Page 283 to 292

Volume 2 • Issue 1 • 2018

Research Article

Multidisciplinary Advances in Veterinary Science

ISSN: 2573-3435

Prevalence of Common Skin Diseases of Small Ruminants in Dibate District Metekel Zone of Benishangul Gumuz Regional State, Northwestern Ethiopia

Abriham Kebede[1]*, Etenesh H/Mariam[2] and Jiregna Dugassa[1]

[1]School of Veterinary Medicine, College of Medical and Health Science, Wollega University, P.O. Box, 395, Nekemte, Ethiopia

[2]Dibatie District of Metekel zone, Benishangul gumuz region, Ethiopia

***Corresponding Author:** Abriham Kebede, School of Veterinary Medicine, College of Medical and Health Science, Wollega University, P.O.Box, 395, Nekemte, Ethiopia.

Received: February 10, 2018; **Published:** February 26, 2018

Abstract

A cross-sectional type of study design was conducted from November 2016 to March 2017 in Dibatie District under Metekel Zone in BGRS, to identify the prevalence of skin diseases in sheep and goats. A total of 384 small ruminants (190 sheep and 194 goats) were examined, 22.54% (86/384) were affected by skin disease. When examining animals in different agro-ecological zone, the highest prevalence was observed in Yamp (28.9%), which represents as a lowland, followed by Dibate01 (19.53%), which represents as a midland and Angtok (18.9%), which represents as a highland. However, there was no statistically significant difference ($p > 0.05$) in the prevalence rates of skin diseases among the three selected sites. The prevalence of skin disease in sheep and goats was 23.04% and 21.88% respectively. In this study bacterial, viral, parasitic and fungal infection were observed. The prevalence of sheep and goat pox was the predominant disease in the study area, which accounted for 11.23% (43/384), followed by parasitic infestation 4.7% (18/384), (2.78% for mange mites, and 1.83% for ticks), 3.7% dermatophilosis, but the least prevalence was seen from fungal infection (dermatophytosis, 2.7%). A total of 212 females and 172 males were examined, 11.8% (25/212) females and 8.5% (18/172) males were infected, there was no statistically significant difference ($p > 0.05$) in the prevalence rates of skin diseases among sex. Prevalence observed among the body condition score, 15.41% (59/384) in poor body condition, 4.4% (17/384) in medium body condition, and 2.614 % (10/384) in good body condition. There was statistically significant difference ($p < 0.05$) of prevalence among different body condition scores of the study animals. Attention should be given to the control and prevention of skin disease of small ruminants that result in the downgrading of the skin as well as reduction of source of foreign currency earning of the leather industry to the country.

Keywords: *Dibate; Prevalence; Skin disease*

Volume 2 Issue 1 February 2018

Introduction

Among the African countries, Ethiopia has the largest livestock in having more than 53.4 million cattle, 25.5 million sheep, 1.1 million camels, 8.5 million equines, 49 million chickens and 22.7 million goats with livestock ownership currently contributing to the livelihoods of an estimated 80% of the rural population (CSA, 2011).

Small ruminants are important contributors to food production in Ethiopia, providing 35% meat consumption and 14% of milk consumption. In central highlands where mixed crop livestock production system is practiced, small ruminants account for 40% of cash income and 19% of the household meat consumption (Tefera, 2004). Owing to their high fertility, short gestation 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 purchase such as improved seed, fertilizer and medicine for rural household (Tefera, 2004).

The term hide-refers to the external surface layer of large animals like cattle and camel whereas skin refers to external surface layer of small ruminants such as sheep and goats (Desta., *et al*. 2001 and). Hides and skin have a wide importance as source of foreign currency of the leather industry to the country in general and SNNPR specially (Sheferaw., *et al*. 2010; and Zemene, 2012).

Hides and skins account for 12-16% of total value exports. The current utilization of hides and skins is estimated to be 48% for cattle hide, 75% for goat skin and 97% for sheep skin with the expected off take rate of 33% and 75% for sheep, goat and cattle respectively (Tefera, 2004; Yacob., *et al*. 2008). The reason why sheep and goats have received a scant attention is the small size of most breeds found in the tropics, but this is unjustified since their productivity relative to their size is greater than that of large ruminants like cattle (Charry., *et al*. 1992).

Sheferaw., *et al*. (2010) in his study on prevalence of sheep and goat skin defects in the metekel Zone, Benishangul Gumuz reported the presence of 1.4 million sheep and 2.2 million goats to be existed in Benishangul Gumuz Regional state (BGRS) wide important as source of income for agricultural community. Even though small ruminants are important components of Ethiopian farming system, their contribution to food production, rural income and export income are far below the expected potential. This is because small ruminant production in Ethiopia is constrained by compound effects of disease, poor feeding and management (Tefera, 2004). Over the last 10 years there are indications that the quality of raw material has deteriorated with an increasing number of reject grades and the appearance of skin diseases like "ekek" that is mainly due to lice, tics and mange infestation. Hides and skins are downgraded as a result of various ante-mortem and post mortem factors, including poor animal husbandry, disease and transportation, storage and general handling (Abadi, 2000).

The existence of various skin disease and other poor animal husbandry practices are frequently reported from different parts of the country Ethiopia (Abadi, 2000; Haffiz, 2001; Tefera, 2004; Yacob., *et al.* 2008). But there was no such a study conducted before in Metekel Zone in general and in Dibate Woreda specifically; and the status of the disease was not known in this area, however, it is well understood that before any control attempt of skin defects and diseases, it is necessary to know what diseases are present and how important they are. It is therefore necessary to generate relevant information that helps to design control strategy.

Therefore, the objectives of the present study were:

- To estimate the prevalence of small ruminant skin diseases in the study area
- To identify the different etiological agents involved in small ruminants' skin disease
- To identify risk factors for skin disease of small ruminants

Materials and Methods

Study Area Description

The study was conducted in Benishangul Gumuz Ethiopia on small ruminant animals obtained from three selected sites of Dibate District, under Metkel Zone, representing three agro- ecological areas; namely Angtok (highland), Dibate 01 (midland) and yamp (Low-land) from December 2016 to June 2017. The study area lies approximately 900m to 1800m above sea level and the average annual rainfall varying from 950mm to 1150 mm that characterized by a mono-modal type of distribution.

The three selected study areas are located 547 km northwest of the capital city of Ethiopia, Addis Ababa. The mean annual minimum and maximum temperature respectively is 15.4°C in the high land and 37.2°C in the lowland. Dibate district is found in BSG National Regional State. Dibate is located in the North western part of Ethiopia some 550 km from the main capital, Addis Ababa. Bordered by the Amhara National Regional State in the North- east and Bulen district in the south while by Mandura district in the North, the district is becoming a strategic location for connecting three districts. Dibate district has about 15,454 households with a total population of approximately 72,270. People in Dibate district base their livelihood on agriculture and rely largely on rain-fed agriculture and livestock rearing.

Study Animals

A total of 384 (194 goats and 190 sheep) small ruminants were selected from the three selected study areas. The animals were categorized in two age groups, namely young (lambs and kids) and adults although determination of the exact age of each animal was difficult. But age was determined as young (up to 2 years) and adult (above 2 years) by considering the rate of eruption of teeth as given in annex 1 and 2 (Gatenby, 2002; Steele, 1996). Animals of both sexes were included. The body condition scoring of the study animals was determined subjectively following the technique explained by Desta., *et al*. (2001) and Tefera (2004) and is categorized into 3 groups as poor, medium and good both for adults and young.

Study Design

A cross-sectional type of study design was used to determine the prevalence of skin disease among small ruminants of the study area, age, sex, geographical location and body condition of the study animals were recorded as test variables during data collection.

Sample Size Determination and Sampling Procedures

The sample size (N) can be determined based on the formula provided by Thrusfield, (2006).

$N= (1.962*P_{exp}* q)/d^2$

Where, N = sample size required '

P_{exp} = expected prevalence

Q = 1-pexp

D = desired absolute precision

In this formula expected prevalence (p_{exp}) of 50% was used as previous research works on the current study title were nonexistent and absolute precision of 5% was considered. Accordingly, a total of 384 animals were required for this study. However, a total 384 animals were sampled in the 3 selected sites, which was one less than the required number as mentioned above.

Sampling

Simple random sampling technique was used to select small ruminants and in the respective study areas. Three visits were made to each of the selected study sites during the study period. A total of 384 small ruminants were sampled from the three selected sites (127 from highland, 128 from midland and lowland). All total the recovered external parasites from the body part of the study animals were fixed in universal sampling bottle containing 70% ethyl alcohol. Skin diseases associated with bacterial, viral and fungal infection were identified by physical clinical examination and laboratory tests as much as the laboratory facilities allowed.

Data Collection and Recording

A structure data reporting format was prepared and used for recording of the data. The information targeted and collected include Agro-ecological zone or woreda, age, sex, body condition, and type of skin defect obtained.

Study Methodology

The recovered external parasites of the study animals were preserved in 70% ethyl alcohol in a universal sampling bottle. Mite genera were identified directly under light microscope (40x-100x magnifications) and tick genera using a stereomicroscope.

Ticks and mites were identified by following the morphological keys described by Soulsby (1982), Urquhart (1987) and Taylor., *et al*. (2007). Bacterial, viral and fungal infections were identified and diagnosed based on detailed physical clinical examinations. Staining and laboratory tests were done especially on bacterial and common fungal infections when possible.

Statistical Analysis

The data collected was entered into Microsoft excel spreadsheet and analyzed using SPSS 20.0 (2008). The prevalence of skin disease of small ruminants in the selected study areas was calculated as the number of animals that harbor the skin diseases, divided by the total number of small ruminants examined. The degree of association with the various risk factors was assessed using the Pearson chi-square (χ^2) test. For all analyses, a p-value of less than 0.05 was taken as significant.

Results

Prevalence of Skin Diseases

A total of 384 small ruminants (194 goat and 190 sheep) were examined for the skin diseases. The overall prevalence was 22.4% (86/384), from which sheep and goat pox was the predominant disease in the study areas, which accounts 11.2% (43/384), followed by parasitic infestation 4.7% (18/384), (2.78% for mange mites and 1.83% for ticks), but the least prevalent was seen from dermatophytosis, (2.7%). The prevalence of skin diseases was compared among the three selected sites as well as different causative agents that cause skin diseases in both sheep and goats. When examining of animals in the study areas, the highest prevalence was observed in Yamp (28.9%), which represents as a lowland, followed by Dibate01 (19.5%), which represents as a midland and Angtok (18.9%), which represents as a highland.

There was no statistically significant difference ($p > 0.05$) in the prevalence rates of skin diseases among the three selected sites, however, a relatively higher infection was observed in Yamp (lowland, 28.91%) as compared to mid and high altitude.

		Prevalence n (%)					
Agro ecology	**№ Examined**	**Dermatophilosis**	**SGP**	**Mange**	**Tick**	**Dermato-phytosis**	**Total**
Highland	128	4 (3.13)	11 (8.6)	3 (2.4)	3 (2.3)	3 (2.3)	24 (18.8%)
Midland	128	6 (4.7)	12 (9.4)	3 (2.3)	2 (1.6)	2 (1.6)	25 (19.53%)
Lowland	128	4 (2.4)	20 (15.6)	5 (3.9)	2 (1.6)	6 (2.4)	37 (28.9%)
Total	384	14 (3.65)	43 (11.2)	11 (2.9)	7 (1.8)	11 (2.9)	86 (22.4%)
χ^2		0.582	3.763	0.737	0.303	2.418	3.645
p-value		0.748	0.152	0.692	0.860	.0299	0.162

Table 1: *Prevalence of skin diseases of small ruminants in the three study districts (SGP: Sheep and Goat Pox).*

Prevalence of Dermatophilosis

Lesions observed on the skin of lips, nose, face, ears, neck and limbs were scabs and dry crusty exudates matted with hairs. The overall prevalence of dermatophilosis observed was 3.6% (14/384). Prevalence among animals in medium body condition was 13.6 % (3/22), 12.8% (10/78) in poor body condition and 0.4 % (1/284) in good body conditioned animals. There was statistically significant difference (p = 0.000) on the prevalence of Dermatophilus congolensis infection among the body condition. On the other hand, no statistically significant difference was observed in the prevalence of among small ruminants of different sexes, species, age and origin (table 2).

Risk factors		Sample size	Prevalence n (%)	χ^2	p-value
Sex	Female	212	5 (2.4)	2.205	0.138
	Male	172	9 (5.2)		
Age	Young	136	5 (3.7)	0.000	0.987
	Adult	248	9 (3.6)		
Species	Caprine	194	5 (2.6)	1.297	0.255
	Ovine	190	9 (4.8)		
Body condition	Good	284	1 (0.4)	34.062	0.000
	Medium	22	3 (13.6)		
	Poor	78	10 (13.0)		

Table 2: *Association of prevalence of dermatophilosis with different risk factors.*

Prevalence of Sheep and Goat Pox

The overall prevalence of shoat pox was 11.23% (43/384), out of which 12.9 % (25/194) of goats and 9.5 % (18/190) of sheep were infected by poxvirus. A total of 211 females and 172 males were examined, 11.8% (25/212) females and 8.5% (18/172) males were infected. The prevalence of sheep and goat pox, animals which had medium body condition accounts 40.9% (9/22), followed by animals that had poor body condition 40.3% (31/78) and 1.1% (3/284) had good body condition. There was no statistically significant difference ($p > 0.05$) among both sexes, species, age and origin of animals, but there was statistically significant difference ($p < 0.05$) among body condition of the animals (Table 3).

Risk factors		Sample size	Prevalence n (%)	χ^2	p-value
Sex	Female	212	25 (11.8)	0.182	0.670
	Male	172	18 (8.5)		
Age	Young	136	14 (10.3)	0.184	0.668
	Adult	248	29 (11.7)		
Species	Caprine	194	25 (12.9)	1.086	0.297
	Ovine	190	18 (9.5)		
Body condition	Good	284	3 (1.1)	114.04	0.000
	Medium	22	9 (40.9)		
	Poor	78	31 (40.3)		

Table 3: *Association of prevalence of sheep and goat pox with different risk factors.*

Prevalence of Mange Mite Infestation

A total of 384 small ruminants (136 young and 248 adults) were examined, the overall prevalence was 2.87% (11/384). Out of which 4.4% (6/136) in young and 2.15% in adults were observed. The prevalence of mange mite infestation of 2.1% (4/194) in caprine, 3.7% (7/190) in ovine and 3.3% (7/212) in females, 2.3% (4/172) in males was observed. There was no statistically significant difference ($p > 0.05$) in the prevalence of mange mites among the age of animals, agro-ecology, species and sex, but there was significant difference ($p < 0.05$) among the body condition of small ruminants (table 4).

Risk factors		Sample size	Prevalence (%)	χ^2	p-value
Sex	Female	212	7(3.3)	0.334	0.563
	Male	172	4(2.3)		
Age	Young	136	6(4.4)	1.485	0.223
	Adult	248	2(2.15)		
Species	Caprine	194	4(2.1)	0.925	0.336
	Ovine	190	7(3.7)		
Body condition	Good	284	0(0)	35.356	0.000
	Medium	22	1(4.545)		
	Poor	78	10(13.0)		

Table 4: *Association of prevalence of mange mite infestation with different risk factors.*

Prevalence of Tick Infestation

Of the total 384 small ruminants examined, 1.83% (7/384) was affected by ticks. The overall prevalence of tick infestation in small ruminants was 2.4% (3/127) in highland, 1.6% (2/128) in both midland and lowland. A significant difference of prevalence was found among age and body condition. There was no statistically significant difference ($p > 0.05$) on the prevalence of tick infestation among the agro-ecology, sex and species (table 5).

	Prevalence n (%)				
	Agroecology			Species	
Mite genus	Highland	Midland	Lowland	Sheep	Goats
Demodex	1 (0.78)	1 (0.78)	2 (1.56)	1.058	2 (1.03)
Psoroptes	1 (0.78)	-	1 (0.78)	2 (1.58)	1 (0.51)
Sarcoptes	1 (0.78)	1 (0.78)	1 (0.78)	1 (0.78)	1 (0.51)
Chorioptes	-	-	1 (0.78)	1 (0.78)	-

Table 5: *Identification of mite genera.*

Prevalence of Dermatophytosis

A total of 384 small ruminants were examined, the overall prevalence was 2.87% (11). The respective prevalence of dermatophytosis in sheep and goats were 3.7% (7/190) and 2.1% (4/194). Poor and medium body conditioned small ruminants were significantly higher infected than animals in good body condition (6.5%, 13.6% and 1.1%, respectively; $p < 0.05$).There was no statistically significance difference ($p > 0.05$) among the three selected sites of Dibate District, age, species and the sex of animals(table 6).

Risk factors		Sample size	Prevalence (%)	χ^2	p-value
Sex	Female	212	4(1.9)	0.012	0.912
	Male	272	3(1.7)		
Age	Young	248	6(4.4)	7.848	0.005
	Adult	136	1(0.4)		
Species	Caprine	194	4(2.1)	0.120	0.729
	Ovine	190	3(1.6)		
Body condition	Good	284	3(1.1)	7.664	0.022
	Medium	22	2(9.1)		
	Poor	78	2(2.6)		

Table 6: *Association of prevalence of tick infestation with different risk factors.*

	Prevalence n (%)				
	Agro-ecology			Species	
Tick genus	Highland	Midland	Lowland	Goats	Sheep
Amblyomma	2 (1.57)	1 (0.78)	1 (0.78)	2 (1.03)	1 (0.51)
Boophilus	1 (0.78)	-	1 (0.78)	1 (0.51)	1 (0.51)
Rhipicephalus	-	1 (0.78)	-	-	1 (0.51)
Hyalomma	-	-	1(0.78)	1 (0.51)	-

Table 7: *Identification of tick genera.*

Risk factors		Sample size	Prevalence (%)	χ^2	p-value
Sex	Female	212	7(3.3)	0.334	0.563
	Male	172	4(2.3)		
Age	Young	136	6(4.4)	0.335	0.562
	Adult	248	5(.024)		
Species	Caprine	194	4(2.1)	0.925	0.336
	Ovine	190	7(3.7)		
Body condition	Good	284	3(1.1)	16.115	0.000
	Medium	22	2(13.6)		
	Poor	78	6(6.5)		

Table 8: *Association of prevalence of dermatophytosis with different risk factors.*

Discussion

The prevalence of sheep and goat pox in the present study 11.23% is similar to 11.46% found by Yacob., *et al*. (2008) in Adama. The prevalence of dermatophilosis in small ruminants was 4.8% and 2.6% in sheep and goats, respectively. There are few published reports on small ruminant dermatophilosis from Ethiopia where prevalence of 3% was observed (Woldemeskel 2000; Woldemeskel and Ashenafi 2003), which is slightly lower than the present study this may be because the difference in agro-ecology of the study areas.

The overall prevalence of mite in sheep and goat were 3.7% and 2.1% respectively, with a prevalence of 2.1% for *Demodex*, 2.2% for *Psoroptes*, 2.14% for *Sarcoptes* and 0.70% for *Chorioptes*. This is lower than different mange mite infestation rates that have been reported from different parts of the country by various authors 6.8% (Zerihun, 1994), 3.96% (Mohammed Hussen, 2001) and 4.27% (Worku, 2002) from Eastern, Central and Southern parts of Ethiopia respectively. This may be because special attention was given to manage small ruminants in the study area. There was no statistically significant difference ($p > 0.05$) among the prevalence of mange mite infestation in small ruminants in the different kebeles of the study area, but there was statistically significant difference ($p < 0.05$) among the body condition score of the animals, which was found to be 13.0% in animals in poor body condition 4.54% in medium condition and 0% in good condition.

The overall prevalence of tick infestation in the present study was, 2.1% in goats, 1.6% in sheep, out of which 1.54% *Amblyomma*, 1.03% *Boophilus*, 0.52% *Rhipicephalus* and 0.515% *Hyalomma*, which was lower than the previous work by Serste and Wossene (2007) in North East Ethiopia with 3.4% and 22.2% for goats and sheep respectively. This difference in the prevalence might be due to the geographical difference, breed difference and seasonal difference. The overall prevalence of tick infestation was 0.4% and 4.4% in adults and young respectively, and 2.4% in highland and 1.6% in both lowlands and midland. The current result reflected that the occurrence of external parasites in small ruminants of the study area is lower than the prevalence of external parasites reported by Serste and Wossene (2007) about 50% and 56% in sheep and goats respectively in different agro-climatic zones of Eastern Amhara Region of Ethiopia. This may be due to the shortage of the study period.

Conclusions and Recommendations

The present study indicated that small ruminants in the three selected sites of Dibate district, under Metekel zone, North West Ethiopia were highly infected by different infectious agents that cause skin problems in the study area. Out of the infectious agents, the highest prevalence was observed for sheep and goat pox. In this study, skin diseases were more common in lowland areas than in mid- and highland. All skin diseases investigated in this study were especially prevalent in animals in poor body condition. The consequences of these skin diseases include economic losses through downgrading of skin for the leather industry as well as the loss of condition and carcass quality. Another problem is the possible transmission of tick borne diseases. Overall, skin diseases can be considered one of the major constraints of small ruminant productivity in the study area.

According to the above conclusion, the following recommendations are forwarded:

- Integrated management of small ruminants and control strategies have to be put in place where prevalence of skin diseases is high
- Vaccination campaigns against sheep and goat pox should be conducted regularly
- Spraying and dipping activities should be conducted regularly.
- Awareness should be raised among farmers about the importance of skin diseases
- Farmers should be educated as to proper management of animals and improvement of hygienic conditions to reduce the transmission of bacterial and fungal skin diseases
- In addition to this, other research works in the areas of small ruminant's skin disease should be conducted in order to determine the economic losses caused by these diseases

Authors' Contributions

Abriham kebede and Etenesh H/Mariam have designed the methodology and created the survey instrument, drafting and writing of the manuscript and analyzed the data. Etenesh H/Mariam has again participated in the data collection, whereas; Abriham kebede and Jiregna Dugassa again contributed to Reviewing the manuscript to be ready for publication. All authors read and approved the final manuscript.

Competing interest

The authors declare that they have no competing interest

Acknowledgements

The authors are extending their grateful acknowledgements to Wollega University, whole staff of school of Veterinary medicine, for their inspiration to complete this work. Also we would like thanks the respondents (farmers and animal health workers) of in and around Debate district for their collaboration in allowing their animals for collection of sample and required responses.

References

1. Abadi Y. "Current problems of the leather industry". Goat production in East Africa.
2. Charry J., *et al*. "Sheep farming in humid tropical Africa" CAB International" Wallingford, UK. 1992.
3. CSA Agricultural Sample Survey 2010/11. Central Statistical Agency, Addis Ababa, Ethiopia. (2011).
4. Desta H., *et al*. "Body condition scoring of sheep and goat". Ethiopian sheep and goat productivity improvement program.
5. Gatenby R. "Sheep. In: The Tropical Agriculturalist, Macmillan Education" London, UK (1991.) 7-8.
6. Girma M., *et al*. "Lifesaving emergency obstetric services are inadequate in south-west Ethiopia: a formidable challenge to reducing maternal mortality in Ethiopia". *BMC Health Services Research* 2013: 13-459
7. Halima H., *et al*. "phynotopic characterstics of Ethiopian Goat indigenous goat population". International center for agriculture research (2012).
8. Hoffize M. Study on skin disease of small ruminants in central Ethiopia. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia (2001).
9. Kassaye E and Kebede E. Epidemiological survey on mange mite, lice and sheep keds of small ruminants in Tigray Region, Northern Ethiopia". *Ethiopian Veterinary Journal* 14.2 (2010):123-130.
10. Map Library (2007). Ethiopia - SNNPR - Gamo Gofa. [http://www.mapmakerdata.co.uk.s3-website-eu-west-1.amazonaws.com/library/stacks/Africa/Ethiopia/SNNPR/Gamo %20Gofa/index.htm], accessed June 24 2014.
11. Mohammed H. "Study on skin diseases of small ruminants in Central Ethiopia". DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit (2001).
12. Serste T and Wosene A. "A study on ectoparasites of sheep and goats in Eastern parts of Amhara Region, Northeast Ethiopia". *Small Ruminant Research* 69.1 (2007): 62-67.
13. Sheferaw D., *et al*. "Epidemiological study of small ruminant mange mites in three agro-ecological zones of Wolayta, Southern Ethiopia". *Ethiopian Veterinary Journal* 14.1 (2010): 31-38.
14. Soulsby and EJI Helminths. "Arthropods and protozoa of domesticated animals. 7th edition. Balliere, Tindall" (1982).
15. Steel EJ., *et al*. "The Tropical Agriculturalist". Macmillan, London, UK (1996): 79-80.
16. SPSS Inc. SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc. 2008.
17. Taddesse Z. "Preliminary survey of mange mites and ticks of camel and small ruminants in Dire Dawa Town". DVM Thesis, FVM, Addis Ababa University, Debre Zeit (1994).
18. Taylor MA., *et al*. "Veterinary parasitology 3rdedition". Blackwell Publishing (2007): 679-680.
19. Tefera S. "Investigation in ectoparasites of small ruminants in selected sites of Amhara Regional state and their impact on Tanning industry". MSc Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia (2004).
20. Thrusfield M. "Veterinary Epidemiology, 3rd edition". *Blackwell Science* (2005): 182-189.
21. Worku T. "Study on small ruminant's skin disease in Sidama Zone, DVM Thesis" FVM, Addis Ababa University, Debre Zeit (2002).
22. Urquhart G.M., *et al*. "Veterinary parasitology, 2nd edition". Blackwell Science London (1996): 282-284.
23. Yacob HT., *et al*. "Prevalence of major skin disease in cattle, sheep and goats at Adama veterinary clinic, Oromia regional state Ethiopia". *Revue de Médecine Vétérinaire* 159.8 (2008): 455-461.

24. Zemene Z and Addis M. "Assessment of major factors that cause skin defects at Bahir Dar tannery, Ethiopia". *Advances in Biological Research* 6.5 (2012): 177-181.