

Ectoparasites of Small Ruminants in Three Agro-Ecological Districts of Southern Ethiopia

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Abstract: The present study was carried out in three different agro-ecological zones of southern Ethiopia to determine the prevalence of ectoparasites and identify associated risk factors. Out of 1396 sheep and 908 goats examined, 85.6% and 95.0% of sheep and goats, respectively were infected with one or more ectoparasites. The ectoparasites identified in sheep were *Damalinoavis* (36.1%), ticks (18.8%), *Melophagus ovinus* (14.2%), *Linognathus species* (5.1%). In goats, ticks (57.6%), Sarcoptic mange (25.7%), *Ctenocephalides* spp (9.1%), *Linognathus* spp (4.6%), Demodectic mange (1.7%) and *Damalinacaprae* (1.4%) were identified. The prevalence of *Damalinoavis* in sheep was significantly ($P < 0.05$) higher in the highlands than in the midlands. The young animals were significantly ($P < 0.01$) affected than adults. *Melophagus ovinus* was identified only from the highland areas. Male animals were at least two times ($P < 0.05$) at risk than females to this parasite while young animals were more affected ($P < 0.05$) than adults. In goats, the risk of Sarcoptic mange infestation in lowlands were significantly ($p < 0.05$) higher than in the highlands and midlands and was more prevalent in rainy season. Male animals were two times ($OR = 2.0$) at risk than females. The young animals were more at risk ($OR = 1.4$) than adults. For *Ctenocephalides* spp, goats in midland areas were significantly at risk ($OR = 63.4$) than lowlanders. The risk of tick infestation of goats in lowlands was higher ($OR = 8.4$) compared to the highlands. This study demonstrates that ectoparasites greatly affect ruminant health and require an urgent control intervention.

Key words: Goats • Sheep • Prevalence • Risk factors • Control

INTRODUCTION

In Ethiopia, ectoparasites are among major parasitic health problems encountered throughout the year, occupying every corner of the country and cause enormous economic loss. Among ectoparasites of veterinary importance namely lice (both sucking as well as biting types), sheep ked, ticks and mange mites were reported to be abundant and known to affect both large and small ruminants while their prevalence and distribution varies in different agro-ecological zones [1-7]. Meanwhile, sheep and goats are among highly affected livestock group by these ectoparasites [2, 8].

Even though small ruminants are important components of Ethiopian farming system, their contribution to food production and export income are far below the expected potential. This is because small ruminant production in Ethiopia is constrained by the compound effects of diseases, poor feeding and poor

managements [9-11]. The ectoparasite associated skin diseases occurring in small ruminants cause substantial economic losses by reducing the productivity and reproduction performance and degrade skin quality [1-3].

Skin diseases caused by ectoparasites of small ruminants were known to cause serious economic loss to the small holder farmer, the tanning industry and the country as a whole [8, 13]. As many as one-quarter to one third of all skins processed at tanneries have various defects and are unsuitable for export purposes [14-15]. Up to 65% of these defects occur in the Pre-slaughter stage of production while the animals are alive. Considerably large portions of these Pre-slaughter defects are directly related to parasitic and /or to secondary self-inflicted damages [16-17].

Even though there was a huge small ruminant population in the Southern Nation, Nationalities and Peoples Region (SNNPR), South Ethiopia, no studies had been so far carried on the types of parasitic skin diseases

prevailing in the area and their magnitude of infestation under natural conditions. The present study was therefore designed with objectives of identifying ectoparasitic skin diseases of small ruminants in three agro-climates in south Ethiopia and thereby to assess the associated risk factors.

MATERIALS AND METHODS

Study Area: This study was conducted in three selected agro-climatic districts of Southern Ethiopia namely, Chenchu (highland), Lanfro (midland) and Benatsemaye (lowland) situated about 532km, 285km and 720km away from Addis Ababa, respectively. The altitude ranges between 2400-3200; 1700-2300 and 550-1600 meters above sea level, respectively. The mean annual rainfall ranges from 300mm to 2200mm and the mean annual temperature ranges from 10 to 37°C in low land, 18 to 25 °C in mid land and 16 to 46 °C in lowland, respectively. The production systems consist of mixed crop-livestock in Chenchu and Lanfro and agro-pastoral in Benatsemaye District.

Study Animal and Study Design: The study population included indigenous sheep and goats managed under smallholder mixed crop livestock farming system and kept under traditional extensive husbandry system of communal herding. The study design was cross sectional. The systematic random procedure was applied in sampling the study animals. The sample size for the study was determined using the formula stated by [18] taking estimated prevalence of the disease as being 50% in each agro-climate, level of precision (5%), accepted error and confidence level 95%.

Clinical and Laboratory Examination: A total of 2304 animals (1396 sheep and 908 goats) randomly selected from the three agro-climates were visually and palpated for any skin lesions and ectoparasites at six body sites (neck, shoulder, belly, flank, back and rump). In addition, the ears and digits were examined. All the examinations on each side were done as described by [19]. The age, sex and body condition of each selected animal was recorded. Body condition score was made by modifying the scoring system described by [20] and [21] for sheep and goats, respectively. Animals were grouped as young (sheep and goats up to one year of age) and adults (older than one year) and body condition scores of the animals were categorized as poor and good, by modifying the system described by [20] for sheep and [21] for goats.

Identification of the mange mites, species was based on morphological characteristics described by [22]. Ticks, keds, lice and fleas were collected from the attachment sites manually and kept in 70% alcohol until examined. Identification of the parasites was carried out according to [22, 23] respectively.

Questionnaire Survey: A questionnaire was prepared in an attempt to obtain the general information on livestock ownership patterns, importance of small ruminant rearing, awareness about ectoparasites, their effects and the vernacular names of parasitic skin diseases, the market values of the skins the control practices exercised in the area. Five sheep and goat owners were selected for interview from each peasant association. Overall, 30 owners were interviewed from each agro-climatic zone.

Data Analysis: The variables analyzed included skin scrapings, identified ectoparasites and of the risk factors associated with the parasitic conditions. The STATA and SPSS soft wares were used for data analysis. Analysis of variance (ANOVA) and odds ratio were the statistical tests employed to analyze the data.

RESULTS

Questionnaire Survey Result: The results of the questionnaire survey showed that the skin diseases were very important cause of severe damage to skins and were second to Contagious Caprine Pleuro-Pneumonia (CCPP) and cause severe damage in goats in the lowland. Sheep ked was found to be an important skin problem of flocks for highland farmers. Small ruminants were second major species of animals ranked by farmers were used to provide meat and milk products.

Accordingly, 66.6% of the respondents reared small ruminants for income generation and insurance and 20%, for milk, meat and skin and 13.3% for personal meat consumption. A proportion of 31% of the respondents mentioned the occurrence of mange and ticks at early part of the rainy season and 53% respondents indicated the seasonality of lice and 27.7% reported occurrence of sheep ked at early part of rainy season. About 11.1% of farmers claimed about the damage caused by blood sucking birds locally called (chimba) on sheep skin. The vernacular name of skin diseases were identified in each agro-ecology. The highlanders called lice “chucha”, ticks “Dankule” Keds “shuchule”, and the lowlanders called ticks “Shoko”, mange “kesi” and demodex “Forto”. The midlanders also called lice “Kumal” and lice “Kinacho”

Table 1: Overall prevalence of ectoparasites in sheep and goats

Parasite species	Sheep (n =1396)		Goat (n = 908)	
	Prevalence%	95% CI	Prevalence%	95% CI
<i>Damalineaovis</i>	36.1	2.35-2.70		0.00-0.00
<i>Damalinacaprae</i>	0	-	1.4	0.05-0.15
<i>Linognathusspp</i>	5.1	0.31-0.50	4.6	0.26-0.48
<i>Melophagusovinus</i>	14.2	1.36-1.76		0.00-0.00
<i>Sarcoptic mange</i>	2.9	0.18-0.34	25.7	2.05-2.57
Demodectic mange	0	-	1.7	0.08-0.05
Ticks	18.8	2.17-2.71	57.6	7.07-7.91
<i>Ctenocephalidesspp</i>	1.5	0.04-0.11	9.1	0.36-0.55
Overall	85.6	83.8-87.4	95.0	93.6-96.4

Table 2: Prevalence (%) of ectoparasites by agro climate

Parasite identified	Sheep			Goat		
	Highland	Midland	Lowland	Highland	Midland	Lowland
<i>Damalineaovis</i>	62	15.8	0	0	0	0
<i>Damalinacaprae</i>	0	0	0	17.3	0	0
<i>M. ovinus</i>	28.5	0	0	0	0	0
<i>Linognathus spp.</i>	1.58	12.8	0	54.6	0.33	0
<i>Sarcoptic mange</i>	0	0	16.9	0	0	43.8
Demodectic mange	0	0	0	0	0	2.82
Ticks	3.89	0	97.8	1.33	0	98.1
<i>Ctenocephalides</i>	0.86	3.21	0	0	26.4	0.56
Overall	79.6	94.2	98.7	78.6	92.0	99.0

Of the respondents, 64.4% used modern medicine and 22.2% claimed that ticks were untreatable. About 18.8 % of farmers used traditional medicinal plants for the treatment of lice and mange and 12.2% used hot fire wood to kill clusters of ticks during periods of heavy challenge. This method exacerbated the damage of the skins by the ectoparasites.

Prevalence of Ectoparasites: A total of 1396 sheep and 908 goats examined for ectoparasites 1195 (85.6%) sheep and 863 (95%) of goats were infested with one or more ectoparasites (Table 1). The major ectoparasites identified in sheep were *Damalineaovis*, tick infestation and *Melophagusovinus* whereas in goats, tick infestation, *Sarcoptic mange*, *Ctenocephalidesspp.*, followed by *Linognathusspp.* and Demodectic mange.

The common sites of *D. ovis* infestation were the skin of neck, shoulder, sides and back. For *M. ovinus* infested sheep, the common sites parasitized were the rump, shoulder, tail and neck in order of importance. The major tick attachment sites on sheep were head/ear the tail, sternum inter digital space *Sarcoptic mange* in sheep were mostly localized mainly on the muzzle, lips, nose and ears without generalized infestation in black head Ogaden sheep.

In goats, 65.8% of *Sarcoptic mange* and 75% of Demodectic mange infestation were recorded in generalized form. The legs, groin, sides, back scrotum, ear/head medial thigh were the major sites of infestation. Four tick genera namely, *Amblyomma*, *Rhipicephalus*, *Hyalomma* and *Boophilus* were identified. The main attachment sites for these ticks were ear/head, sternum under the tail, interdigital space, scrotum in males and udder in females.

For *Ctenocephalidesspp* attachment sites were sides of the body and lower abdomen and for *Linognathusspp* in goats were mainly attached on the neck, udder and sides of abdomen sides of the body and rump. The summary of all the parasites observed in this study are given in table 2.

Prevalence of ectoparasites by Agro-Climate: The overall prevalence of ectoparasites in highlands, midland and lowlands were 79.6%, 94.2% and 98.7% in sheep and 78.6%, 92% and 99% in goats, respectively (Table 2). The prevalence of *Damalineaovis* in sheep was significantly higher ($P < 0.05$) in highlands than the midlands but was not found in lowlands. *Melophagusovinus* was found only in highlands. *Linognathusspp* was significantly higher ($P < 0.05$)

Table 3: Prevalence (%) of ectoparasites on sheep and goats by season

Parasites	Dry season		Rainy season	
	Sheep n= (698)	Goats (n=454)	Sheep (n=698)	Goats (n=454)
<i>Damalinoavis</i>	35.6	-	36.5	-
<i>Damalinacaprae</i>	-	0.66	-	1.43
<i>Linognathusspp</i>	5.58	3.14	4.58	3.58
<i>Melophagusovinus</i>	9.45	-	18.9	-
Sarcoptic mange	1.57	19.8	4.15	31.5
Demodectic mange	-	-	-	3.3
Ticks	1.85	58.4	19.1	56.8
<i>Ctenocephalidesspp</i>	2.0	6.6	1.0	11.6
Overall	61.7	68.7	61.4	76.4

Table 4: The prevalence of ectoparasites by sex

Parasites	Sheep		Goats	
	Female (n=1082)	Male(n=314)	Female(n= 662)	Male (n=246)
<i>Damalinoavis</i>	35.7	37.3	-	-
<i>Damalinacaprae</i>	-	-	1.1	2.4
<i>Linognathusspp</i>	5.2	4.8	4.8	4.1
<i>Melophagusovinus</i>	11.4	23.6	-	-
Sarcoptic mange	2.6	3.8	20.2	40.2
Demodectic mange	-	-	1.7	1.6
Ticks	17.5	23.6	54.4	66.1
<i>Ctenocephalidesspp</i>	1.4	1.9	8.5	11.0
Overall	59.0	14.3	93.8	58.7

in the midlands than highlands. It was not found in lowlands. The prevalence of ticks was significantly higher in lowlands than highlands, but not in the midlands. The prevalence of sarcoptic mange was significantly higher in lowlands and not in both midlands and highlands.

The prevalence of *Ctenocephalidesspp* in sheep was not different among the agro climatic zones. The prevalence of Sarcoptic and Demodectic mange infestation in goats was significantly higher in lowlands compared to both midlands and highlands. The prevalence of *Damalinacaprae* was significantly higher ($P<0.05$) in highland goats, than in midland and lowland goats. The prevalence of tick in goats was significantly higher ($P<0.05$) in lowlands than highlands. The prevalence of ticks in goats was significantly higher ($P<0.001$) in lowlands than highlands, but not found in the midlands. The prevalence of *Ctenocephalides* spp. in goats was significantly higher ($P<0.05$) in midlands than lowlands but not in highland goats.

Prevalence of Ectoparasitesin by Season: The overall prevalence of ectoparasites in sheep in dry and rainy season was 61.7%, 61.4% and Goats 68.75 and 76.4%

respectively (Table 3). The prevalence of *Damalinoavis*, *Linognathusspp* and *Ctenocephalides* spp. in sheep was similar in both dry and rain seasons. The prevalence of *Melophagusovinus* and tick in sheep was significantly higher in rainy season than dry season. The prevalence of Sarcoptic mange in sheep was significantly higher in rainy than dry season. The prevalence of Demodectic mange in goats was found only in rainy season, but not during dry season. The prevalence of tick infestation was similar in both seasons. The prevalence of *Ctenocephalides* spp. was significantly higher ($P<0.05$) in rainy season than dry season.

The Prevalence of Ectoparasites by Sex: The overall prevalence of ectoparasites in sheep in female and male was 59.0% and 14.3% and 93.8% and 58.7% in goats respectively (Table 4). The prevalence of *Melophagusovinus* in sheep was significantly higher ($P<0.05$) in males than in females. In goats Sarcoptic mange was significantly higher ($P<0.05$) in males than in females and there were no differences for the remaining ectoparasites.

Table 5: Prevalence of ectoparasites in sheep and goats by age

Parasites	Sheep		Goats	
	Young (n=512)	Adult (n=884)	Young (n=322)	Adult (n=586)
<i>Damalineaovis</i>	42.9	32.0	-	-
<i>Damalinacapreae</i>	-	-	3.1	0.9
<i>Linognathusspp</i>	5.3	5.0	5.3	4.3
<i>Melophagusovinus</i>	16.4	12.8	-	-
Sarcoptic mange	1.8	3.5	30.1	23.2
Demodectic mange	-	-	1.2	1.9
Ticks	17.5	19.4	62.4	54.9
<i>Ctenocephalidesspp</i>	1.8	1.5	13.4	6.6
Overall	66.0	58.8	84.4	66.2

The Prevalence of Ectoparasites by Age: The overall prevalence of ectoparasites in lambs and adult sheep was 66% and 58.8% and in kids and adult goats were 84.4% and 66.2% respectively. In sheep and goats no significant differences were observed in prevalence of all ectoparasites between adults and young (Table 5).

DISCUSSION

The result of Questionnaire survey revealed that mange is the most important ectoparasites next to CCPP in the lowlands of Benatsemaye District, South Omo Zone and southern Ethiopia. The disease of mange in the district was locally known as “ketsi”. The small ruminant owners reported that this problem became more severe and spread intensively in the last two years prior to this study. According to [24] mange caused by *Sarcoptes* is often fatal and the mortality rate is higher in young and in animals with poor body condition [25] also indicated that sarcoptic mange cases of sheep and goats are often fatal and is most prevalent species in Ethiopia. The present study showed that Mange was highly transmissible and fatal in the area. Poor management, nutrition and hygienic conditions, in addition to the less awareness of the owners on the effect of the ectoparasites in sheep and goats are attributes of the wide spread and occurrence of infestation.

Results of the current study showed that among the different parasitic skin diseases, lice infestation (*Damalineaovis*) and tick infestation had 36.1% and 18.8% in sheep, respectively, whereas in goats the tick infestation was 57.6% and sarcoptic mange was 25.7%. Mean while, *Damalineaovis* in sheep was highly prevalent (62%) in the highlands that resulted in 72 % of heavy infestation. This might be due to favourable climatic condition for the ectoparasites biology. According [26]

when the temperature is cooler than optimum, eggs do not develop while, during hot temperatures prevent of egg lying hatching increases. In addition, these hot temperatures also kill the lice.

In this study louse infestation was not recorded in lowlands probably due to hot climate of the area. There were significant differences among the age groups. It was observed that lambs were more affected by lice than adults (OR=1.56, $P < 0.05$). This might be due to the fact that transfer of lice occurs from dam to lambs. Louse infestation may indicate some other underlying problem such as malnutrition and chronic diseases according to [23]. The present study showed the presence of significant difference ($P < 0.05$) in lice infestation between, poor and good body conditioned animals. In the hot humid climate, the parasite is restricted to cooler highlands and infestation may be lost when sheep are moved to hot dry areas [26].

In this study *Melophagusovinus* was the second leading infestation of sheep 28.5% recorded in the highlands. Out of all animals infested by *M. Ovinus*, 95.9% of them were concomitantly infected by *Damalineaovis*. Meanwhile, young animals were found to be significantly ($P < 0.005$) infected than adults. This finding is in congruent with [8] who reported on the susceptibility to ectoparasites because of higher ratio of accessible surface to body volume and grooming behaviour.

This study revealed that 43.8 % of the goats in lowlands were infested with sarcoptic mange. According to [1] the course of sarcoptic mange is rather more acute than the other forms of mange in that they may involve the entire body surface in short time. Sarcoptic mange occurs throughout the year, but the incidence is higher in the wet cold months when the moisture and temperature are optimum. These conditions are very favourable for the development of mites [26]. Infestation by sarcoptic mange

was significantly ($P < 0.05$) higher in rainy season than dry season where it was 1.7 times (OR=1.7) more in the rainy season. An odds ratio of 5.0 explained that goats were five times more at risk than sheep species of the lowland (black head Ogaden) and also males were two times more at risk than females (OR=2.0) of having this parasitic infestation. According to this study, sarcoptic mange infestation of the poor body conditioned animals was significantly ($P < 0.05$) higher than good body conditioned goats and also young animals were significantly ($P < 0.05$) affected than adults.

In the present study, Demodectic mange infestation of goats was observed only in lowlands in rainy season and had a prevalence of 1.7%. The lesions of Demodectic mange were non-pruritic papules and nodules and in most animals observed all the body had extensive skin damage. In addition, goats were more (OR=38.9) at risk than sheep. In some of previous studies such as [17, 27, 28] Demodectic mange was reported as the most important parasitic disease in goats than sheep.

Demodicosis is potentially immunosuppressive disease as it affects the cell mediated immunity (CIM) especially T-lymphocytes response [22]. In the present study, this disease was found only during the rainy seasons. This may be due to drought and long dry season the animals were debilitated and weakened thus becoming prone to this infestation. The *Demodex caprae* can stay in the skin of animals commensally without clinical signs and mites may be found in scraping from areas of the body not showing lesions [26].

The tendency towards a high occurrence of mange mites in the study areas could be associated to the nutritional and climatic stress following repeated drought. Due to feed scarcity sheep and goat flocks come into close contacts at available communal watering and grazing sites favouring the establishment and spread of mange mite infestation.

In this study it was identified that a total of 18.8% sheep and 57.6% goats were infested by four genera of ticks namely, *Amblyomma*, *Rhipicephalus*, *Hyalomma* and *Boophilus*. Out of 57.6% of goats positive for tick infestation, 42.2% of them were also positive for sarcoptic mange. Further, out of 18.8% of sheep infested by ticks, 2.9% were positive for sarcoptic mange.

Among all tick infested animals 90.3% had heavy infestations. *Amblyomma*, *Rhipicephalus*, *Hyalomma* were the most prevalent genera in the lowlands while, *Boophilus* was predominantly found in the highlands. Agro-pastoralists claimed about resistance of ticks

against the existing acaricides however this needs further investigation and confirmation. Because of resistant and heavy challenge of ticks the agro-pastoralists in the study area used hot firewood to destroy the tick clusters on the body of animals. This practice adversely and severely affected the skin quality. High temperature, humidity and prolonged sunlight favour the survival and reproduction of ticks [29]. According to the present study, the risk of tick challenge in goats was eight (OR=8.4) times higher in lowlands than the high lands. Most ticks spend more time off the host, but are totally dependent on the host for sustenance [29].

Ctenocephalides species occasionally infest sheep and goats causing formation of papule, crusts, pruritus and excoriation [23]. The prevalence of Ctenocephalides species in goats in the midland was more frequent and significantly ($P < 0.05$) higher than in the highlands. This finding agrees with the similar explanation by [1]. This might be associated with the high humidity, usually above 70%, required for oviposition of flea eggs as described by Wall and Shearer [23].

Flea infestation with Ctenocephalides species was 1.5% and 9.1% prevalence in sheep and goats respectively. In the highland all sheep, which were infested by flea were have mixed infection of *D. ovis* and with the exception of other animals carrying heavy crusts. A feature heavy infestation was marked hyper keratinisation with scaling resembling lesions of Sarcoptic mange, but no mites was isolated in multiple skin scrapes taken from such animals. Flea was not also found in agro-pastoral areas. This finding is in agreement with the results of [10].

In conclusion, ectoparasites are among highly prevalent and the major constraints of sheep and goat production in the study area. The major ectoparasites affecting sheep and goat were lice, keds, mites and ticks. Among parasitic skin diseases recorded in the area sarcoptic mange was found to be highly prevalent among sheep and goats while demodectic mange affects only goats. Meanwhile, poor veterinary service and absence of strategic treatment of animals were also among highly contributing factors for the widespread of these ectoparasites and skin diseases.

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