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ORIGINAL RESEARCH

Ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region, Ethiopia

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Abstract A study on ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region, Ethiopia disclosed an overall prevalence of 55.5% and 58% in each examined 750 sheep and goats, respectively. In the sheep population, *Melophagus ovinus* (19.1%), tick infestations (16%), *Damalinia ovis* (15.3%), *Linognathus africanus* (11.5%), and *Ctenocephalides felis* (9%) were the major ectoparasites. The major ectoparasites identified in goats were tick infestations (29.7%), *L. africanus* (27.9%), *Sarcoptes scabiei* var. *caprae* (12.5%), *C. felis* (11.1%), and *Demodex caprae* (6.8%). In sheep, there was a statistically significant difference ($P<0.001$) in the prevalence of *Damalinia ovis*, *M. ovinus*, *L. africanus*, and ticks between midland and highland. In goats, the risk of *Sarcoptes scabiei* var. *caprae* infestation in midland (odds ratio (OR)= 17.2, $P<0.001$) and lowland (OR=5.2, $P<0.001$) was 17.2 times and 5.2 times, respectively, higher than the highland. Favorable climatic conditions, backward level of management, poor level of consciousness and awareness of farmers, and weak animal health extension services are believed to have contributed for widespread distribution and occurrences of ectoparasites. The growing threat of ectoparasites to small ruminant production and the tanning industry needs well-coordinated and urgent control intervention.

Keywords Ectoparasites · Goats · Sheep · Tigray region · North Ethiopia

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Introduction

Small ruminants constitute about 30% of the total livestock population of Ethiopia (Gryseels and Anderson 1983) and are important contributors to food production, providing 35% of meat consumption and 14% of milk consumption (Wondwossen 1997). Among exports of livestock products, skins and hides have the largest share of exports followed by live animals (Ayele et al. 2003). The small ruminant population of Ethiopia is about 18.1 million sheep and 14.8 million goats (Central Statistics Authority 2006). Parasitic skin diseases of small ruminants caused by lice, keds, ticks, and mites are among the major diseases causing serious economic loss to small holder farmer, the tanning industry, and the country as a whole (Ministry of Agriculture and Rural Development 2005).

The small ruminant population of Tigray Region of north Ethiopia is estimated to be 1,022,779 sheep and 1,588,779 goats. However, skin diseases have affected seriously the regional small ruminant production and productivity and skin quality (Tigray Bureau of Agriculture and Rural Development 2006). Therefore, the objective of the study was to determine the prevalence of ectoparasites in small ruminants in different agro-climatic areas of the region.

Materials and methods

Study area

The study on small ruminant ectoparasites was conducted in three districts of Tigray Region of North Ethiopia, namely Atsbi-womberta (highland, 2,500 m above sea level) and Erob (midland, 1,500 and 1,800 m above sea level) from eastern zone, and Seharti-samre (lowland, 1,500 m above sea level) from the southeastern zone of

the region, north of Ethiopia which is located about 851, 968, and 833 km away from Addis Ababa, respectively. Atsbi-womberta district has a common boundary with Afar Regional State, Erob with Eritrea, and Afar Regional State and Seharti-samre with Amhara Regional State. The livestock in the districts are indigenous breeds with small number of crossbreed cattle kept around the town and exotic poultry breeds distributed through poultry improvement packages. The production system of the area is mixed crop livestock in which livestock are managed under extensive system in all of the three districts (Tigray Bureau of Agriculture and Rural Development 2006).

Study population

The present study was conducted from November 2007 to April 2008. Indigenous sheep and goats owned by farmers and managed under extensive management system in different agro-climatic zones were used.

Design and methods

The study of ectoparasites on sheep and goats involved districts, peasant associations (PAs), and sheep and goats as a sampling unit. The districts were selected purposively based on their representation of different agro-climatic zones; five PAs from each district having the corresponding agro-climate were selected randomly. Sheep and goats in selected PAs were also selected randomly from animals grazing in communal pastures.

The sample size for the study was determined based on expected prevalence of the disease 20% in each district (Wukro Sheba Tannery 2005), absolute desired precision of 5% at confidence level of 95%. The sample size was calculated according to the following formula (Thrusfield 2005). Accordingly, the minimum sample size for the present study was found to be 250 sheep and 250 goats from each agro-climatic zone. The study consisted of a cross-sectional study on ectoparasites of small ruminants. A total of 1,500 animals (750 sheep and 750 goats) randomly selected from the three agro-climatic zones were examined for the presence of ectoparasites or skin lesions. Before clinical examination, explanatory variables such as sex, age, body condition, and hairiness of the selected animals were recorded. Body condition score of the animals as poor and good and age categorization into young (lamb/kid) and adult were recorded as described (Steele 1996). Accordingly, sheep and goats under 1 year were categorized as young and the rest as adult.

The clinical examination was performed by multiple fleeces parting in the opposite direction that in which hair or wool normally rests and visual inspection and palpation of the skin for parasites or lesions on all parts of the body of the animal including the ears and digits. Encountered ectoparasites were collected and identified based on their morphological structures (Chauhan and Agarwal 2006).

Statistical analysis

The effects of different epidemiological risk factors such as climate, age, and body condition on prevalence of ectoparasites in sheep and goats were analyzed by logistic regression using SPSS 11.5 for windows, and $P<0.05$ was considered to be statistically significant.

Results

Out of 750 sheep and 750 goats examined for ectoparasites, 414 (55.2%) sheep and 435 (58%) goats were found to be infested with one or more ectoparasites. *Melophagus ovinus* (19.1%) tick infestations (16%), *Damalinia ovis* (15.3%), *Linognathus africanus* (11.5%), and *Ctenocephalides felis* (9%) infestations were the major ectoparasites identified in sheep (Table 1). The major ectoparasites identified on goats include tick infestations (29.7%), *L. africanus* (27.9%), *Sarcoptes scabiei* var. *caprae* (12.5%), and *C. felis* (11.1%). The tick species identified in sheep were 7.5% *Amblyomma variegatum*, 4.1% *Rhipicephalus pulchellus*, 2.9% *Boophilus decoloratus*, 2% *A. gemma*, and 1.7% *R. evertsi evertsi*, while the tick species identified in goats were *A. variegatum*, *R. pulchellus*, *B. decoloratus*, *A. gemma*, and *R. evertsi evertsi* at prevalence of 10.8%, 9.1%, 7.2%, 4%, and 2.9%, respectively.

The overall prevalence of ectoparasites in young and adult sheep and goats was 48.9% and 59.2% and 44.8% and 66.4%, respectively (Tables 2 and 3). However, there was no statistically significant difference ($P>0.05$) in prevalence of *Damalinia ovis*, *M. ovinus*, and *S. scabiei* var. *ovis* infestations between young and adult sheep. Statistically significant difference (odds ratio (OR)=3.15, $P<0.001$) in prevalence of *L. africanus*, *C. felis* (OR=0.22, $P<0.001$), and tick infestation (OR=2.06, $P<0.01$) was observed between adults and young age groups of sheep.

In goats, there was a significant difference between the prevalence of *L. africanus* (OR=2.85, $P<0.001$), *Demodex caprae* (OR=35.66, $P<0.001$), *S. scabiei* var. *caprae* (OR=4.61, $P<0.001$), and tick infestations (OR=2.20, $P<0.001$) between young and adult goats, respectively. However, there was no significant difference ($P>0.05$) in the prevalence of *C. felis* and *Damalinia caprae* infestations between the two age groups of goats.

The overall prevalence of ectoparasites in animals with good and poor body condition was 44.7% and 85.1% in sheep and 44.5% and 87.6% in goats, respectively. Body

Table 1 Prevalence of ectoparasites on sheep and goats in selected agro-climatic sites of Tigray Region North Ethiopia

Ectoparasites	Sheep (n=750)		Goats (n=750)	
	Prevalence (%)	95% CI	Prevalence (%)	95% CI
M. ovinus	19.1	0.16–0.22	–	–
Damalinia ovis	15.3	0.13–0.18	–	–
Damalinia caprae	–	–	2.7	0.02–0.04
L. africanus	11.5	0.09 –0.14	27.9	0.25–0.31
C. felis	9.0	0.07–0.16	11.1	0.09–0.13
S. scabiei var. *ovis*	1.3	0.01–0.02	–	–
S. scabiei var. *caprae*	–	–	12.5	0.10–0.15
Demodex caprae	–	–	6.8	0.05–0.09
Tick infestations	16.0	0.13–0.19	29.7	0.31–0.38
A. variegatum	7.5	0.06–0.09	10.8	0.09–0.13
A. gemma	2.0	0.01–0.03	4.0	0.03–0.05
B. decoloratus	2.9	0.02–0.04	7.2	0.05–0.09
R. pulchellus	4.1	0.03–0.06	9.1	0.07–0.11
R. evertsi evertsi	1.7	0.01–0.03	2.9	0.02–0.04
Overall	55.2	0.512	58.0	0.592

condition specific prevalence of ectoparasites in sheep and goats are shown in Tables 2 and 3.

In sheep, logistic regression analysis indicated statistically significant differences in the prevalence of *Damalinia ovis* (OR=1.986, P<0.01), *L. africanus* (OR=17.33, P< 0.001), *M. ovinus* (OR=2.085, P<0.001), and tick infestations (OR=2.007, P<0.01) between poor and good body condition of animals, while no statistically significant difference (P>0.05) was noted in the prevalence of *C. felis* and sarcoptic mange infestations between poor and good body conditioned animals. There was a significant difference in the prevalence of *Damalinia caprae* (OR=13.31, P< 0.001), *L. africanus* (OR=7.783, P<0.001), *S. scabiei* var. *caprae* (OR=336.63, P<0.001) between poor and good body condition goats. However, no statistically significant difference (P>0.05) was observed in the prevalence of *C. felis* infestations between poor and good body condition goats.

The overall prevalence of ectoparasites in highland, midland, and lowland were 67.6%, 49.2%, and 48.8% in sheep and 41.6%, 66.4%, and 66% in goats, respectively (Tables 2 and 3). The effect of agro-climate on the prevalence of ectoparasites identified on sheep was analyzed using logistic regressions. The prevalence of *M. ovinus* among the agro-climates showed statistically significant difference between midland and highland (OR=0.046, P<0.001), but there was no statistically significant difference (P>0.05) between midland and lowland agro-climates. A similar logistic regression analysis performed on the prevalence of *Damalinia ovis* among the three agro-climates indicated statistically significant difference (OR= 0.250, P<0.001) between highland and midland while no significant difference (P>0.05) was recorded among highland and lowland and midland and lowland.

A statistically significant difference in the prevalence of *L. africanus* (OR=46.024, P<0.001) was found between

Table 2 Prevalence of ectoparasites of sheep based on age, body condition, and agro-climate in selected sites of Tigray Region North Ethiopia

Ectoparasites type	Age		Body condition		Agro-climate		
	Adult (n=456)	Young (n=294)	Good (n=555)	Poor (n=195)	Highland (n=250)	Midland (n=250)	Lowland (n=250)
M. ovinus	20.4%	17.0%	15.9%	28.2%	52.4%	4.8%	–
Damalinia ovis	16.8%	12.9%	12.8%	22.6%	34.4%	11.6%	–
L. africanus	15.4%	5.4%	3.1%	35.4%	0.4%	15.6%	18.4%
C. felis	4.2%	16.7%	8.1%	11.8%	–	13.2%	14.0%
S. scabiei var. *ovis*	2.0%	0.3%	–	5.1%	–	3.2%	0.8%
Ticks	19.5%	10.5%	13.3%	23.6%	1.2%	15.2%	31.6%
Overall	59.2%	48.9%	44.7%	85.1%	67.6%	49.2%	48.8%

Table 3 Prevalence of ectoparasites of goats based on age, body condition, and agro-climate in selected sites of Tigray Region North Ethiopia

Ectoparasites type	Age		Body condition		Agro-climate		
	Adult (n=458)	Young (n=292)	Good (n=515)	Poor (n=235)	Highland (n=250)	Midland (n=250)	Lowland (n=250)
Damalinia caprae	4.1%	0.3%	0.6%	7.2%	4.0%	4.0%	–
L. africanus	35.4%	16.1%	14.6%	57.0%	23.2%	32.4%	28.0%
C. felis	4.8%	20.8%	11.8%	9.4%	10.8%	10.0%	12.4%
S. scabiei var. *caprae*	17.7%	4.4%	0.2%	18.3%	2.0%	26.0%	9.6%
Demodex caprae	10.9%	0.3%	1.7%	17.9%	3.2%	7.6%	9.6%
Ticks	35.8%	20.2%	26.6%	36.6%	7.2%	36.4%	45.6%
Overall	66.4%	44.8%	44.5%	87.6%	41.6%	66.4%	66.0%%

midland and highland and also between lowland and highland (OR=56.15, P<0.001). The prevalence of ticks indicated statistically significant difference between midland and highland (OR=14.76, P<0.001) and between lowland and highland (OR=38.04, P<0.001). The prevalence of sarcoptic mange and *C. felis* infestations in sheep was not statistically significant (P>0.05) among the different agro-climates.

In goats, logistic regression analysis indicated statistically significant difference in prevalence of sarcoptic mange infestations between midland and highland (OR=17.22, P< 0.001) and between midland and lowland (OR=3.31, P< 00.001). The difference in the prevalence of *Linognathus* spp. between highland and midland was statistically significant (P<0.05) while no significant difference (P> 0.05) was indicated between highland and lowland and midland and lowland. The prevalence of *C. felis* showed no statistically significant difference between all agro-climates.

The prevalence of *M. ovinus* on hairy, less wooly, and wooly sheep was 0.4%, 6.3%, and 49.6%, respectively. There was a statistically significant variation in the prevalence of *M. ovinus* (χ^2=150.01, P=0.000) between wooly 125/252 (49.6%) and hairy 1/229 (0.4%) sheep. Similarly, a statistically significant difference was observed (χ^2=122.9, P=0.001) in the prevalence of *M. ovinus* in wooly 125/252 (49.6%) and less wooly 17/269 (6.3%) sheep.

Discussion

The high overall prevalence of ectoparasites in selected agro-climatic sites of Tigray Region of North Ethiopia recorded in sheep (55.2%) and goats (58%) is indicative of the importance of these disease problems in small ruminants in the study area. Lice infestations were the most prevalent ectoparasites recorded in both species with a prevalence of 26.8% in sheep and 30.6% in goats.

The overall prevalence of lice infestation obtained in the study was relatively higher than observations made in around Kombolcha (Numery 2001) 14.2%, in Southern range land (Molu 2001) nil in sheep, and 0.5% in goats and 26.64% in sheep in Wolayta Sodo (Yallew 2007). On the other hand, the present prevalence of lice infestation was relatively lower than 39.8% in sheep and 29.2% prevalence in goats in Amhara Regional State (Sertse and Wossene 2006). Such differences in prevalence may arise from differences in agro-climate, in season during which the study was conducted, management, and health care of sheep and goats in the study areas.

Lice infestations may indicate some other underlying problems such as malnutrition and chronic diseases. The possible reasons for such high prevalence of lice in the study area includes: poor feeding and management, poor sanitation, and inadequate utilization of veterinary service. These conditions were observed during the study period where small ruminants were allowed to graze on devastated areas with little vegetation cover, managed mixed with other species of animals, and kept under dirty barns. Lice infestations were also associated with damage to the skin, loss in production, irritation, and possibly vector in disease transmission (Wall and Shearer 1997). The irritation caused by even modest population of lice leads to scratching and rubbing, causing damage to the skin, and severe infestation with *L. africanus* may cause anemia (Foreyt 2001). *Damalinia ovis* is responsible for the development of nodular hypersensitivity reaction lesion (cockle) in pickled skins (Sertse and Wossene 2006).

Damalinia ovis requires suitable temperature and fiber of appropriate diameter to which eggs can be attached during its oviposition (Kettle 1984). *Damalinia ovis* eggs develop and hatch over the range of 33–39°C and are virtually independent of relative humidity over the range of 7–75%. The temperature at skin surface of sheep is 37.5°C, and this is the temperature at which maximum oviposition of *Damalinia ovis* occurs. High prevalence of the parasite on

highland agro-climate can be explained by requirement of *Damalinia ovis* for its oviposition.

L. africanus infestation was found to be more prevalent in sheep and goats with poor body condition (35.4% and 57%) than those with good body condition (31.1% and 14.6%), respectively. Poor body-conditioned goats were 7.7 times more at risk for *L. africanus* infestations than those with good body condition. Animals in poor body condition which are fed improperly and exposed to debilitating diseases carry heaviest infestations of lice since debilitated animals do not groom themselves and live the lice undisturbed causing anemia (Urquhart et al. 1996).

M. ovinus was the second most important ectoparasite observed in sheep accounting for 19.1% over all prevalence. Infestation with *M. ovinus* leads to irritation and staining of the wool by the feces of the ked. The irritation results in animal biting and rubbing with resultant damage to the fleece and development of a vertical ridging of the skin called cockle (Kassa 2006). The prevalence of *M. ovinus* was 52.4% in highland and 4.8% in midland. However, no case of *M. ovinus* was recorded in the lowlands. In hot and humid tropics, the parasite is restricted to cooler highlands, and infestations may be lost when sheep are moved to hot dry areas. Temperature may play an important role in the dynamics of the ked (Kettle 1984). The present finding of higher prevalence of *M. ovinus* 55.9% in wooly sheep and 0.4% in hairy sheep was suggestive of the fact that wooly breeds are susceptible to ked infestation (Steele 1996).

Ticks of three genera (*Boophilus*, *Amblyomma*, and *Rhipicephalus*) were identified both in sheep and goats. The species identified were *B. decoloratus*, *A. variegatum*, *A. gemma*, *R. pulchellus*, and *R. evertsi evertsi*; with over all prevalence of 16% and 29.7% in sheep and goats, respectively. Infestation of *A. gemma* and *A. variegatum* were reported in sheep and goats. Similarly, *R. evertsi evertsi*, *R. pulchellus*, *B. decoleratus*, *A. variegatum*, *A. gemma*, *R. pulchellus*, and *R. evertsi evertsi* were reported to exist in sheep and goats in different areas of Ethiopia (Morel 1980). The prevalence of tick infestation in sheep and goats was found to be higher in lowland and midland with prevalence of 31.6% and 45.6% and 15.2% and 36.4%, respectively. Relatively higher prevalence of tick infestation was observed in animals with poor condition (23.6% in sheep and 36.6% in goats) than with good body condition (13.3% in sheep and 26.6% in goats).

Clinical mange due to *S. scabiei* var. *caprae* and *S. scabiei* var. *ovis* were among the ectoparasitic diseases diagnosed in sheep and goats with an overall prevalence of 1.3% and 19.3%, respectively. The prevalence of mange obtained in the present study was higher than the observations made in other parts of Ethiopia. Previous studies reported mange 2.1% in sheep and 4.3% in goats in Sidama zone (Teshome 2002), and nil in sheep, and 0.98% in goats Wolayta Sodo (Yallew 2007).

There was statistically significant difference ($P<0.01$) in the prevalence of *S. scabiei* var. *caprae* among highland (2%), midland (26%), and lowland (9.6%) agro-climates. Goats in midland and lowland were 17.2 and 5.2 times at risk for *S. scabiei* var. *caprae* infestations than those in the highland, respectively. High temperature, humidity, and sunlight favor mange infestation. Mites have been shown to be capable of surviving off the host for short periods, but the length of time that *S. scabiei* var. *caprae* can survive off the host depends on environmental conditions but may be between 2 and 3 weeks (Steele 1996). The burrowing and feeding activities of *S. scabiei* var. *caprae* cause intense itching, inflammation, hair loss and formation of crusts of exudates, loss of condition, and death (Olubunmi 1995).

Infestation by fleas of *C. felis* was one of the ectoparasite problems encountered in sheep and goats in the study area. Most species of flea are not host specific and feed on any available animals, but in many cases, full fertility is achieved after feeding on specific host. *C. felis* occasionally infests sheep and goats, and the clinical signs include papules, crusts, pruritis, and excoriation (Chauhan and Agarwal 2006).

Ectoparasites are among the major causes of sheep and goat production constraints and quality deteriorations of exported skin in the country. The present study disclosed lice, ked, mites, ticks, and fleas to be the major ectoparasites of sheep and goats in selected agro-climatic sites of Tigray Region North Ethiopia. Even though difference in distribution of different ectoparasites among agro-climates was observed, the overall prevalence is generally high resulting in high economic losses through decreased production and productivity, deaths, and damages of the skin. Poor management and poor level of awareness of small ruminant owners on the effect of ectoparasites are strongly believed to have contributed to the widespread occurrence of the diseases. Hence, effective extension system and programs that could raise public awareness on management of animals, effect of ectoparasites, and control methods is highly recommended. Treatment guidelines should be developed in accordance with the agro-climatic situation of an area, where in the midlands and lowlands, mange is a serious problem and natural caves are abundant, effective acaricides should be used, and animals should be kept away from the caves to avoid reinfestation by mites.

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