Part I: Ectoparasite prevalences in sheep and in goats in and around Wolaita Soddo, Southern Ethiopia

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SUMMARY

The study was conducted during the period between November 2006 to May 2007 to identify ectoparasites and to determine their prevalence in small ruminants in and around Wolaita Soddo (Southern Ethiopia). A total of 214 sheep and 102 goats of both sexes (169 females and 147 males) divided in young and adult animals (72 and 244 respectively) were examined for the presence of ectoparasites or skin lesions. The overall ectoparasite prevalence was 55.7% (147 infested sheep and 29 infested goats) and sheep were significantly more often infected than goats. Within the sheep population, the ectoparasite frequency was significantly higher in females than in males. The main ectoparasites identified in this geographic area were ticks (Rhipicephalus, Boophilus and Amblyomma) and fleas (Ctenocephalides felis and canis at a lesser extend). The tick infestation was significantly more frequently observed in sheep (31.78%) than in goats (18.63%) and was unaffected by the sex or the age. By contrast, the flea prevalence was similar in the 2 ruminant populations, the females (particularly in goats) or the young animals (particular in sheep) being significantly less resistant to the flea infestation. Only one case of mange (Demodex caprae) was diagnosed in a goat and pediculosis (Damalinia ovina) was only observed in sheep with a relative high frequency (25.70%). Although these results emphasize the relative higher resistance of goats compared to sheep towards ectoparasites and the low tick prevalence in Southern Ethiopia whereas the pediculosis infection rate would considerably vary according to the climatic conditions during the experimental period, this study demonstrates that ectoparasites greatly affect ruminant health and require an urgent control intervention.

Keywords: Ectoparasites, prevalence, sheep, goat, Wolaita Soddo, Ethiopia.

Introduction

It has been estimated that more than 38 millions cattle and 30 millions small ruminants, constitute the major portion of livestock resources in Ethiopia [8]. Meanwhile, small ruminants constitute about 30% of the total live stock population of the country [10] and are among important contributors to food production in Ethiopia, providing 35% of meat consumption and 14% of milk consumption [3]. 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 [22].

Hides and skins account for 12-16% of the total value exports [3]. The current utilization of hides and skin is estimated to be 48% for cattle hide and 75% for goat skin [19]. Besides, wool and manure are also important products of small ruminants [15]. Even though small ruminants are important components of the Ethiopian farming system, their contribution to food consumption, rural income and export income are below the expected potential because small ruminant population in Ethiopia is constrained by the compound effect of diseases, poor feeding and poor managements [7].

Skin diseases caused by lice, sheep keds (Melophagus ovina), ticks and mange mites are among the major diseases of...
small ruminants and cause serious economic loss to farmers through mortality, decreased production and reproduction, down grading and rejection of skins which also affect the tanning industries. According to tanneries report, skin diseases due to external parasites cause 35% sheep skin and 56% goat skin rejection [4].

In the study area (Southern Ethiopia), the population density of small ruminants is high and estimated to be 76 713 sheep and 98 493 goats [5]. However, because of various ectoparasites and skin diseases, small ruminant production and skin quality have been seriously affected and the situation is aggravated after nutritional and climatic stress following repeated drought [9]. Accordingly, the enormous economic losses induced by ectoparasites in small ruminants necessitate detailed investigation on their incidence in order to organize efforts to at least minimize these losses. This study is therefore aimed for assessing the prevalence of ectoparasites and determining the magnitude of these diseases in relation to age and sex of the animals.

Materials and Methods

STUDY AREA

The study was carried out in and around the Wolaita Soddo region located between 6 36’N to 7 18’N latitude and 37 12’E up to 38 24’E longitude [5], in the Southern Ethiopia, at 383 km from Addis Ababa. Topographically, this region mainly consists in rugged and undulating mountains, rolling hills, plateaus and flat step slopes that extend to the Abaya Lake and to the Omo River [5]. The annual rainfall in the Wolaita Soddo region ranges from 1 200 - 1 300 mm with a mean average temperature of 21°C [5].

ANIMALS

From November 2006 to May 2007, 214 sheep and 102 goats of both sexes (147 males and 169 females) and of local breeds coming to the Soddo Veterinary clinic were included in the study. The age determination was made according to AIELLO and MAYS [2]. When lambs and kids were less than 6 month old, they were considered as “young animals” whereas when small ruminants were more than 6 month old they were included in the “adult” group.

Ectoparasites Sheep (n = 214) Goats (n = 102) P
Ticks 31.78 (68) 18.63 (19) < 0.05
Lice 25.70 (55) 0.00 (0) < 0.001
Flea Overall 11.21 (24) 8.82 (9) NS
C. canis 3.74 (8) 1.96 (2) NS
C. felis 7.48 (16) 6.86 (7) NS
Mange 0.00 (0) 0.98 (1) -
Total 68.69 (147) 28.43 (29) < 0.001

C. canis: Ctenocephales canis, C. felis: Ctenocephales felis, NS: not significant

Table I: Prevalences in % (and number of cases) of ectoparasites observed in sheep (n = 214) and in goats (n = 102) in and around Wolaita soddo, Southern Ethiopia.

PROTOCOL DESIGN AND METHODS

Animals were examined for presence of ectoparasites and skin lesions and after proper restraining some specimens were collected from diseased animals. Ectoparasites encountered either on the skin surface or attached to the hair were sampled and were collected in 70% alcohol. Further identification of the species was conducted in the laboratory according to methods described by SOULSBY [20]. Skin scraping from suspected cases of mange were collected and preserved in 10% formalin. After addition of 10% KOH to the specimen, mites may be released from scabs and crusts before examination following procedures indicated by SOULSBY [20]. Multiple sites were scraped to increase the likely hood of ectoparasite detection. Both superficial and deep skin scrapping were made to diagnose both burrowing and non burrowing mange [6]. Mange mites encountered were identified based on their morphological features [18].

STATISTICAL ANALYSIS

Proportions and the Pearson’s chi-square test (X^2) were used to analyze the data collected and differences were considered as significant when p-value was less than 0.05 [1].

Results

The different ectoparasites identified were ticks (31.78% in sheep and 18.63% in goats), lice (25.70% in sheep and 0% in goats), flea (11.21% in sheep and 8.82% in goats) and mange (Demodex) (0% in sheep and 0.98% in goats) and the overall prevalence of ectoparasite was significantly higher in sheep (68.69%) than in goats (28.43%) (p < 0.001) (Table I). Moreover, considering the whole population of small ruminants, females (60.4%) tended to more often infested than males (49.7%) (p < 0.1) and the susceptibility of females to ectoparasites was confirmed in the sheep population (females: 75.45% and males: 61.54%, p < 0.05) but not in the goat population (Tables III and IV). No significant association between the ectoparasite prevalence and the age was evidenced in the whole population of small ruminants or in the sheep and goat specific populations.
The proportion of sheep infected by ticks was significantly higher than that of goats (p < 0.05) (Table I) although the densities of ectoparasite by animal were similar (1.4 and 1.2 tick/animal in sheep and goat respectively) (Table II). The main tick species identified were *Rhipicephalus* (38.7% in sheep and 39.1% in goats), *Boophilus* (35.5% in sheep and 39.1% in goats) and *Amblyomma* (23.7% in sheep and 21.7% in goats). Only 2 ticks belonging to the *Hyalomma* genre were observed in sheep (Table II). No significant increase of the tick infestation risk was associated with the age or the sex in the 2 small ruminant species (Tables III and IV).

The lice infestation was diagnosed only in sheep with a relative high prevalence (25.70%) whereas no case was observed in goats. Only the *Damalinia* genre was identified. Consequently, the difference for the pediculosis prevalences between the 2 small ruminant species was highly significant (p < 0.001) (Table I). The incidence of lice infestation was similar in both sexes, while the young sheep tended to be more resistant to this ectoparasite disease (p < 0.10) (Table III).

In small ruminants, 2 flea species were identified: *Ctenocephales canis* and *Ctenocephales felis*, the last one being significantly more commonly detected in small ruminants with a frequency of 69.7% vs. 30.3% for *C. canis* (p < 0.05) (Table V). The prevalences of infestation induced by fleas whatever their genres or specifically by a given genre were similar in sheep and in goats. Moreover, males were significantly more resistant to the flea infestation than females within the whole small ruminant population (p < 0.05) (Table V) and particularly in goats (p < 0.05) (Table IV). Besides, young ruminants appeared to be significantly more frequently infected than adults by fleas (p < 0.05) and particularly by *C. felis* (p < 0.01) (Table V). This preferential infestation of young animals by *C. felis* was specifically evidenced in sheep (p < 0.05) (Table III).

### Table II: Tick infestation in sheep (n = 214) and in goats (n = 102) in and around Wolaita Soddo, Southern Ethiopia.

<table>
<thead>
<tr>
<th>Tick Species</th>
<th>Sheep (n = 214)</th>
<th>Goats (n = 102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence</td>
<td>31.78%</td>
<td>18.63%</td>
</tr>
<tr>
<td>Number of infected animals</td>
<td>68</td>
<td>19</td>
</tr>
<tr>
<td>Total number of ticks</td>
<td>93</td>
<td>23</td>
</tr>
<tr>
<td><em>Amblyomma</em></td>
<td>22 (23.7%)</td>
<td>5 (21.7%)</td>
</tr>
<tr>
<td><em>Boophilus</em></td>
<td>33 (35.5%)</td>
<td>9 (39.1%)</td>
</tr>
<tr>
<td><em>Hyalomma</em></td>
<td>2 (2.2%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><em>Rhipicephalus</em></td>
<td>36 (38.7%)</td>
<td>9 (39.1%)</td>
</tr>
</tbody>
</table>

### Table III: Prevalences in % (and number of cases) of ectoparasites observed in sheep (n = 214) according to the age and sex in and around Wolaita Soddo, Southern Ethiopia.

<table>
<thead>
<tr>
<th>Ectoparasites</th>
<th>Prevalence (and number)</th>
<th>Sex</th>
<th>Age</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 104)</td>
<td>Females (n = 110)</td>
<td>Young (n = 51)</td>
<td>Adult (n = 163)</td>
</tr>
<tr>
<td>Tick</td>
<td>31.78 (68)</td>
<td>28.85 (30)</td>
<td>34.55 (38)</td>
<td>NS</td>
</tr>
<tr>
<td>Lice</td>
<td>25.70 (55)</td>
<td>24.04 (25)</td>
<td>27.27 (30)</td>
<td>NS</td>
</tr>
<tr>
<td>Flea</td>
<td>11.21 (24)</td>
<td>8.65 (9)</td>
<td>13.64 (15)</td>
<td>NS</td>
</tr>
<tr>
<td><em>C. canis</em></td>
<td>3.74 (8)</td>
<td>2.88 (3)</td>
<td>4.55 (5)</td>
<td>NS</td>
</tr>
<tr>
<td><em>C. felis</em></td>
<td>7.48 (16)</td>
<td>5.77 (6)</td>
<td>9.09 (10)</td>
<td>NS</td>
</tr>
<tr>
<td>Total</td>
<td>68.69 (147)</td>
<td>61.54 (64)</td>
<td>75.45 (83)</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

### Table IV: Prevalences in % (and number of cases) of ectoparasites observed in goats (n = 102) according to the age and sex in and around Wolaita Soddo, Southern Ethiopia.

<table>
<thead>
<tr>
<th>Ectoparasites</th>
<th>Prevalence (and number)</th>
<th>Sex</th>
<th>Age</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 43)</td>
<td>Females (n = 59)</td>
<td>Young (n = 21)</td>
<td>Adult (n = 81)</td>
</tr>
<tr>
<td>Tick</td>
<td>18.63 (19)</td>
<td>18.60 (8)</td>
<td>18.64 (11)</td>
<td>NS</td>
</tr>
<tr>
<td>Lice</td>
<td>0.00 (0)</td>
<td>0.00 (0)</td>
<td>0.00 (0)</td>
<td>-</td>
</tr>
<tr>
<td>Flea</td>
<td>8.82 (9)</td>
<td>2.33 (1)</td>
<td>13.56 (8)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td><em>C. canis</em></td>
<td>1.96 (2)</td>
<td>0.00 (0)</td>
<td>3.39 (2)</td>
<td>-</td>
</tr>
<tr>
<td><em>C. felis</em></td>
<td>6.86 (7)</td>
<td>2.33 (1)</td>
<td>10.17 (6)</td>
<td>NS</td>
</tr>
<tr>
<td>Total</td>
<td>27.45 (28)</td>
<td>20.93 (9)</td>
<td>32.20 (19)</td>
<td>NS</td>
</tr>
</tbody>
</table>

*C. canis*: *Ctenocephales canis*, *C. felis*: *Ctenocephales felis*, NS: not significant.
ECTOPARASITES IN SMALL RUMINANTS FROM WOLAITA SODDO

Discussion

In the small ruminants from the Wolaita soddo region investigated in the present study, a total ectoparasite prevalence of 55.7% was registered. The rate of infestation by ectoparasites was markedly elevated in sheep (68.7%) whereas goats appeared to be significantly more resistant (28.4% of infestation rate) probably because of their self grooming, licking, scratching, rubbing and grazing behaviours which would contribute to rapid ectoparasite elimination [17]. Within the sheep population, it was also noticed that females were significantly more frequently affected than males (75.45% vs. 61.54%): this result could be due to the weakness of pregnant and lactating females which could not efficiently get rid of ectoparasites, and particularly of ticks.

A relative low prevalence of the tick infestation (31.8% in sheep and 18.6% in goats) was observed in the present study area. Comparable results (23.8% in sheep and 16% in goats) were reported from the Sidama Zone in Southern Ethiopia [21] whereas ZELALEM [22] observed very higher tick prevalences (65.6% in sheep and 33.0% in goats) in the Dire Dawa region (Eastern Ethiopia). Differences in the environmental conditions (study season and design) could have contributed for this variation. Indeed, low tick prevalence may be related to an impaired tick development due to unfavourable climatic conditions (intermittent and weak rainfall in the Wolaita soddo area during the study period coupled to relative high temperatures).

Three main tick genres were identified in the small ruminants in the present study: Boophilus spp, Rhipicephalus spp and Amblyomma spp. A similar frequency of the genre Amblyomma spp in sheep and goats has been reported in the Sidama zone (Southern Ethiopia) [21]. Furthermore, these 3 genres are known to be widely distributed in Ethiopia and to heavily parasitize live stock, the remaining species occurring in limited number and having little practical significance to livestock production [16]. In the present study, goats were significantly more resistant than sheep to the tick attacks. This result is in agreement with the admitted preference of ticks towards sheep [22].

On the other hand, LEHMAN [14] observed a greater susceptibility of young animals to ectoparasites and attributed it to a higher ratio of accessible surface to body volume and a poor grooming behaviour. But in the present study no significant difference for tick infestation between young and adult animals was evidenced in the sheep, goat or whole small ruminant populations. This discrepancy would be related to a poor access of young animals to pasture and to the climate unfavourable to tick development during the study period. No privileged tick infestation in females from sheep, goat or total small ruminant populations was encountered in this study contrary to HOSKINS et al. [12] which reported a particular susceptibility of females to tick attacks.

According to the present study, only one genus of louse was identified in sheep (Damalina ovis) with a prevalence rate of 25.70%. This parasite has been considered as one of the major causes of rejection of skins at tanneries: it causes a defect known as “Ekeke” which is not a disease but a generic (Amharic) grading term used by tanneries in Ethiopia that means “itching”. It is an allergic hypersensitivity reaction to louse Damalina ovis and ked Melophagus ovnis in the local sheep breed. According to BAYOU [4], such a defect usually appears on the grain side of semi-processed skin but it is not normally observed in raw or unprocessed state. The Damalina ovis prevalence observed in the present study is by far higher than previous results obtained from central Ethiopia (0.8%) [11] and from Southern Ethiopia (Sidama region) (13%) [21]. These discrepancies could be explained by favourable climatic conditions of the study area for the biology of lice. Pediculosis was not observed in goats probably because of the particular goat behaviour that would reduce ectoparasite infestation rate.

Only one case of mange (Demodex caprae) in goats was identified in this study the prevalence being 0.98% whereas no case was diagnosed in sheep. These results were comparable with previous studies conducted in the same study area (1.3% in goats and 0% in sheep) [7] and in the Sidama zone (Southern Ethiopia) (0.95% in goats and 0% in sheep) [21]. By contrast, KEDIR [13] obtained higher prevalences of mange mite infestation in small ruminants (26.1% in goats and 30% sheep) from the Tigray region in Northern Ethiopia. Nevertheless, this study was conducted on non-randomly selected sheep and goats showing visible skin lesions. Environmental factors might also have contributed to this great variation. In the same way a very elevated mange mite infestation prevalence (52.2%) was reported in goats from the Dire Dawa region whereas sheep were not contaminated [22].

There was no significant variation (P > 0.05) in the prevalence of flea infestation in male and female sheep but significant difference in flea infestation rate was observed between the two sexes in goats. Significant difference in the infestation by Ctenocephalides felis was noticed between young and adult sheep.
As a conclusion, this study demonstrates that ectoparasites mainly ticks (*Boophilus, Rhipicephalus* and *Amblyomma*), fleas (*Ctenocephalides felis* and *C. canis* at a lesser extend) and lice (*Damaлина ovis*) infested small ruminants, particularly the sheep population, with a high global prevalence (55.7%) in the Wolaita Soddo region and lead to severe economic losses.

References

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