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Prevalence of Small Ruminant Ectoparasites in Selected Districts of South Omo Zone, Southern Ethiopia

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Abstruct: A cross-sectional study was conducted from November 2013 to December 2014 with the aim of determining the prevalence of ectoparasites and identifying the potential risk factors associated with the ectoparasitisim in selected districts of South Omo zone, Southern Ethiopia. A total of 304 small ruminants (103 sheep and 201 goats) were examined for presence of ectoparasites, 269 animals were found infested by one or more ectoparasite recording an overall prevalence of 88.4%. The proportion of major ectoparasite infestation in small ruminants in the study districts were, ticks (86.51%), lice (10.19%) and fleas (0.65%). Twelve species of external parasites which belong to tick, lice and flea were found infesting sheep and goats. Accordingly, *Rhipicephalus pulchellus* (48.35%) account for the highest proportion followed by *Rhipicephalus decoloratus* (30.92%), whereas, *Linognatus.ovillus, Linognatus stenopsis* and *Ctenocephalides felis* were found with low proportion. The prevalence of ectoparasite infestation (tick, lice and flea) was not significantly (P>0.05) affected by district, species, sex and age, except the occurrence of flea was significantly (P>0.05) higher in the young than the old group. In conclusion, the present study reaffirmed high prevalence of ectoparasites. Therefore, to reduce the growing threat of ectoparasites on sheep and goats' productivity in the area and tanning industry in the country, compulsory ectoparasite control and intervention measures which can be adoptable for the pastoral community need to be designed and implemented.

Key words: Ectoparasites · Prevalence · Risk Factors · Small Ruminants · South Omo

INTRODUCTION

Small ruminants (sheep and goats) in Ethiopia are widely distributed across different agro-ecological zones and production systems. They are an integral part of livelihood of rural households and a source of export earnings for the country [1]. Small ruminants significantly contribute to income generation and food security of households, supplying about 23-39% of farm cash income [2]. Sheep and goats have a high reproduction rate and they are very important as immediate sources of cash income and as source of meat for home consumption [3]. However, the contribution from this vast population to food production and export income is far below the expected potential. Among the several causes, one of the associated factors responsible for hampering the expected potential of small ruminants production and productivity is ectoparasitism [4, 5].

Infestation by ectoparasites could lead to significant economic losses to farmers due to loss of productivity, mortality and skin diseases. Ectoparasites including lice, sheep keds, ticks, fleas and mange mites are reported to cause a wide range of health problems such as mechanical tissue damage, irritation, inflammation, hypersensitivity, abscesses, weight loss, lameness, anaemia and in severe cases death of infested animals with the consequential socioeconomic implications [6, 7]. They are also responsible for great preslaughter and tannery processed skin defects, resulting in downgrading and rejection of small ruminant skins [8-10]. Moreover, ectoparasites are known to have zoonotic importance and be capable of transmitting several types of disease pathogens from animals to animals and from animals to human due to their blood sucking habit [11].

South omo is among the known pastoral areas of Ethiopia and possesses huge livestock resource and small ruminants are an important component of livestock play

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a significant role in supporting the pastoralists and farmers' livelihood in the area. Therefore, despite these huge consequences of ectoparasites reported from different parts of the country the status of ectoparasite infestation on small ruminants in the study area was never reported. Therefore, this study was designed with the aim of determining the prevalence of ectoparasite and identifying the potential risk factors associated with the ectoparasitisim in selected districts of South Omo zone, Southern Ethiopia.

MATERIALS AND METHODS

Study Area Description: The study was conducted in two districts of South Omo zone. South Omo is one of the 14 zones in the Southern Nations, Nationalities and Peoples Regional State (SNNPRS) in Ethiopia. Two of the study districts (Hamer and Bena-Tsemay districts) have a total land area of 9,496 km2 (Hamer = 5,742 km^2 and Bena-Tsemay = 3, 754 km^2). The districts are located between latitudes 4° 27'-5° 39' North and longitudes 35° 23'- 37° 49' East, bordering Kenya to the south, Debub Ari district to the north, Borana zone and Konso district to the East and Kuraz and Selamago districts to the west. The capitals of the districts, Dimeka (Hamer) and Key Afer (Bena-Tsemay), are located at about 839 and 739 km south of Addis Ababa, respectively. The districts are characterized by semi-arid and arid climatic conditions, with mean annual rainfall increasing from the extreme south lower part, with some 350 mm, to the upper part where it ranges to 838 mm. The rainfall is bimodal, which occurs between September and November and between March and May. In general, the area has an erratic, variable rainfall and high ambient temperature ranging from 26-35 °C. The vegetation cover is a mixture of Acacia, Boswellia and Commiphora woody species and short grass types with varying density of woody vegetation [12, 13]. The communities' livelihoods in the districts are based on pastoralism and agro-pastoralism [14].

Study Animals: The study animals were local Black Head Ogaden sheep and Woito Guji goat breeds managed under the extensive pastoral production system. Sheep and goats of all age group including both sex was used for ectoparasite sample collection. Age of the animals was determined based on owners' information and dental eruption; accordingly, animals were categorized in to two age groups: 0 months - 2 year (young) and >2 years (old).

Study Design and Sampling Technique: A cross-sectional study was conducted from November 2013 to December 2014. The study districts (Hammer and Bena-Tsemay) were selected purposively then multi-stage random sampling procedure was used to select pastoral associations (PAs) and households (farmers). Systematic random sampling method was employed for sampling of individual animals. Animals were selected systematically the first animal being selected randomly from the flock then at an interval until the required number of sample size in that PA was attained; this was done early in the morning before animals were released for grazing.

The sample size was calculated according to the formula given by Thrusfield [15] by considering 78.38 % expected prevalence [16], using 95% confidence interval at a 5% absolute precision. Thus, the calculated sample size was 261.

Ectoparasite Collection and Identification: A total of 305 small ruminants (103 sheep and 201 goats) were examined from head to tail including legs using visual inspection and palpation for the presence of external parasites and/ or lesions. Ectoparasites (ticks, lice and fleas) either encountered on the skin surface or attached to the hair were collected manually from their sites of attachment. The ticks were gently removed from the host skin with the help of thumb forceps to avoid any damage of the mouth part. A coat brushing technique was applied to collect lice and fleas from host skin. Then the collected samples were placed in labelled universal bottles containing 70% ethanol and taken to the Parasitology Laboratory of the Wolaita Sodo Regional Animal Health Laboratory. In the laboratory, identification at species level was conducted using a stereomicroscope according to their key morphological structures using Walker *et al.* [17] suggestions for ticks Urquhart *et al.* [18] and Wall and Shearer [19] for lice and fleas.

Data Analysis: The collected data were entered in to Microsoft Office Excel 2010 computer program and all statistical analyses were performed using STATA version 13 software (Stata Corp., College Station, TX). Descriptive statistics were used to analyze the proportions of recoded variables. The association with different risk factors (age, sex, district and species of animals) on the prevalence and distribution of ectoparasites was analyzed using χ^2 test. A P-value less than 0.05 was considered for significance.

RESULTS

Overall prevalence: Out of 305 examined animals (103 sheep and 201 goats), 269 animals were found infested by one or more ectoparasite recording the overall prevalence 88.4% (Table. 1). Among the collected and identified ectoparasites, the proportion of ectoparasite infestation in small ruminants in the study districts (Hammer and Bena -Tsemay) were, ticks (86.51), lice (10.19%) and fleas (0.65%). Ectoparasites identified in sheep were: ticks (88.34%), lice (13.59%) and fleas (0%), with total prevalence of 90.2%; whereas, in goat ectoparasites encountered were: ticks (85.57%), lice (8.45%) and fleas (0.9 %) with total prevalence of 87.5% (Table. 1).

Species Identification: Overall, five genera and twelve species of external parasites which belong to ticks, lice and fleas were found infesting sheep and goats in the study districts of Hammer and Bena-Tsemay. Accordingly, *Rhipicephalus pulchellus* (48.35%) account for the highest proportion followed by *Rhipicephalus decoloratus* (30.92%), *Rhipicephalus pravus* (23.68) and *Rhipicephalus evertsi evertsi* (21.38%). whereas, *Linognatus.ovillus, Linognatus stenopsis* and *Ctenocephalides felis* were found with low proportion (Table. 2).

Risk factors: The prevalence of ectoparasite infestation (ticks, lice and fleas) was not significantly (P>0.05) affected by district, species, sex and Age, except the occurrence of flea affected by age. Which the young age has significantly affected (P>0.05) than the old age group (Table. 3).

DISCUSSION

The overall prevalence of small ruminant ectoparasites in the study area was 88.4%. The current prevalence is higher than findings of other studies in the country: 45.5% by Seyoum, Tadesse and Addisu [20],

Table 1: Overall prevalence of ectoparasites in sheep and goats in the study areas

	Sheep (n=103)		Goat (n= 201)		Total (n=304)	
Ectoparasite	Infested	Prevalence	Infested	Prevalence	Infested	Prevalence
Ticks	91	88.34	172	85.57	263	86.5
Lice	14	13.59	17	8.45	31	10.19
Fleas	-	-	2	0.9	2	0.65
Overall	93	90.29	176	87.56	269	88.48

Table 2: Prevalence of ectoparasites species of sheep and goats in the study districts

	Sheep (n=103)		Goats (n=201)		Overall (n=304)	
Ectoparasite	Infested (prevalence)	95% CI	Infested (prevalence)	95% CI	Infested (prevalence)	95% CI
Ticks						
Rh. pulchellus	51 (49.5)	39.91 - 59.15	96(47.7)	40.89 - 54.70	147 (48.35)	42.70 - 54.00
Rh. decoloratus	35 (33.9)	25.43 - 43.71	59(29.3)	23.43 - 36.06	94 (30.92)	25.69 - 36.14
Rh. pravus	26 (25.2)	17.73 - 34.58	46 (22.8)	17.56 - 29.24	72 (23.68)	18.87 - 28.49
Rh. evertsi evertsi	18 (17.4)	11.25 -26.13	47(23.3)	18.01 - 29.77	65 (21.38)	16.74 - 26.01
A. variegatum	3 (2.9)	0.93 - 8.72	8(3.9)	1.99 - 7.78	11 (3.61)	1.50 - 5.72
A. lepidum	7 (6.7)	3.25 - 13.65	1 (0.4)	0.06 - 3.48	8 (2.63)	0.82 - 4.44
A. gemma	3 (2.9)	0.93 - 8.72	2 (0.99)	0.24 - 3.92	5 (1.64)	0.20 - 3.08
A. coherence	1 (0.9)	0.13 - 6.67	3 (1.4)	0.47 - 4.55	4 (1.31)	0.02 - 2.60
Lice						
Damalina ovis	3 (2.9)	0.93 - 8.72	0(0)	-	3 (0.98)	-0.13- 2.10
Linognatus.ovillus	1 (0.9)	0.13 - 6.67	1(0.4)	0.06 - 3.48	2 (0.65)	0.25- 1.57
Linognatus stenopsis	0 (0)	-	2(0.9)	0.24 - 3.92	2 (0.65)	-0.25- 1.57
Fleas						
Ctenocephalides felis	0 (0)	-	2(0.9)	0.24 - 3.92	2 (0.65)	-0.25- 1.57

Table 3: Prevalence of ectoparasites based on risk factors

Ectoparasite	Variable	Category	No. Obs	No. Positive	Prevalence (%)	95% CI	χ^2	P value
Tick	District	Hammer	151	128	84.76	78.06 - 89.69		
		Bena-Tsemay	153	135	88.23	82.04 - 92.48	0.7829	0.376
	Species	Sheep	103	91	88.34	80.51 - 93.2		
		Goat	201	172	85.57	79.96 - 89.80	0.4502	0.502
	Sex	Male	79	67	84.81	75.00 - 91.2		
		Female	225	196	87.11	82.03 - 90.91	0.2653	0.606
	Age	Young	88	71	80.68	70.99 - 87.69		
		Old	216	192	88.88	83.92 - 92.45	3.6095	0.057
Lice	District	Hammer	151	21	13.90	9.21- 20.44		
		Bena-Tsemay	153	24	15.68	10.71 - 22.3	0.1907	0.662
	Species	Sheep	103	14	13.59	8.18 - 21.73		
		Goat	201	17	8.45	5.30 - 13.21	1.9606	0.161
	Sex	Male	79	6	7.59	3.42 - 16.00		
		Female	225	25	11.11	7.60 - 15.96	0.7894	0.374
	Age	Young	88	7	7.95	3.81 - 15.85		
		Old	216	24	11.1	7.54 - 16.07	0.6803	0.409
Flea	District	Hammer	151	2	1.32	0.32 - 05.18		
		Bena-Tsemay	153	0	0	-	2.0399	0.153
	Species	Sheep	103	0	0	-		
		Goat	201	2	0.9	0.24 - 3.92	1.0317	0.310
	Sex	Male	79	1	1.26	0.17 - 8.59		
		Female	225	1	0.44	0.06 3.12	0.6036	0.437
	Age	Young	88	2	2.27	0.56 - 8.74		
		Old	216	0	0	-	4.9416	0.026

50.3% [21], 54.8% [22] and 78.3% by Fentahun *et al.* [16]. However, the current prevalence is lower compared to the previous finding which reported prevalence of 99.38% in wolmera district of Oromia regional state [23]. The difference in prevalence of ectoparasite in our study as compared to earlier reports could be attributed to differences in control activities among the study areas, differences in agro-ecology, animal management practices, production systems and population density.

The current study has shown that 88.34% of the sheep and 85.57% of the goats examined were found to be infested by at least single or more tick parasites recoding an overall prevalence of 86.5%. This result was in agreement with the findings of a research conducted in Dhas district of Borena pastoral area, Southern Rangelands of Ethiopia, which reported overall prevalence of 87.76 % [24]. However, this result was found higher than the previous observations of 76.50% and 79.7% reported by Abunna, Tura and Regassa [25] and Mohammed and Admasu [26] respectively.

In our finding two genera of eight species of ticks were observed, Among, *Rhipicephalus pulchellus* was the most dominant tick species followed by *Rhipicephalus decoloratus*, *Rhipicephalus pravus* and *Rhipicephalus evertsi evertsi* infesting small ruminants in the study districts. The current finding was in line with the previous works Jafer *et al.* [27] and Eyob and Matios [24], reported *Rhipicephalus pulchellus* was the dominant tick species, research conducted in other parts of the country.

This study confirmed that three species of lice comprising of *Demalina ovis*, *Linognathus ovilis* and *Linognathus stenopsis* from both sheep and goats with the prevalence of 10.19%. This finding was in close agreement with a previous finding, Tesfaye *et al.* [28] which reported prevalence of 9.7% Bahir Dar veterinary clinic with similar composition of lice species. However, the current prevalence was much lower than findings of other studies conducted in Tiyo district of Arsi Zone reported an overall prevalence of lice in sheep 83.34% [29] and a prevalence of 24.40% was reported in both sheep and goats by Misgie *et al.* [30]. The variation might possibly be attributed to management factor such as overcrowding, feeding and climate variations among the study areas. Lice infestation was reported to be higher in debilitated animals that suffer from malnutrition and intestinal parasitism [31].

In our finding one flea species *Ctenocephalides fleas* was identified only in goats with a prevalence of 0.65%. The current prevalence is much lower than findings of other studies in the country: 8.8% by Tamerat and Tesfaheywet [32], 11.3% [28] reported the infestation flea in sheep and goats. Flea infestation was significantly ($p<0.05$) higher in young than old age goats. This result was in agreement with the observation made by Tesfaye *et al.* [28], reported higher prevalence of flea infestation in young than old age and it may be associated to the shorter hair and thinner skin in young animal in which the flea can easily access the skin and penetrate it without difficulty. It has been observed that kids and lambs are more severely affected by fleas and louse than adult animals [33].

The prevalence of ectoparasite infestation (ticks, lice and fleas) was not significantly ($P>0.05$) affected by district, species, sex and Age. Except, the occurrence of fleas was significantly ($P<0.05$) higher in young than the old age. This may be associated to the study districts, Hammer and Bena-Tsemay are categorized under pastoral production system with lowland altitude coupled with unrestricted animal movements. Therefore, the dynamics and frequent mobility of flocks involving different animal species of all age groups together and frequent exposure to the same open rang land in pastoral areas increase the chance of direct contact between animals. Therefore, this favored the transmission of external parasites from animal to animal regardless of district, species, sex and Age.

In conclusion, the present study reaffirmed high prevalence of ectoparasites in the study areas. According, ticks, lice and fleas were found the major ectoparasites of small ruminants. These ectoparasites have been identified as the major causes of sheep and goat production constraints and quality deteriorations of skin in Ethiopia. Therefore, to reduce the growing threat of ectoparasites on sheep and goats' productivity in the pastoral area, compulsory ectoparasite control and intervention measures which can be adoptable for the pastoral community need to be designed and implemented.

REFERENCES

1. FAO (Food and Agriculture Organization of the United Nations), 2004. Livestock sector brief: Ethiopia. Livestock information, sector analysis and policy branch (AGAL), FAO, Rome, Italy.
2. Legesse, G., M. Siegmund-Schultze, G. Abebe and A. Valle Zárate, 2010. Economic performance of small ruminants in mixed-farming systems of Southern Ethiopia. Tropical Animal Health and Production, 42: 1531-1539.
3. Tolera, A. and A. Abebe, 2007. Livestock production in pastoral and agro-pastoral production systems of southern Ethiopia. Livestock Research for Rural Development, 19: 1-13.
4. Kassa, B., 2006. Cockle, mange and pox: major threats to the leather industry in Ethiopia, in Ethiopian leather industry: Perserverance towards value addition, Proceedings of the National Workshop, December 14-15, Addis Abeba, Ethiopia, pp: 71-92.
5. Kumsa, B., K. Beyecha and M. Geloye, 2012. Ectoparasites of sheep in three agro-ecological zones in central Oromia, Ethiopia, Onderstepoort Journal of Veterinary Research, 79(1): 1-7.
6. Beyecha, K., B. Kumsa and D. Beyene, 2014. Ectoparasites of goats in three agroecologies in central Oromia, Ethiopia, Comparative Clinical Pathology, 23(1): 21-28.
7. DeMatos, C., C. Sitoe, L. Neves, J.O. N¨othling and I.G. Horak, 2009. "The comparative prevalence of five ixodid tick species infesting cattle and goats in Maputo Province, Mozambique, Onderstepoort Journal of Veterinary Research, 76(2): 201- 208.
8. Yacob, H.T., 2014. "Ectoparasitism: threat to Ethiopian small ruminant population and tanning industry: a review, Journal of Veterinary Medicine and Animal Health, 6(1): 25-33.
9. Mersha, C., 2013. "Effect of small ruminant ectoparasites in the tanning industry in Ethiopia: a review, Journal of Animal Science and Advances, 3(9): 424-443.
10. Tadesse, A and K. Mebrahitu, 2010. Study on ectoparasitic defects of processed skins at Sheba Tannery, Tigray, Northern Ethiopia. Trop Anim Health Prod., 42: 1719-1722.
11. Ofukwu, R.A., C.I. Ogbaje and C.A. Akwuobu, 2008. "Preliminary study of the epidemiology of ectoparasite infestation of goats and sheep in Makurdi, north central Nigeria, Sokotto Journal of Veterinary Science, 7(3): 23-27.
12. Alemayehu, M. and G. Tezera, 2002. Socio-economic of pastoral Community in Bena-Tsemay and Hamer Woredas of South Omo Zone, Southern Nations and Nationalities Peoples Regional State. September 2002, Addis Abeba, Ethiopia.

13. Admasu, T., E. Abule and Z. Tessema, 2010. Livestock-rangeland management practices and community perceptions towards rangeland degradation in South Omo zone of the Southern Ethiopia. Livestock Res. Rural Dev., 22(1), http://www.lrrd.org/lrrd22/1/tere22005.htm
14. Debo, G.W. and D.H. Kassa, 2016. Prevalence of malaria and associated factors in Benna Tsemay district of pastoralist community, Southern Ethiopia. Tropical Diseases Travel Medicine and Vaccines, 2 (16), doi: 10.1186/s40794-016-0033-x
15. Thrusfield, M.V., 2005. Veterinary Epidemiology. 3rd ed. Blackwell science Ltd, London, pp: 228-246.
16. Fentahun, T., F. Woldemariam, M. Chanie and M. Berhan, 2012. 'Prevalence of Ectoparasites on Small Ruminants in and Around Gondar Town Faculty of Veterinary Medicine, University of Gondar, Faculty of Veterinary Medicine, University of Gondar, American-Eurasian Journal of Scientific Research, 7(3): 106-111.
17. Walker, A.R., A. Bouattour, J.L. Camicas, P.A. Estrada, I.G. Horak, A. Latif, R.G. Pegram and P.M. Preston, 2003. Ticks of domestic animals in Africa. In: A guide to identification of species. Bioscience Reports, U.K., pp: 157.
18. Urquhart, G.M., J. Armour, J.L. Duncan, A.M. Dunn and F.W. Jennings, 1996. Veterinary Parasitology, 2nd edition. Blackwell Science Ltd., UK, pp: 141-205.
19. Wall R. and D. Shearer, 2001.Veterinary External Parasites: Biology, Pathology and Control, 2nd edition, Blackwell Science Ltd., UK., pp: 262.
20. Seyoum, Z., T. Tadesse and A. Addisu, 2015. 'Ectoparasites Prevalence in Small Ruminants in and around Sekela, Amhara Regional State, Northwest Ethiopia, Journal of Veterinary Medicine, pp: 1-6.
21. Israel, Y., T. Abera and B.U. Wakayo, 2015. Epidemiological study on ectoparasite infestation of small ruminants in Sodo Zuria District, Southern Ethiopia, Academic Journals, 7(4): 140-144.
22. Abebe, R., M. Tatek, B. Megersa and D. Sheferaw, 2011. Prevalence of Small Ruminant Ectoparasites and Associated Risk Factors in Selected Districts of Tigray Region, Ethiopia, Global Veterinaria, 7(5): 433-437.
23. Bekele, J., M. Tariku and R. Abebe, 2011. External parasite infestations in small ruminants in Wolmera district of Oromiya Region, Central Ethiopia. Journal of Animal and Veterinary Advances, 10(4): 518-523.
24. Eyob, E. and L. Matios, 2014. Preliminary Survey on the Distribution of Ixodid Ticks in small ruminants of Dhas District of Borena pastoral area, Southern Rangelands of Ethiopia, Advances in Bioresearch, 5(1): 87-91.
25. Abunna, F., J. Tura and A. Regassa, 2012. 'Status of Tick Infestation in Small Ruminants of Bedelle District, Oromia Region, Ethiopia, Global Veterinaria, 8(5): 459-462.
26. Mohammed, K. and P. Admasu, 2015. 'Prevalence of Ixodid Ticks in Small Ruminants in Selected Districts of Fafen Zone, Eastern Ethiopia, European Journal of Applied Sciences, 77(2): 50-55.
27. Jafer, A., W. Danel, T. Abraham, S. Samson and A. Henok, 2017. Prevalence of Tick Infestation on Small Ruminants in and around Dire Dawa, Eastern Ethiopia. International Journal of Research - Granthaalayah, 5(5): 326-336.
28. Tesfaye, D., M. Assefa, T. Demissie and M. Taye, 2012. Ectoparasites of small ruminants presented at Bahir Dar Veterinary Clinic, Northwest Ethiopia, African Journal of Agricultural Research, 7(33): 4669-4674.
29. Bedaso, A., K. Kibebew and A. Adem, 2017. 'Prevalence Study of Sheep Lice and Species Composition in Tiyo District of Arsi Zone, Journal of Biology, Agriculture and Healthcare, 7(3): 78-83.
30. Misgie, A., D. Baye, A. Belete and G. Getaneh, 2016. Prevalence of Ectoparasites Among Small Ruminants in and Around Bahir Dar Town, Ethiopia, World Journal of Pharmaceutical and Medical Research, 2(3): 24-32.
31. Pugh, D.G., 2002. Sheep and Goat Medicine. United States of America, Saunders, Elisever Sci., pp: 19-25.
32. Tamerat, N. and Z. Tesfaheywet, 2015. Prevalence and Identification of Ectoparasites Fauna in Small Ruminants in Selected Areas of Eastern Ethiopia, African Journal of Basic & Applied Sciences, 7(5): 240-246.
33. Kusiluka L. and D. Kambarage, 1996. Disease of small ruminant, 1st ed., Scotland VET AID, pp: 102-105.