched for the presence of lungworm larvae (Hendrix, 1998).

3.4.2. Postmortem examination

Small ruminants slaughtered at Maksegnite and Gondar town restaurants and hotels were examined during the study period. The lungs were palpated for the presence of protostrogylidea nodules. These are brood nodules and worm nodules. Brood nodules are cone shaped granuloma-like areas of the affected lung tissue varying in size and color, which contains active worm and caused by parenchyma-dwelling small lungworms (Protostrongylidae). The worm nodules are pin head shaped mostly sub pleural, grey (*Mullerius*) cyst which contain adult worms. If the nodules are present, they are trimmed off and worms extracted from the tissue by gentle pressing of a small non-calcified nodule or part of large nodule between two glass slides and then carefully teasing the worm away from the tissue. The air passages will be opened starting from the trachea down to the small bronchi with fine blunt pointed scissors, to detect parasites (Kassai, 1999; Schneider, 2000).

3.5. Methods of Data Management and Analysis

The collected data were checked, coded and entered in to Microsoft excel work sheet and were analyzed using SPSS software version 20. Descriptive statistics like percentage was used to express prevalence and it was calculated as the number of positive small ruminants harboring the worms divided by the total small ruminants examined while chi-square ($\chi 2$) test was used to compare the association of lung worm infection with different risk factors. In all the cases, 95% confidence level and 0.05 absolute precision errors were considered. A p-value $\leq$ 0.05 was considered as statistically significant.

4. Result

4.1. Coprological Examination

In the present study a total of 432 fecal samples were examined by modified Baermann technique collected from three districts (Gondar, Maksegnit and Dabat) of North Gondar Zone of the Amhara Region to establish the prevalence of lungworm infestation in

small ruminants (313 sheep and 119 goats). The study result disclosed an overall prevalence rate of 32.2 %(139/432) lungworm infection. The recovery rate of lung worm was found to be 16.3%, 64.2% and 23.2% in Gondar, Maksegnit and Dabat districts, respectively (Table 1). There was a statistical significance difference (P<0.05) in infestation rate of lung worm in small ruminant between the three study sites (Table 1).

Table 1: Prevalence of lung worm infection in study sites

Study site	No examined	Positive	Prevalence	X^2	P- value
Gonder	86	14	16.3%	69.983	0.000
Maksegnit	109	70	64.2%		
Dabat	237	55	23.2%		
Total	432	139	32.2%		

Table 2: Prevalence of lung worm infection in sheep and goat

Species	No examined	Positive	Prevalence	X^2	P- value
Ovine	313	67	21.4%	60.396	0.000
caprine	119	72	60.5%		
Total	432	139	32.2%		

Table 3: Prevalence of lung worm infection on the basis of sex

Sex	No examined	Positive	Prevalence	X^2	P- value
Male	101	28	27.7%	1.198	0.274
female	331	111	35.5%		
Total	432	139	32.2%		

Table 4: Prevalence of lung worm infection on the basis of age

Age	No examined	Positive	Prevalence	X^2	P- value
Young	140	36	25.7%	3.963	0.047
Adult	292	103	35.3%		
Total	432	139	32.2%		

Table 5: Prevalence of lung worm infection in different body conditions

Body condition	No examined	Positive	prevalence	X^2	P- value
Poor	88	24	27.3%	2.599	0.273
Medium	221	69	31.2%		
Good	123	46	37.4%		
Total	432	139	32.2%		

In this study the prevalence of lung worm infection was estimated in small ruminants that were kept under extensive and semi-intensive management systems. The result disclosed higher prevalence (36.1%) in extensive management system than semi-intensive (16.3%). The difference was statistically significant (p<0.05) as shown in Table 6.

Table 6: Prevalence of lung worm infection under different management systems

Management System	No examined	Positive	prevalence	X^2	P- value
Semi- intensive	86	14	16.3%	12.434	0.000
Extensive	346	125	36.1%		
Total	432	139	32.2%		

Table 7: Identified lung worm species during fecal examination in small ruminant

Lung worm species	No animal examined (n =432)	
	No positive	Prevalence (%)
M.capillaris	90	20.8
D. filaria	27	6.21
P.rufescens	12	2.78
Mixed infection	10	2.31

Total	139	32.2%

Table 8: Prevalence of lung worm species in small ruminants during postmortem examination

Lung worm species	No animal examined (n =100)	
	No positive	Prevalence
M.capillaris	18	18%
D. filaria	8	8.0%
P. rufescens	4	4%
Mixed infection	14	14%
Total	44	44.0 %

Table 9: The overall prevalence of lung worm infection in small ruminants in the study areas.

Type of examination	**No examined**	**Positive**	**Prevalence**
Coproscopy	432	139	32.2%
Postmortem	100	44	44%

5. Discussion

Lung worm infection is a chronic and prolonged nematodosis that affects the lungs of Animals. In small ruminants, this disease is caused by *D. filaria, M. capillaris* and *P.rufescens* in most part of Ethiopia. It causes a significant financial loss through morbidity, mortality, carcass weight loss and high treatment costs.

The present study which was conducted in three districs (Gonder, Maksegnt and Dabat) of N. Gonder zone of the Amahara Region disclosed an overall prevalence of 32.2% lungworm infection in small ruminants. This finding is in line with the findings of Mekonnen *et al* (2011) at Gonder (33.83%), Mersha *et al* (2012) at Deneba, (30.46%) Northeast Ethiopia, Desta *et al.* (2013) at Ambo, Oromia (34.9%), Ethiopia and Gebreyohannes *et al* (2013) in Mekdela (28.6%). In contrary to the present finding, high prevalence rates were reported by Nibret *et al* (2011) in Wogera, Northern Ethiopia (67.69%), Mihreteab and Aman (2011) in Tiyo, South east Ethiopia (57,1%) and Eyob and Matios (2013) (72.44%) in Assela province, central Ethiopia. However, the result of the present study is higher than Kassa and Abdu (2013) and Ibrahim and Degefa (2012) Who reported prevalence rates of 20.2% and 13.4% in Bahr Dar and Mekele town, respectively. The possible explanation for such variation in the infection rate could be attributed to the variation in altitude, rain fall, humidity and temperature which favor the survival of parasites larvae in general and/or the presence or absence of snail intermediate host in case of *P. rufescens* and *M. capillaris* in the study sites. The variation could be also due to time of sampling, methods followed to detect the parasitic larvae, level of immunity of sampled animals and expansion of veterinary services and the intensification of nearby veterinary drug shop, which enable the farmers (animal owners) to have an access to control most prevalent small ruminant parasitic infection including lung worm parasites in small ruminants.

As shown in Table 2, the prevalence rate of lung worm infection was higher in goats (60.5%) than sheep (21.4%) ($X^2 = 60.396$, p = 0.000). This result is in coherent with the findings of Yitagel (2013), Alemu *et al*. (2006) and Woldesenbet and Mohamed (2012) who reported goats were more susceptible than sheep. This variation could be explained by the fact that goats are more susceptible to helminthes than sheep and acquire less immunity due to their grazing behavior (Wismore, 2006).

An attempt was made to Know the impact of sex on the prevalence of lungworm infection, the study clearly shown that sex had not any influence on the occurrence of lung worm infection (P>0.05). This result is in agreement with previous studysof Desta *et al* (2013), Mekonnen *et al* (2011)), Nibret *et al* (2011), Mihreteab and Aman (2011) and Basaznew *et al* (2012) who reported high prevalence rates in female than their counter male animals. On the other hand Nemat and Moghadam (2010) reported high prevalence of lungworm infection in male sheep than female. This difference might be due to the fact that improper distribution of samples between male and female animals and resistance to infection decrease at the time of parturition and during early lactation. This per parturient relaxation resistance may result in the female inability to expel adult worms which cause higher level of larvae detection (Radostits *et al*., 2007; Taylor *et al.*, 2007).

With regard to age, highest prevalence (35.3%) was observed in adult animals than young age groups (25.7%)**.** This finding is in line with the findings of Besaznew *et al* (2013) who reported higher prevalence rate in aged animals. The possible explanation for this similarity could be attributed to that young animals were kept near to home steady while adult animals were grazed far from homestead

on parasite contaminated grazing fields. In contrast, Nibret *et al* (2011), Mihreteab and Aman (2011), Mersha *et al* (2012) and Gebreyohannes *et al* (2013) reported that young sheep were found to be infected more than adults and lung worm infection decrease with increasing age of the animal. This might be associated with the fact that the apparent ability of the host to develop acquired immunity so that adult animals have the lowest infection and the lowest prevalence (Urquhart *et al.*, 1996).

Regardless of body condition, animals were almost infected equally with lung worms (X^2=2.599, P =0.273). This finding coincides with the finding of Mekonen *et al*., (2011). The possible explanation for this observation could be, Wight loss in small ruminants cannot be attributed to the lung worm infection alone since *haemonchuscontortus* and other Gastro- intestinal parasites could be encountered. Poor body condition could be also due to lack of feed or nutritional factors (Soulsby, 1982).

In this study, small ruminant kept under extensive management system had more infection (36.1%) than semi-intensive management system (16.3%) (P<0.05). The result is in accordance with the findings of Alemu *et al* (2006), Mekonnen *et al* (2011), Eyob and Matios (2013) and Yitagel *et al* (2013). This could be due to the fact that in extensive management system animals have achance of grazing in the field contaminated with intermediate host for *P. rufescens*and *M.capillaris*; or are they possibly infested with larvae as well as easily obtained *D. filaria*from the herbage and on other hands management practice such as provision of ample nutrition increases the resistance of the host under the semi- intensive management system (Soulsby, 1986).

In this study, *M. capillaris*was the most identified lung worm species (20. 8%) followed by *D. filaria* (6.21%) and *P. rufescens* (2.78%) in samall ruminants. This result agrees with the previous findings of Yitagel *et al.* (2013) and Basaznew *et al. (2012)* but it disagrees with the findings of Alemu *et al.* (2006*),* Mihreteab and Aman (2011) and Eyob And Matios (2013) who reported higher prevalence of *D. filaria*. The reason for the predominance of *M. capillaris*in the study area might be attributed to the presence of favorable environmental conditions for the breeding and development of the snail intermediate hosts and the parasite larvae (Taylor *et al*., 2007).

Evaluation of the overall prevalence of lung worm infection was found to be higher in postmortem examination (44%) than the result obtained by coproscopic examination (32.2%). The possible explanation for this variation could be attributed to the fact that larvae of the parasite are absent when the adult parasites are in the prepatent, postpatent phase or during hypobiosis. Furthermore, egg laying adult female parasites might be inhibited by immune reaction of the host (Hansen and perry, 1994).

6. Conclusion And Recommondation

The study was conducted in three districts of North Gondar zone Of the Amhara Region, to determine the prevalence of lung worm infection in small ruminants. Coproscopic and postmortem examination revealed high prevalence of lung worm infections. *M.capillaries, D. filarial,* and *P. rufescens*were in counter during the study period. Lung worm infection is considered as important health problem of small ruminants in the study. Therefore, the following recommendations are forwarded.

- ❖ Restriction of small ruminants to graze in swampy and marsh areas.
- ❖ Treating small ruminants with appropriate anthelmentics twice a year before and after rainy seasons.
- ❖ Keeping young animals and adult animals and also sheep and goats separately if possible.
- ❖ Further epidemiological investigation should be conducted to understand the distribution and the magnitude of the infection in the study sites.

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References

1. Aitken, I.D. (2007): Diseases of sheep. 4th ed. Oxford, UK: Blackwell puplishing; Pp: 236-238.
2. Alemu, S., Esayas, G; Galegay A. and Aschalew, Z. (2006). Study on small ruminant lung worm in Northern Ethiopia. *Veterinary Parasitology*; Pp: 330-335.
3. Ayalew, T. (1995): A preliminary survey of sheep helminthosis in Kembebit district, North-

West Shoa. Proceedings of the 9th Annual Conference. Ethiopian Veterinary Association, Addis Ababa, Ethiopia.

4. Basaznew, B., Ayalew, E. and Achenef, M. (2012): Ovine Lungworm Infection: Prevalence, Species Composition and Associated Risk Factors in Dessie Zuria District, Northeastern Ethiopia. Faculty of Veterinary Medicine, University of Gondar, Gondar Ethiopia. *African Journal of Basic and Applied Sciences*; 4 (3): 73-76.
5. Charles, M. and Robinson, E. (2006): Diagnostic veterinary parasitological for veterinary technicians, 3rd edition, *Mosby Inc. St.Louis,* Missouri; Pp: 243.
6. Central Statistical Authority (CSA) (2009): Central for statistical authority. Ethiopian agricultural sample enumeration results. Statistical reports on livestock and farm implements. Addis Ababa, Ethiopia.
7. Desta, B., Sisay, N., Dinka, A. and Fufa, A. (2013): The Prevalence of Lungworms in Naturally Infected Sheep of Ambo District, Oromia, Ethiopia. *Global Veterinarian*; 10 (1): 93-98.
8. Eyob, E. and Matios, L. (2013): The prevalence and risk factors associated with ovine Lungworm infestation in the Asella province, Central Ethiopia. Department of Parasitology, Yabello Regional Veterinary Laboratory, Ethiopia. *Journal of Parasitology and Vector Biology*; 5(8):116-121.
9. Food and Agricultural Organization (FAO) (1986): Small ruminant production in the developing countries. In: proceedings of an Expert consultation held in Sofia, Bulgaria, 8-12 July 1985 (http://www.fao.org/docrep/009/ah221e/ah221e00.htm).
10. Food and Agricultural Organization (FAO) (2006): International scheme for the coordination of dairy development and International meat development scheme, Report of a mission to Ethiopia; May 27- June 28; Working paper 23; Rome, Italy.
11. Fraser, C.M. (1991): The Merck veterinary manual. A hand book of diagnosis therapy and disease prevention and control for the veterinarians. 7th ed. USA: Merk and Co; Pp:664-714.
12. Gatentby, R. M. (1991): Sheep: The tropical agriculturalist. London and Basingstoke, education Ltd, ACCT; Pp: 6-10.
13. Gebreyohannes, M., Alemu, T. and Kebede, E. (2013): Prevalence of Ovine Lungworms in Mekedella Woreda, Ethiopia. *Journal of Animal Production Advances*;3(6): 208-214.
14. Hansen, J. and Perry, W. (1994): The epidemiology, diagnosis and control of helminthes parasites of ruminants. ILRAD, Nairobi, Kenya; Pp:38.
15. Hendrix, C. (1998): Diagnostic of veterinary parasitology, 2nd ed. Mosby, London; Pp: 49.
16. Ibrahim, N. and Degefa, Y. (2012): Prevalence of ovine lungworm infection in Mekele Town, North Ethiopia. The internal journal of veterinary medicine;9(1):1-15.
17. International livestock center for Africa (ILCA) (1990): Annual report of 1989. Addis Ababa, Ethiopia; Pp:37-39.
18. Johnstone, C. (1998): Parasite and parasitic disease of domestic animals, university of pennsyvania. (Available at: http//cal.vet.upenn.edu/menial/Nematodes/nemes-5htm. (Accessed on: March 27, 2011). Febiger.
19. Jubb, K., Kennedy, P. and Palmer, N. (2007): Pathology of domestic animal. 5th edition, Elsevier, New Delhi; Pp:627-628.
20. Kassa, T. and Abdu, M. (2013): Prevalence of Ovine Lung Worms- Around Bahir Dar, East Africa, Ethiopia, University College of Agriculture and Veterinary Medicine School of Veterinary Medicine, Jimma, Ethiopia. *Acta Parasitologica Globalis*; 4 (3): 71-79.
21. Kassai, T. (1999): Veterinary Helminthological. Butterworth helminthology, Budapest, Hungary; Pp: 85-93.
22. Kimberling, C.V. (1998): Jensen and swift's disease of sheep. 3rd ed. Philadelphia: Lea and Febiger; Pp: 188-192.
23. Love, S. (2008): Lungworm in cattle, sheep and goat. Australia: Prime fact; Pp:811.
24. Mandal, S.C. (2012): Veterinary parasitology At a Glance. 2nd Revised and Elarged ed. India: ibdc; Pp:254-258.
25. Mekonnen, A., Abebe, F. and Yohanis, A. (2011): Study on the prevalence of lung worm infection in Gondar town. *Veterinary Research;* 4(3):85-89.
26. Mersha, C., Tekletsadik, Y. and Tewodros, F. (2012): Ovine Lungworm Infections are Serious Production and Health Problems in Amhara National Regional State, Deneba, Northeast Ethiopia, Faculty of Veterinary Medicine, University of Gondar, Gondar, Ethiopia. *American-Eurasian Journal of Scientific Research*; 7 (4): 168-171.
27. Mezgebu, M. (1995): A survey on ovine *fascioliasis*and lungworm infection in Addis Ababa and the surrounding highland areas. DVM

Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre-Zeit, Ethiopia.
28. Mihreteab, B. and Aman, A. (2011): Ovine Lungworms in Tiyo District, South-East Ethiopia: Prevalence, Effect of Altitude and Major Host Related Risk Factors. *Global Veterinary*; 7(3):219-225.
29. Nemat, E.A. and Moghadam, G.A. (2010): A survey on annual infestation of sheep with lung worms based on faecal test and slaughter house study. *Tabriz Journal of Veterinary Research*; Pp:339-342.
30. Nibret, M., Basaznew, B. and Mersha, C. (2011): *DictyocaulusFilaria* and *Muelleriuscapillaris* are Important Lungworm Parasites of Sheep in Wogera District, Northern Ethiopia. *International Journal Animal and Veterinary Advance;*3(6): 465-468.
31. North Gondar Zone agricultural and development office (2012).
32. Radostits, O.M., Gay, C.C., Blood, D.C. and Hinchclift, K.W. (2007): Veterinary medicine, A text book of the diseases of cattle, sheep, goats, pigs and horses 10th edition, London Hrcourt publishers Ltd; Pp:1564 - 1569.
33. Radostits, O.M. and Gay, C.C. (1989): veterinary medicine, a text book of the disease of cattle, sheep, goats, pigs and horses. 7thed. balillieretindal; Pp: 1037-1044.
34. Regassa, A., Toyeb, M., Abebe, R., Megersa, B., Mekibib, B., Mekuria, S., Debela, E. and Abunna, F. (2010): Lungworm infection in small ruminants: Prevalence and associated risk factors in Dessie and Kombolcha districts, northeastern Ethiopia. *Veterinary Parasitology*; 169(1-2):144-148.
35. Schneider, T. (2000): Helminths of respiratory system. In: Veterinary Medicine Parasitology, Vol. 5. Voll standing auflage. pareyBuch vet log. Berlin; Pp: 193-198.
36. Sileshi, Z. andDesalegn, L. (2007): Control of internal parasites in sheep and goats. Ethiopia sheep and goat productivity improvement program (ESGPIP), URL: http: //www.ESGPIP.org.
37. Solomon, A. and Kassahun, A. (2009): Estimation of weight and age of sheep and goats. ESGPIP; Pp:6-9.
38. Soulsby, E. J. L. (1982): Helminthes, arthropods and protozoa of domestic animals.7th edition, Lea and Fediger, Philadelphia; Pp: 262-267.
39. Soulsby, E.J.L. (1986): Helminthes, Arthropods and Protozoa of domesticated animals. 7th ed. London: Bailliertindal; Pp: 262-271.
40. Soulsby, E.J.L. (2006): Helminthes, Arthropods and Protozoa of domesticated animals. 7th ed. India: Ballieratindal; Pp: 262-274.
41. Tewodros, F., Yeshiwas, S., Mersha, C. and Nibret, M. (2012): Prevalence of lungworm infection in small ruminants in and around Jimma Town, South west Ethiopia. University of Gondar, Faculty of veterinary medicine, Gondar, Ethipia. Global veterinaria; Pp: 580-585.
42. Thrusfield, M. (2005): Veterinary epidemiology. 3rd ed. London: Blackwell science Ltd; Pp: 182-189.
43. Tony, W. (2006): The veterinary epidemiology and economic research unit, school of agriculture, policy and development. Diseases of Small Ruminants UK; Pp: 6–8.
44. Tylor, M.A., Coop, R.L. and Wall, R.L. (2007): Veterinary parasitology. 3rd ed. Australia: Blackwell publishing Ltd; Pp: 195-198.
45. Upadhayay, A. K. (2005): Text book of preventive medicine. India: pantnager; Pp: 387-390.
46. Urquhart, G., Armour, J., Duncan, J., Dunn, A. and Jennings, F. (1995): Veterinary parisitolgy 2nd edition, Long man English language society, Blackwell Publishing, USA; Pp: 39-58.
47. Urquhart, H.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W. (1996): Veterinary parasitology. 2nded. Scotland: Blackwell science; Pp: 301-309.
48. Weldesenbet, D. and Mohamed, A. (202): Prevalence of small ruminant Lung worm infection in Jimma town. *Global Veterinary*. 8(2):153-159.
49. Wilsmore, T. (2006): Disease of small ruminants in Ethiopia, the veterinary epidemiology and economics research unit of agriculture's policy and development the university of read, UK; Pp: 602.
50. Yitagele, T., Ketema, T., Getachew., F. and Nigatu, K. (2013): Prevalence of lungworm infection in small ruminants in North Gondar zone, Amhara National Regional State, Ethiopia. *Journal of Parasitology and Vector Biology*; 5(4):40-45.
51. Zajac, A. M. and Conboy, G. A. (2006): Veterinary clinical parisitolgy. 7th edition, Black Wall publishing, State Avenue; Pp: 95.