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Original Article

Epidemiology and Risk Factors Associated with Zoonotic Ectoparasite Infestation Among Human and Small Ruminants in Sanandaj, West Iran

Zainab Sadeghi Dehkordi[1*], Ali Mahmoudi[1], Ali Saeghinasab[1], Gamal Gharekhani[2,3]

[1]Departmant of Pathobiology, Faculty of Veterinary Science, Bu Ali Sina University, Hamedan Iran
[2]Department of Clinical ScienceFaculty of Veterinary Science, Bu Ali Sina University, Hamedan Iran
[3]Department of Laboratory Science, Central Veterinary Laboratory, Iranian Veterinary Organization, Hamedan, Iran

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***Corresponding author:**
Zainab Sadeghi Dehkordi,
Email: z.sadeghidehkordi@basu.ac.ir

Abstract

Background: Ectoparasites in domestic animals (sheep and goats) play important roles in transmitting the widest range of pathogens and can induce considerable economic losses in the animal husbandry industry. This study was undertaken to evaluate the prevalence and species' variation of ectoparasites in the sheep and goats and its risk factors in Sanandaj, Kurdistan province, western Iran.

Methods: The ectoparasites of 4576 animals; that is, 1954 sheep (416 + 1538) and 2622 goats (1084 + 1538) were collected in the abattoir and different rural regions (N = 32) of Sanandaj. Determination of ectoparasites was done using a stereomicroscope according to the identification keys.

Results: Results indicated that 925 sheep (47.33%) and 811 goats (30.93%) were infested with ectoparasites. There was a significant difference between the prevalence and sex in sheep aged less than one-year old ($P \leq 0.05$). Moreover, the highest and lowest prevalence of ixodid tick infestations was observed for *Boophilus* spp. (35.36%) and *Rhipicephalus* spp. (3.06%), respectively. In addition, the highest body infestation to be detected was on the ears (24.82%) of *Rhipicephalus* ($P \leq 0.05$) with 2.13 ticks in each animal. The frequency of tick infestation was remarkably higher in spring (33.82%) than in other seasons. Furthermore, 143/416 (34.37%) and 109/416 (26.2%) sheep as well as 113/1084 (10.42%) and 87/1084(0.86%) goats were infested with *Ctenocephalides canis* and *Pulex irritans*, respectively. Myiasis resulting from *Przhevalskiana* fly larvae was merely observed in the goat population at the abattoir. *Haematopinus* spp, *Linognathus* spp., and *Damalinia* were detected, and the prevalence of lice infestation was significantly higher in the goats 831/1538 (54.03%) rather than in the sheep 20/1538 (1.3%).

Conclusion: This is the first report on ectoparasites fauna in the sheep and goats in Sanandaj, western Iran. Furthermore, it was confirmed that various ticks can not only transmit pathogens to humans but also induce tick-borne disease in animals in the region.

Keywords: Sheep, Goat, Flea, Louse, Tick, Ked, Sanandaj

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Introduction

Animal farming involves numerous agricultural activities, and it is an important source of income for the agricultural communities in Iran. It is estimated that over 57% of the domestic animal husbandry units are dedicated to sheep and goats, which are mostly used for their meat, fur, and dairy purposes (1). According to the previous reports, 28 typical sheep breeds and 20 determined goat breeds have been characterized in Iran. Nevertheless, regarding the traditional breeding of these animals in most parts of Iran, the animals may have been highly exposed to zoonotic infectious agents (2). Being prevalent among animal kingdoms, arthropods were found in almost all of the habitats among the most abundant animals (3).

Based on the state policies and their financial facilities, sheep and goat raring have been encouraged throughout Iran. Therefore, monitoring the constant health status of ectoparasites infestation, especially zoonoses is necessary for the protection of livestock and public health (4). Ectoparasites have considerable effects on the host's physical appearance. The research has reported blood loss (5) and weight loss from fly bites (6) in cattle. Some ectoparasites such as ticks and lice may cause weight loss and anemia, and the large parasite burdens can be fatal to the host (7). Furthermore, ectoparasites can transmit several pathogens, including protozoa,

helminths, bacteria, rickettsia, spirochetes, and viruses. In addition, ectoparasite infestations have significantly led to economic impacts on performance, milk and meat production, health of the flock, skin irritation and prevention, and control costs (8). Moreover, the most important effects of ticks on humans and veterinarians included the vectors of bacterial, protozoal, rickettsial, and viral diseases, tick paralysis agents, blood loss, as well as skin damage. In livestock, serious tick-borne diseases include babesiosis, anaplasmosis, tularemia, and theileriosis. Empirical data that record the geographical tick distribution require predicting the occurrence of tick-borne diseases in the animals and farm control measures (9,10). On the other hand, humans will suffer from parasitic diseases if their control and management policies are neglected (11). Additionally, ectoparasites are known to have zoonotic importance with the ability to transmit different types of pathogens from animals to humans (12,13). Several studies on the ectoparasites of sheep and goats have been carried out in Iran (2,14-16). However, the prevalence of ectoparasite infestation in livestock has not been determined in Sanandaj, Kurdistan province. Accordingly, the main purpose of this study was to investigate the prevalence of ectoparasites infestation in sheep and goats and its risk factors in this area.

Materials and Methods

Study Area

Kurdistan Province is 28,817 km^2, located in the west of Iran (28,817 km^2: 35˚14' 45" N, 47°00' 33" W). The mean annual rainfall and temperature are 492 mm and 12.8˚C, respectively. Agriculture and livestock husbandry play considerable economic roles in this region.

Sampling

This study was conducted between February 2019 and January 2020. Ectoparasites were randomly collected from the body surface of animals (sheep = 1538 and goats = 1538) monthly in different rural regions (N = 32) of Sanandaj, Kurdistan province. Furthermore, 1500 animals (416 sheep and 1084 goats) were inspected before slaughtering in the Sanandaj abattoir during this period.

Methodology

Before the examination, an epidemiological questionnaire was given to each animal owner addressing age, sex, history of antiparasitic treatment, number of detected ectoparasites, infected organs, herd size, and the type of livestock and husbandry were recorded. Upon animal examination, the isolated ticks were preserved in glass vials containing 70% ethanol plus 5% glycerin. The data sampling and place collection were labelled on each vial. Skin lesions were recognized via visual examination and palpation and were sampled. In cases of mange bites, skin scrapings were taken until bleeding from the multiple body sites of the suspected animals. Subsequently, scraping samples were placed in a petri dish, treated with 10% treated with 10% potassium hydroxide for 20 minutes, and transferred to the slides. Then, a cover glass was placed on them for further examination of mites at 100 × magnification. At the abattoir, infected body animal sites were scraped, transferred to a container, and mixed with soap and water for 5 minutes. For the detection of myiasis-causing larvae, several body sites consisting of the scrotum, nostrils and lateral skin, and hair coat were precisely examined. For this purpose, extraction could be made by gentle pressure around the site of infestation by the occlusion of the opening (to prevent larval respiration) into the cavity below the larva to force it out. Mites remained embedded either superficially or deep into the skin of these hosts and could be collected by taking the skin scrapings. The lice and fleas were picked up with the help of forceps into the container. The scraping was transferred to a clean glass slide, and a drop of any mineral oil was added and mixed properly with a stick. A cover slip was then applied and examined under a low objective (6,17,18). The determination of ectoparasites was done using a stereomicroscope according to the identification keys in the parasitology laboratory (6,18).

Data Analysis

For the investigation of the relevance between the variables, the chi-square test was used, and *P* values less than 0.05 were considered statistically significant.

Results

Tick Infestation

Most tick infestations in the ewes more and less than one-year-old (89% vs. 80%) were found in April. Further, most cases of tick infestation in the rams more and less than one-year-old (79% vs. 75%) were detected in May. Among the sheep populations, *Rhipicephalus* spp. constituted the maximum tick infestation in the spring and summer (65%); while, *Rhipicephalus* (*Boophilus*) *annulatus* was involved in most cases during autumn and winter (90%). Based on the obtained results, 70% and 65% of the isolated ticks from sheep were female *R. (B). annulatus* and male *Rhipicephalus* spp., respectively. The highest tick infestation in the does more and less than one-year-old (70% vs. 54%) as well as in the bucks more and less than one-year-old (69% vs. 53%) were identified in May. Among goats, *Rhipicephalus* spp. was mostly dominated in February and March (45%), whereas *R. (B). annulatus* was prevailed for the rest of the year (75%). Our findings also showed that 66% and 57% of the identified tick species in the goats were male *R. (B). annulatus* and male *Rhipicephalus* spp., respectively. Most ticks were isolated from the animals in flatlands (N = 549).

Flea Infestation

Ctenocephalides canis was more prevalent than *Pulex irritans*, particularly in the ewes comparable to the rams. The highest prevalence rate of the fleas was reported for the female sheep and rams over one-year old (38% vs. 35%),

likely in the female sheep and rams less than one-year-old (51% vs. 48%). In the goats, *C. canis* was more abundant, especially in the does. Most cases of flea infestation in the does and bucks more than one-year old (40% vs 44%) and in the does and bucks less than one-year old (52% vs 50%) were recorded in March.

Lice Infestation

Haematopinus was detected in 1% of the rams more than one-year old, whereas *Linognathus* and *Haematopinus* were recorded in 1% of the female sheep and rams more than one-year-old. The highest infestation among female sheep over one-year-old was demonstrated in January (2%), while no infestation was observed during spring and summer. Despite the poor prevalence of the louse in sheep, several lice were isolated from the goats, most of which were dedicated to *Damalinia* in the does more than one-year-old. In August, most cases of louse infestation were recorded in the does and bucks more than one-year old (97% vs. 95%); meanwhile, most lice-infested does and bucks less than one-year old (50% vs. 55%) were observed in February. Overall, out of the 1538 examined animals, 20 (1.3%) sheep and 831/1538 (54.03%) goats were infested with *Damalinia* and *Linognathus* species of lice, respectively.

Cutaneous Myiasis

Most cases among the sheep (80%) and goats (75%) were related to *Lucilia cuprina*, and the lowest prevalence (20%) belonged to *Oestrus ovis*. Among the female sheep and rams more than one-year-old, the most and the least *O. ovis* infestation cases were found in June (45%) and January (9%), respectively. In the female sheep and rams less than one-year-old, the most (14% vs 12%) cases were found in August, and the least (1% vs 1%) prevalence rates of *O. ovis* larvae were isolated in January. Bucks more and less than one-year-old were mostly affected in June (30%) and July (9%), respectively. Additionally, does more and less than one-year old were both highly influenced in June (37% vs. 9%)

At the Abattoir

Only myiasis resulting from *Przhevalskiana* spp. larvae was isolated from the goat population. Totally, 100 out of 1500 animals (9.22%) were infested, of which 35% and 65% belonged to the female and male, respectively. Moreover, does more and less than one-year-old were 23% and 12% infested, consecutively, and bucks (male) more and less than one-year-old were 57% and 8% infested, respectively. Overall, three types of fly larvae were reported, including L1 (n = 110) mostly in October, L2 (n = 173) frequently in November, and L3 (n = 137) with a high prevalence in January. The most infestation cases were recorded in November (17 cases) and December (10 cases). Infestation with *Melophagus ovinus* was just detected in 0.72% of the goats, and all animals were not infested by the mites and bugs at the time of sampling.

Discussion

This study is the first epidemiological report on the sheep and goat ectoparasites in Sanandaj, western Iran. Hypodermosis is a parasitic disease in goats and sheep caused by ectoparasites. Hard ticks transmit specific pathogens that cause the diseases such as babesiosis, theileriosis, and anaplasmosis. A high level of ectoparasites can cause several harmful effects, including skin irritation, inflammation, blood loss, reduced performance, hypersensitivity, and public health problems (19-21). In northern Iraq, ectoparasites infestation was reported in sheep (57.7%) and goats (78.9%), including ticks (46.7%, 34.9%), lice (3.84, 33.75%), mites (7.13%, 0.1%), fleas (2.8%, 7.75%), and ked (1.2%, 4.5%). In Ethiopia, the prevalence of ectoparasites was assessed (54.8%) in the examined animals (22). According to the previous studies in Iran, tick (*Rhipicephalus bursa* and *Rhipicephalus sanguineus*: 48%), lice (6.17%), and flea (3.1%) were the most prevalent ectoparasites infestation (16,23). In contrast to our investigation, Mazlum reported that *R. bursa* is the dominant tick in the sheep (24). The lowest distribution of *R. bursa* has been reported in Golestan and Ardabil in the North Iran (25). Further, *R. bursa* and *Rhipicephalus sanguineus* were diagnosed as the main vectors for babesiosis, theileriosis anaplasmosis, ehrlichiosis, and hepatozoonosis (26).

In the present study, *C. canis* was the most prevalent flea infestation (15-50% in the goats and the sheep). Contrary to our finding, in similar studies from Urmia (Iran), Tanzania, and Israel, *Ctenocephalides felis* was the dominant infestation (2,27,28). In our study, *Haematopinus* spp., *Linognathus* spp., and *Damalinia ovis* were isolated in the sheep and goats, which is in close agreement with Murray (29), Mazyad and Helmy (30) and Yakhchali and Hosseini (2). In the present survey, increased lice infestation was significantly estimated in the goats. Sucking lice on sheep and goats can cause fleece damage, skin crusting or scabbing, dermatitis, anemia, and weight loss (2). Moreover, in the current study, *Melophagus ovinus* infestation was detected in 0.72% of the goats. In a similar study from Ethiopia, *M. ovinus* was observed in 6.7% of the sheep (31); moreover, this rate was 1.2% and 4.5% in the sheep and goats population of Iraq, respectively (22). It has been confirmed that *M. ovinus* plays an important role in zoonotic bacteria pathogens' transmission (21). The ectoparasites have been reported to be the most common parasite in mountainous area due to climate changes and herd abundance (16,25). Our findings suggested that different species of ectoparasites are detected due to the weak control methods in this area.

Conclusion

Overall, in the present study lice spp, *Rhipicephalus* spp., *Pulex irritans*, *C. canis, Przhevalskiana* spp., *O. ovis, Lucilia cuprina,* and *M. ovinus* were detected. Effective control measures should be taken to reduce the ectoparasites

infestation. Furthermore, it is necessary to educate owners of animals on the control and prevention of zoonotic parasitic diseases.

Authors' Contribution

Conceptualization: Zainab Sadeghi Dehkordi.
Data curation: Zainab Sadeghi Dehkord.
Formal Analysis: Ali Sadeghinasab.
Funding acquisition: Zainab Sadeghi Dehkordi.
Investigation: Ali Mahmoudi.
Methodology: Zainab Sadeghi Dehkordi, Ali Mahmoudi.
Project administration: Zainab Sadeghi Dehkordi.
Resources: Zainab Sadeghi Dehkordi.
Supervision: Zainab Sadeghi Dehkordi.
Validation: Zainab Sadeghi Dehkordi Gamal Gharekhani.
Visualization: Zainab Sadeghi Dehkordi.
Writing – original draft: Zainab Sadeghi Dehkordi.
Writing – review & editing: Zainab Sadeghi Dehkordi, Gamal Gharekhani.

Competing Interests

The authors declare no conflict of interests.

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