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AN INVESTIGATION ON SPECIES DIVERSITY AND DISTRIBUTION OF TICKS IN CAMELS, SHEEP, AND GOATS OF NEHBANDAN DISTRICT, SOUTH KHORASAN

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ABSTRACT

The family Ixodidae is considered to be one of the largest families of domestic animal ticks, of which 13 genus and 650 species have been reported in five subfamilies up to now. Ticks are considered as one of the most important carriers of pathogens in humans and animals. They are the most important external parasites that cause severe economic losses in ruminants and also they place a role in transmission of viral, rickettsia, bacterial and protozoal agents.
Objectives: The purpose of this study is to evaluate the spread of contamination caused by different species of hard ticks in ruminants quantitatively, as well as determining the species diversity of ticks found in Nehbandan district.
Method: This study was conducted from spring of 2015 up to summer of 2016 in villages around Nehbandan city on 69 camels, 181 sheep, and 279 goats. The ticks were collected from all parts of the animal's bodies and after labeling, samples were stored in vials containing 70% alcohol and 5%glycerin, then the samples were diagnosed using morphological diagnostic keys. Chi-square test was used to analyze the data. SPSS software (version 18) was used to perform statistical evaluations. The significance level was considered as ($P < 0.05$).
Results: The ratio of the isolated ticks to each animal was 10.7 in camels, 9.2 in sheep and 6.8 in goats. The distribution of ticks in camels was mainly behind tail (23.1%), and ears were the main location of distribution in sheep (38%) and goats (42.4%), the Statistical frequency of distribution in the body has significant differences. The prevalence of contamination in camels, sheep, and goats was 79.24%, 24.09%, and 17.02% respectively. The results indicated that at least 14 species of ticks from the families Ixodidae and Argasidae are found in Nehbandan area. Of the 1329 ticks collected, 3 genera of hard ticks (Hyalomma 81.11%, Rhipicephalus 15.5%, and Haemaphysalis 2.6%) and one genus of soft tick (Ornithodoros 0.79%), including 5 species in camels, 9 Species in sheep and 12 species in goats were detected. The dominant species in camel was Hyalomma dromedary (52.1%), Rhipicephalus sanguineus in sheep (21.1%) and Rhipicephalus turanicus (24.7%), and the difference of frequency among them is statistically significant.
Final conclusion: The results of this study indicate the presence of a diversity of hard ticks with a significant prevalence in ruminants in the area. These ticks can play an important role in the transmission of diseases to humans and livestock and from one region to another.

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Introduction

Today, external parasites cause damage to health and economy in many countries and inflict heavy losses in the poultry and livestock industry. Ticks are important in medicine, veterinary medicine, and human and animal health because they are a way of transmission of important and dangerous diseases in humans and animals (13).

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Bites of ticks, especially hard ticks (Ixodidae), cause direct damages including irritation, inflammation or hypersensitivity in bite location, and in case of severe contamination, they may cause anemia and reduced production. Salivary secretions of some ticks may cause toxication and paralysis, although, more importantly, they are capable of transmitting a large number of viral, bacterial, rickettsial and protozoan pathogens. Economically, the presence of external parasites leads to a significant reduction in production of meat, milk, the value of the skin of animals, as well as increased mortality (due to transmission of pathogens) (16).

Ticks play role in transmitting the pathogens agents responsible for ehrlichiosis, Q fever, sweating sickness, theileriosis, babesiosis, tick paralysis and Crimean Congo hemorrhagic fever. Theileria annulata, Theileria lestoquardi, and Theileria equi are transmitted by the Hyalomma species. The vector of Theileria hirci (causing agent of malignant theileriosis in sheep and goats) is Rhipicephalus bursa and Hyalomma anatolicum anatolicum. Babesia motasi and Babesia ovis are the most common forms of bebsiosis in sheep and goats. Vector of Babesia ovis is known to be Rhipicephalus bursa. Hyalomma anatolicum excavatum, Ixodes ricinus, and Rhipicephalus turanicus are also vector of Babesia ovis. 12 species of ixodidae ticks including Dermacentor, Rhipicephalus, and Hyalomma are known to be vector of Babesia caballi and Babesia equi (5,6)

Due to the distribution pattern of hard ticks in geographical areas and adaptation to different climatic zones, as well as the large hosting spectrum, a major challenge is to maintain the health of human societies and control economic damages to livestock industry producing livestock products (16).

Livestock is kept and raised using the traditional and industrial method in herds of Nehbandan district. Considering the fact that there was no comprehensive review conducted on diversity of tick species in Nehbandan area until now and the published information in this manner is very limited, Therefore, the purpose of this study is to provide a report on the contamination status of ruminants (camels, sheep, and goats) to ticks and also to determine the variety of ticks found in ruminants in this region.

Materials and methods

Nehbandan city is located at 58 ° 32 'east longitude and 30 ° 28' south latitude of Greenwich meridian, with an area of 26094 square kilometers, it is the southernmost city of South Khorasan province and is located at an altitude of 1100 meters from the free seas. More than 60% of the inhabitants of Nehbandan city are engaged in agricultural and livestock farming under a dry and semi-dry climate. Demographics show over 180000 sheep and goats and more than 9000 camels.

In this descriptive study, from spring of 2015 to summer of 2016, 22 herds around the city of Nehbandan and 69 camels, 181 sheep and 279 goats were randomly selected.

After being constrained and searching for various areas of the body including head and neck, under the tail, around the anus, perineum, legs, teats, and scrotum, all the ticks in the body were collected and the number of ticks was recorded. For this purpose, with an appropriate forceps, the anterior portion of the tick was rotated around the forceps axis at the point of junction with the host, and then the tick was extracted out of the skin carefully. In some cases, the ticks were first anesthetized by materials such as alcohol in order to be removed from the animal's body easily. The detached ticks were placed in glass labeled containers containing 70% alcohol and 5% glycerin. A label containing the sample number was applied to each tube. Characteristics of the animal (species, age, and gender), the location of tick detachment from the body of the animal, time and place of sampling, as well as the number of ticks were recorded in the designed form. The collected samples were transported to the laboratory of the department of parasitology, faculty of veterinary medicine, University of Zabol, and dried with filter paper, then using a small brush, the artifacts were removed and then it was identified using stereomicroscope and valid diagnostic keys (9,17,20).

Chi-square test was used to analyze the data. SPSS software version 18 was used to perform statistical work. The significance level was considered as ($P < 0.05$).

Results

Out of 1329 ticks collected in this study, 1319 belonged to the family of hard ticks (543 female and 776 male ticks) and 10 ticks belonged to soft ticks family, which were extracted from the animal body (camel: 588, sheep: 415 and goats: 326 ticks). Based on the total number of ticks collected from the body surface of the camels, sheep, and goats, the frequency percentage of ticks in camels was determined 79.7%, sheep 24.9% and goats 17.2% (Figure 1).

Tick contamination average per camel, sheep, and goat was 10.7 , 9.2 and 6.8 respectively, and during the study period, no spraying and anti-tick baths were used in the studied areas (Figure 2).

Hard and soft ticks identified in camel, sheep, and goats in the district of Nehbandan included three hard ticks genus (Hyalomma 81.1%, Rhipicephalus 15.5%, and Haemaphysalis 2.6%) and one genus of soft tick (ornithodoros 0.79%). In camels, one genus of Hyalomma and 5 species , in sheep 3 genus (Hyalomma, Rhipicephalus and Ornithodoros) and 9 species, and in goats 3 genus (Hyalomma, Rhipicephalus and Haemaphysalis) and 12 species were identified. From the aspect of genus, Hyalomma was the dominant tick in the region (81.11%) and from the aspect of species, the dominant tick was Hyalomma dromedarii (29.8%). Concerning the host, in camels, the most common species of tick was Hyalomma dromedarii , in goat it was Rhipicephalus turanicus, and in sheep it was Rhipicephalus sanguineus (Table 1 and 2).

The study of physical distribution of isolated ticks from the body surface of the livestock of the region showed that the main concentration of ticks in camels were sub tail (23.1%), and in sheep and goats in the ear (37% and 42.4% respectively). Chi-square test showed that there is a significant difference between contamination of different organs in camels, sheep, and goats ($p < 0.001$)

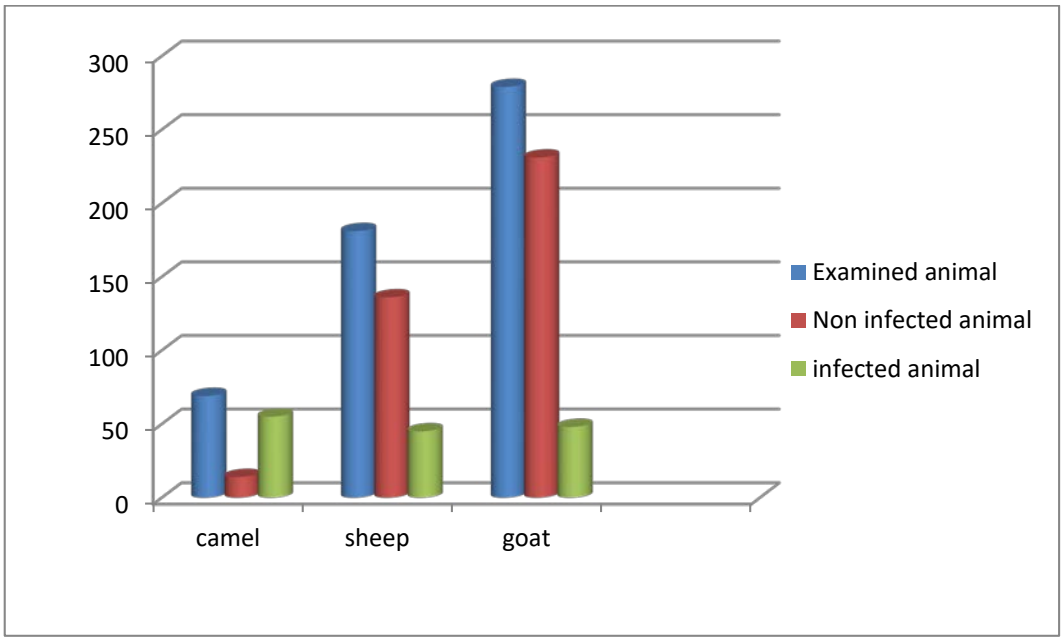

Figure 1. Number of infected and non-infected animals in Nehbandan area

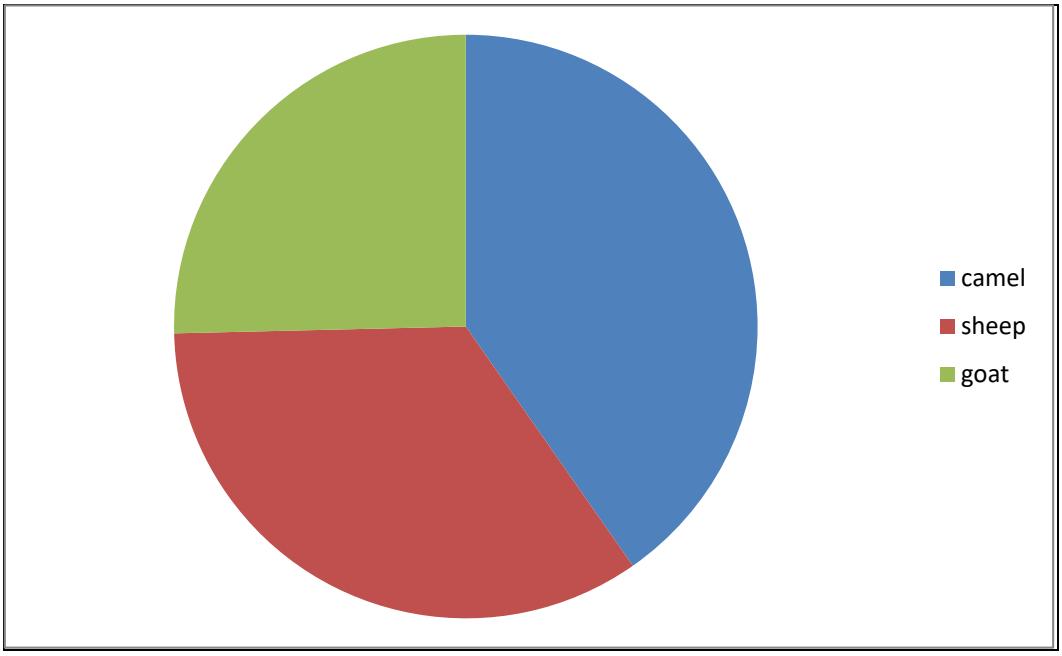

Figure 2 - The ratio of ticks to contaminated animals

Table 1. Total frequency percentage of ticks in Nehbandan area

Genus and species of tick	frequency percentage of species	Frequency percentage of genus
Hyalomma dromedarii	8/29	11/81
Hyalomma schulzei	8/11	
Hyalomma implantum	6/10	
Hyalomma asiaticum asiaticum	1/9	
Hyalomma anatolicum excavatum	1/5	
Hyalomma anatolicum anatolicum	7/2	
Hyalomma dendriticum	2/0	
Rhipicephalus sanguines	2/13	5/15
Rhipicephalus turanicus	2/13	
Haemaphysalis sulcata	2/2	6/2
Haemaphysalis punctata	5/0	
Haemaphysalis concinna	2/0	
Haemaphysalis kolakowski	1/0	0
Ornithodoros lahorensis	3/1	79/0

Table 2. Frequency distribution of examined ticks in livestock of Nehbandan city sorted by species

Tick genus and spices	Camel (percent)	Sheep (percent)	Goat (percent)
Hyalomma dromedarii	1/52	19	2/13
Hyalomma schulzei	8/31	0	0
Hyalomma impeltatum	1/13	4/10	4/5
Hyalomma asiaticum asiaticum	2	4/15	7/10
Hyalomma anatolicum excavatum	0	7/9	4/6
Hyalomma anatolicum anatolicum	1	8/1	4/6
Hyalomma detritum	0	3/0	4/0

Rhipicephalus sanguines	0	1/21	4/21
Rhipicephalus turanicus	0	7/18	7/24
Haemaphysalis sulcata	0	0	2/8
Haemaphysalis punctata	0	0	9/1
Haemaphysalis concinna	0	0	9/0
Haemaphysalis kolakowsky	0	0	4/0
Ornithodoros lahorensis	0	6/3	0

Chi-square analytical test showed that the ratio of ticks in camels, sheep, and goats is significantly different ($P < 0.001$).

Discussion

Each tick is adapted to a specific temperature and relative humidity. Therefore, a number of ticks are active in the warm climate, such as tropical and subtropical areas, and others are known as winter ticks (soft ticks) which are active in a dry climate. Ticks can play an important role in the transmission of some pathogens to humans and animals. Several species of Hyalomma ticks are responsible for the Crimean-Congo hemorrhagic fever, tick typhus (Rickettsia conorii), and Q-fever (Coccidia brunei), and several species of Rhipicephalus have been known to be responsible for transmission of tick typhus and Tularemia disease to humans. Furthermore, a number of tick species can possibly cause transmission of diseases including babesiosis, theileriosis, ehrlichiosis, paralysis and sweating disease to animals (5, 6).Nehbandan is suitable for activity of many hard and soft ticks because of its climatic conditions. In this study on tick infection of different livestock in Nehbandan area, generally, 4 genus and 14 species were identified, of which only Ornithodoros lahorensis belongs to the family Argasidae , and the rest belong to family Ixodidae. The population of identified Ixodidae ticks in the study area in terms of genus and species number shows a variety (Hyalomma, Rhipicephalus and Haemaphysalis). Also, commonly reported hard ticks of sheep and goats in Iran are mainly 3 genus of Hyalomma, Rhipicephalus and Haemaphysalis (7, 16). Based on the results of the study, the highest frequency was observed in Hyalomma dromedarii species (29.28%), Rhipicephalus sanguineus (13.2%) and Rhipicephalus toranicus (13.2%). Haemaphysalis kolakowski (0.1%) and Haemaphysalis concinna (0.2%) had the lowest frequency and 28% of the livestock in the area were infected by tick. Telmadarraiy et al. (2009) examined the frequency of Argasidae and Ixodidae ticks in Meshkinshahr. Among hard ticks, the genus Hyalomma was the most frequent with 65.5%, Rhipicephalus frequency was 34.3%, and Haemaphysalis with 0.2% have the lowest frequency. In the argasidae family, Ornithodoros genus with 97.2% frequency was the most abundant and Argas genus has the lowest frequency (2.8%) (18).

According to the results of this study, Hyalomma dromedarii was identified as the dominant tick in the area. This tick is found abundantly in southern and southeastern part of Iran, although it can be found in different parts of Iran and neighbor countries. The most important host of this tick is camel, but it can also be present in other animals. It may have a role in the transmission of Theileria annulata and Q Fever (12,14).

In the present study, we isolated Hyalomma deromedarii, Hyalomma schulzei, Hyalomma impeltatum, Hyalomma asiaticum asiaticum, and Hyalomma anatolicum anatolicum from camel. During a study in Qom province, Farzinnia et al. (2010-2011) reported the presence of Hyalomma dromedarii, Hyalomma schulzei, Hyalomma marginatum, Hyalomma anatolicum, and Rhipicephalus sanguines (3). RanjbarBahadori (2002) reported the presence of Hyalomma species (dromedarii, schulzei, detritum, anatolicum excavatum, anatolicum anatolicum), Rhipicephalus bursa and Ornithodoros lahorensis in Garmsar (14). Also, in the study of Najjarnejad mashhadi et al. (2009) Hyalomma dromedarii and Hyalomma anatolicum were identified on imported camels in Zabol (12). Ganjali et al (2013) reported four species of Hyalomma (dromedarii, schulzei, marginatum,and anatolicum excavatum) in Zabol (4). In the above studies, Hyalomma dromedarii is the most prevalent species of ticks in camels that is consistent with the present study. The reported difference in diversity of other species is due to the adaptation of different species of ticks to different climatic conditions in the country. Yakhchali et al. (2011) reported Hyalomma anatolicum anatolicum as the dominant species of tick in sheep (46.47%) and goat (77.16%) in southern Iran.

While in the northern part of Iran, the prevalent species of ixodidae ticks is Ixodes ricinus (31.15%) and in goat it is Hyalomma asiaticum asiaticum(50%) (24). The results of this study in Nehbandan area showed that Rhipicephalus sanguineus was found only in sheep and goats. During a study conducted in Isfahan province between 2003 and 2005, Nomann et al. showed that the prevalence of Rhipicephalus sanguineus in sheep is higher than other species (13). Nabian et al. (2007) observed a high prevalence of Rhipicephalus sanguineus among sheep in Mazandaran province during a study in the north part of the country (11). The only species of Ornithodoros found is lahorensis with 0.79% prevalence, found in one sheep and on the first day of spring. This tick can cause the transmission of theileriosis, anaplasmosis, brucellosis, tularemia, Q Fever, and paralysis (14). Haemaphysalis genus provides 2.6% of the total number of ticks found in Nehbandan area including four species of sulcata, punctata, concinna and kolakowski. Shayeghi et al. (2007-2008) identified 6 genera of Boophilus, Haemaphysalis, Ixodes, Hyalomma, Rhipicephalus and Dermacentor in Mazandaran province(15). Bahrami et al. indicated that the highest percentage of infection with ticks in west Azerbaijan is caused by Rhipicephalus (42%) and the lowest is Haemaphysalis with 3% (2). Khayyat Nouri and Hashemzadeh Farhang (2009) studied the variety of sheep tick species in Tabriz. They reported the presence of Hyalomma anatolicum anatolicum, Rhipicephalus Bursa, Rhipicephalus sanguines and Haemaphysalis sulcata. Infection with Hyalomma anatolicum anatolicum was reported to have the highest frequency (70.58%) and Haemaphysalis sulcata had the lowest frequency of infection (3.46%) (10).

Hashtamzadeh Farhang et al. (2009) indicated that among the sampled ticks in the district of Mahabad, Hyalomma anatolicum anatolicum, Rhipicephalus bursa,Hyalomma anatolicum excavatum, and Rhipicephalus sanguines had the highest frequency, and Haemaphysalis punctata had the lowest rate of contamination (8). Yakhchali and Azizi (2003) studied the livestock farms around Bukan and they reported a variety of Rhipicephalus sanguines and Haemaphysalis inermis in sheep and goats (22). Vahedi Noori et al. (2013) collected and identified 5 genera and 13 species of ticks from ruminants of Mazandaran province, which in Rhipicephalus species they included of Rhipicephalus bursa, Rhipicephalus sanguineus, Rhipicephalus anatolicum, Rhipicephalus turanicus,of Ixodes genus they included the only species of Ixodes ricinus, of the Haemaphysalis genus they included Haemaphysalis sulcata, concinna and in Hyalomma genus they included anatolicum, dendriticum, marginatum species, and of Dermacentor genus they included only species Dermacentor marginatus, while the Ixodes and Dermacentor species were not present among samples isolated from the area (19).

The results of studies conducted in other parts of the country are basically similar to those of the present study (especially in terms of genus and species diversity of the samples). However, this study and other studies show that the genus and species of the dominant ticks are different in each region and the geographic location and climatic conditions of the area, sampling and study methods, are the regulator of active ticks in the studying area. The average number of ticks per camel,sheep and goat was 10.7, 9.2 and 6/8, respectively. These results were higher than those reported by Yakhchali and Ranjbar, which calculated the average number of ticks in cattle 1 to 2, sheep 3 and goat 1/5. Also, according to the results of Sohrabi et al., (2013) the proportion of the number of ticks isolated from each animal in Kermanshah was reported 7.9 in sheep and 7.1 goats (16). The study of the distribution of ticks isolated from the body surface of the ruminant in the area showed that the highest accumulation of camel hard ticks was in the sub-tail area, and in sheep and goat, it was in the ear, which was statistically significant. These findings are consistent with the results obtained by Yakhchali and Azizi in 2007, which reported the highest accumulation of hard ticks in sheep and goat in the ears and the lowest levels of accumulation in head and neck region of cattle (22).

In this study, the prevalence of tick infection in the livestock farms was 28%. The prevalence of tick in camels was 79.24%, in sheep was 24.09% and in goats was 17.02%. Yakhchali and Ranjbar garmabeolia (2008) reported the infection in sheep (14.5%) and goats (10%) in the villages of Saleh Abad in the city of Torbatjam (23). Sohrabi et al., (2013) studied a variety of hard ticks in the natural habitat of ruminants in Kermanshah. The frequency of contamination of Ixodidae in sheep was 25.12% and in goats, it was 25.27% (16), which was somewhat consistent with the findings of the present study. Furthermore, compared with the study of Yakhchali and Hashemzadeh Farhang (2004) in Oshnavieh, in which the infection rate in sheep was (14.47%), it was much lower (21). This amount is estimated to be 88% and 82% for cattle and sheep, respectively (1). This relative difference can be justified by the climatic and weather variation and sampling time (21).

With an overview of the mentioned issues, it can be concluded that tick infection in livestock of Nehbandan area is very common and requires serious control and treatment. Another important point to note in this study is that this investigation is the first study in the area of Nehbandan in which the abundance and species diversity of the ticks of the region are by the limit of species. Furthermore, it is suggested that supplementary studies take place about the presence of pathogenic organisms in ticks of the region. Hence, more research is needed to examine their role in transmitting diseases in the region.

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