Prevalence, intensity and associated risk factors for ovine tick infestation in two districts of Semnan area

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Abstract:

BACKGROUND: Ticks are the most important vectors which transmit several arthropod-borne diseases such as theileriosis, babesiosis, and anaplasmosis. **OBJECTIVES:** An epidemiological study was conducted in Semnan area to determine the current situation of tick infestation in sheep and assess the efficacy of usage of CIS-cypermethrin against tick infestation under field condition. **METHODES:** Sampling was done monthly on 5% of a sheep herd in a population of 1000 sheep for one year. Ticks were collected, counted, and diagnosed. **RESULTS:** Ticks species affecting sheep were *Hyalomma marginatum marginatum* in winter quarters and in summer pasture; *Dermacentor marginatus* and *D. raskemensis* were the prominent ticks. In the middle of autumn and during the winter, no ticks were detected from the animals. The preferred sites of tick attachment to infested animals were perineal region and ears in winter quarters; however, in the summer pastures, the ticks were found only under the neck area and on the sternum. There was a significant difference between the numbers of male ticks on ewe and lamb; however, these phenomena were not recorded for female ticks. In this regard, CIS-cypermethrin deeping treatment reduced the rate of infestion (almost 100%) after one day of treatment. Nonetheless, in the next sampling after 4 weeks, the rate of infestation increased again and reached 50%. **CONCLUSIONS:** In order to control the tick infestation, it is recommended that spraying be done monthly on the infected areas.

Introduction

The ticks have great health importance due to the pathogenic factors they impose on the host during blood feeding. These arthropods have been on earth for at least 300 million years (Bowman & Nuttall, 2008). The mentioned arthropods are parasites located temporarily on vertebrata hosts and feed (Kettle, 1995). Ticks are economically the most important external parasite of sheep and other domestic species in tropical and subtropical countries (Jongejan & Uilenberg, 1994). More than 80% of the cattle population is infested with ticks (FAO, 2002), which cause harm to animals through blood loss, general stress and irritation, depression of immune function, and damages to skins (Jongejan & Uilenberg, 1994). The main losses that ticks impose to their hosts are the diseases which they transmit. Theileriosis is the most important disease in many areas of Iran, transmitted to sheep through tick (Heidarpour Bami et al., 2010). The economic loss resulting from nagging and irritation and depreciation of the value of skins and hides (up to 30%) are also significant (Bowman & Nuttall, 2008).

There are many ways to control the contamination of livestock to ticks; however, use of chemical acaricide is still one of the most important methods to control such parasites on animals. Incorrect use of such acaricide has led to resistance of animals to tick infestation in many countries. The mentioned acari-

cide are applied by dipping, spraying, or powdering; however, deeping has been proved to be the most common method of chemical fighting with Ticks (Abbas et al., 1995; FAO, 2002).

The purpose of this study was to assess the tick infection in sheep herd in winter quarters and summer pasture of "Sangsar" area (Province of Semnan), intensity and prevalence of ticks and the influence of deeping sheep with cypermethrin in field situation.

Materials and Methods

Sampling: In order to evaluate the infestation rate of different types of hard ticks in the herds of sheep in winter quarters and summer pasture of "Sangsar" area (North parts of Semnan), a herd of 1000 sheep was selected. The sampling was performed monthly on almost 5% of the population of the herd (in total 629), consisting of ewes (352) and lambs (277) in various regions located in winter quarters of Darjazin (an arid area in proximity of Semnan with the longitude of 53.357 and latitude of 35.639 and 1300 m above the sea level) and the mountainous area of Najafdar (in the north of Firoozkooh with the longitude of 52.383 and latitude of 35.783 and 2600 m above the sea level). Ticks were collected and kept in a labeled container consisting of alcohol 70% and Glycerin 5%, then they were sent to the lab. In the lab, the ticks of each animal were counted and recorded. The gender and species of the ticks were diagnosed using Estrada-Pena keys and by help of Parasitology department of faculty of Veterinary Medicine, University of Tehran (Estrada-Pena et al., 2004). Prevalence was calculated using the following formula (Thrusfield, 1995).

Prevalence = No, of infested cases during specified period/ population at risk during that specified time period × 100

The mentioned herd was in winter quarter until the early of June (The pastures around Darjazin town) and then went to the summer pasture in the north of Firoozkuh in Najafdar region. Due to the short path (about 150 km), the herd moved as usual and, after 2 to 3 weeks, reached the pastures of Najafdar village. In the movement from winter quarters to the summer pasture, at the end of June, acaricide was used on the herd against Arthropods.

To deep the sheep, Mac-Tomeil containing (10%) CIS-cypermethrin, made by Keshavarz National Chemistry Company, was used. First, the batch capacity along with the needed acaricide was calculated, then they were mixed in a bin of water (1:1000). Then the solution was added and mixed using a long wood stick. To ensure the uniformity of the solution in the bath, two sheep were passed through the bath as samples. The two sheep were batched again. Each sheep was bathed for one minute and attempt was made to keep the sheep head beneath the water. Upon deeping, every sheep was kept in bathing pan for at least 10 minutes (O'Brien et al., 1997). After the bath capacity was reduced by 10%, it was replenished at the dilution 1:800. To study the effect of acaricide on sheep, the day after use, two weeks after use, and 4 weeks after use, the external surface of sheep bodies were examined accurately, and hard ticks were taken off. The table of variables being studied consisting of type, age, gender, and the attachment location of the tick were provided in the two studied areas (Table 1). The probable relationships of the mentioned variables with the infestation of domestic livestock to hard ticks were analyzed with SPSS.

Results

On the whole, during a year and 12 samplings in each month on the sheep, 629 livestock, including 352 ewes and 277 lambs, were checked and a total of 1505 hard ticks (646 female ticks & 859 male ticks) were collected. Two species of Dermacentor: *D. marginatus* and *D. raskemensis* and one species of Hyalomma; *H.m.marginatum* were isolated from sheep in Najafdar (summer pasture) which were located in Firoozkuh and winter quarters in Mahdishahr, Darjazin village, respectively (Table 1).

In the examination of 5% of the herd, one day after deeping, on the first day of July, the ticks gathered were all dried up and killed, and no live tick was taken off. However, in the sampling performed 2 weeks later, among 53 animals examined, 12 (22.6%) were infected to ticks and 64 ticks were separated from them.

Due to the effects of the acaricide on reducing the incidence and severity of infection, the number of ticks isolated in these samples was not considered in the overall calculation.

Table 1. Frequency distribution of ticks on sheep during different months of year in Darjozain (valley) and Firuzkuh (Mountain).

Date 2010-2011	No: collected ticks	Prevalence	Male ticks	Female ticks	Average of ticks on infested animal	Average of female ticks on infested animal	Average of male ticks on infested animal	location	Site of attachment	Genus of the tick
15th May	179	70%	125	54	5.11	2	3.7	Valley	Ear, perineum	*Hyalomma*
11th June	170	74%	102	67	4.59	2.23	3.21	Mountain	Sternum	*Dermacentor*
1th July	0	0	0	0	0	0	0	Mountain	-	-
16th July	64	22.6%	37	27	5.3	2.25	3.08	Mountain	Sternum	*Dermacentor*
6th Aug	185	50%	112	73	7.4	3.31	5.33	Mountain	Sternum	*Dermacentor*
3rd Sep	519	82%	298	221	12.65	5.52	8.27	Mountain	Sternum	*Dermacentor*
7th Oct	358	72%	183	175	9.83	4.26	5.58	Valley	Sternum	*Dermacentor*
11th Nov	0	0	0	0	0	0	0	Valley	-	-
5th Dec	0	0	0	0	0	0	0	Valley	-	-
30th Dec	0	0	0	0	0	0	0	Valley	-	-
4th Feb	0	0	0	0	0	0	0	Valley	-	-
15th Mar	0	0	0	0	0	0	0	Valley	-	-
10th Apr	44	22	21	24	4	3	1.81	Valley	Ear, perineum	*Hyalomma*
17th May	50	28	29	21	3.57	2.1	3.2	Mountain	Sternum	*Dermacentor*

A total of 715 Hyalomma ticks and 790 Dermacentor ticks were isolated from the ewes and lambs, respectively. The number of ticks on lambs was significantly ($p \leq 0.01$) higher than the number of ticks on ewes. In this survey, 487 female and 372 male ticks were isolated from lambs and ewes, respectively. 343 female ticks were isolated from ewes and 303 female ticks from the lambs. Although there was a significant difference between the number of male ticks on ewe and lamb ($p \leq 0.01$), there was not a significant relationship between the number of female ticks on ewe and lamb. The results indicated that there was a significant relationship between the population of male and female ticks ($p < 0.01$). The more the number of male ticks, the more the number of female ticks and vice versa. In other words, the ticks attracted and affected each other.

In all months of the year except April, the number of male ticks on the host was more than the number of female ticks. The average prevalence of infestation was 56.85%, and the mean intensity of infestation was 7.56 (Table 1).

Discussion

Existence of both dry and desert and cold and mountains climates, with a distance of about 20 km from each other, has created a unique opportunity to study the animal's tick infestation in different regions. In this study, a flock of sheep was studied for a year for tick infection. Therefore, in contrast to other studies where numerous herds zone sampling are performed, ticks isolated were of less variety (Sohrabi et al., 2013; Yakhchali & Hajihasanzadehzarza, 2004).

In spring when the herd pastured in low areas (Darjazin village), the *H. m. marginatum* ticks were observed that attaching to the ear and perineal region of the animal. In the early summer when the herd moved to the higher levels of the mountainous area of Firoozkuh (Najafdar village), the ticks changed to *D. marginatus* and *D. raskemensis* that were living under the neck and on the sternum.

H. marginatum ticks were isolated from sheep in spring. The most common hard ticks of sheep and goats reported in Salehabad city Torbatejam were *H. marginatum* (Yakhchali & Ranjbargarmabolia, 2008). Also, in a study in DarrehShahr of Ilam Province, *H. marginatum* has been reported as the most abundant sheep tick (Sharifinia et al., 2014). In a study conducted in the city of Kermanshah on sheep, in the east which has less rainfall than the western areas, the most common spesies was *H. marginatum* ticks (in the western part of the city with the most rainfall *Rhipicephalus turanicus* was the most frequent tick isolated) (Sohrabi et al., 2013). Yakhchali and Hosseini (2006) identified *Rhipicephalus bursa* as

the dominant species of hard ticks on sheep and goats around Urmia's villages. Differences in species diversity in different areas show the compatibility of different species with different climatic conditions.

In Iran, three species including *D. marginatus*, *D. raskemensis*, and *D. niveus* have been reported from 6 provinces. In this study, of the mountainous regions of Semnan Province, Nabian has reported that only *D. raskemensis* and the isolation of *D. marginatus* from the animals in this area were unsuccessful (Nabian et al., 2008). *D. marginatus* is a species that has been reported in Asia, Europe, and North Africa. These ticks are usually found at elevations of 800 to 1000 meters above sea level (Estrada-Pena & Eastrada-Pena, 1991). Nabian has reported this tick from the provinces of Kurdistan, Ardabil, East Azerbaijan, and Zanjan. *D. marginatus* was the dominant tick on most of the sheep in early summer in the countryside (Nabian et al., 2008). *D. raskemensis* was studied by Dhanda et al. in 1971 in India and Pakistan (Filippova, 1983). Hoogstraal has reported *D. raskemensis* from the protected area of Khosh-Yeylagh from Alborz herds (Hoogstraal, 1980). Nabian has reported this tick from the provinces of Semnan, Khorasan, Kurdistan, and Eastern Azerbaijan. (Nabian et al., 2008). *D. raskemensis* was isolated from the sheep in the present study in the majority of cases of late summer.

D. marginatus is able to transfer various pathogens, such as *Rickettsia slovaca* that has been reported by Sanogo et al., (Sanogo et al., 2003). Also this tick is able to transfer pathogens such as *Francisella tularensis*, *Coccinella brunetti*, tick-borne encephalitis virus, and rocky mountain spotted fever caused by Rickettsia (Rehacek, 1987; Radulovic et al., 1994; Tokhov, et al., 2001). According to the information available, there are no reports on pathogen transfer by *D. raskemensis*. In laboratory condition, *H. m. marginatum* tick is able to transfer *Theileria annulata* (Estrada-Pena et al., 2004). In a study done by Razmi on sheep affected by *Theileria lestoquardi*, he could not diagnose *T. lestoquardi* in the *H. m. marginatum* that isolated from the sheep (Razmi et al., 2003). This tick is the main carrier of the virus that causes Crimean-Congo haemorrhagic fever (CCHF) in Europe (Estrada-Pena et al., 2004). The virus of CCHF has also been detected in *H. m. marginatum* in Darrehshahr of Ilam Province (Sharifinia et al., 2014).

There is some information regarding the distribution of ticks on the sheep showing the preferred infestation sites, so-called predilection sites, which might contribute to control measures such as mechanical removal and acaricide treatment. The most common assumption regarding the behavior of ticks looking for a place to feed is that they wander around searching for thin and soft skin in sheltered places on the host after being wiped off the vegetation. The study on distribution of ticks on the sheep showed that it was attached in summer pasture just around the ears and perineal areas and in countryside only in the sternum and the neck. In a study in Kermanshah, the highest accumulation of hard ticks was on the ears of the sheep (Sohrabi et al., 2013). In another study that was conducted in villages around Oshnavieh, perineal region and udder were reported as the most important attached site of ticks (Yakhchali & Hajihasanzadehzarza, 2004). Maximum tick infection on the perineal region and hip area of the sheep has been reported in Torbatejam (Yakhchali & Ranjbargarmabolia, 2008) and also in Urmia City (Yakhchali & Hosseine, 2006). Taib has reported the highest number of ticks in from ear's sheep (Taib et al., 2007).

In early summer, the sheep herd was treated using Cypermethrin.Cypermethrin was first employed as an ectoparasiticide dip in 1987 and has been widely used since then for such control. The advantage of Cypermethrin is its long lasting nature for several weeks due to its adhesion to animal wool and hair (O'Brien et al., 1997). During sampling, carried out the day after deeping the sheep, all isolated ticks were dried and killed. However, 2 weeks after deeping, of the 53 animals examined, 12 (22.6%) were infected to ticks, and totally 64 ticks were removed. Tick prevalence is considerably less, compared to the months before and after administration of cypermethrin in the same year. In preliminary studies in 1997, the effect of cypermethrin was observed up to 4 weeks after treatment (O'Brien et al., 1997).

Nonetheless, studies by Khaladj, to evaluate the effects of acaricide on ticks, showed that the effectiveness rate of the acaricide was 94.7% one day after treatment, which would be reduced to 49% and 25.3% trend in the fourteenth and twenty-first days after treatment, which led to the acceptable effect of

acaricide until the 14th day (Khaladj, 2007). In another study, it was shown that the use of Cypermethrin acaricide at concentrations recommended was not able to kill larvae Boophilus with rate of 99% (Khaladj, 2007). Due to a decrease in the prevalence and intensity of infection in the calculation of annual incidence and severity of infection, the data obtained on the first day and 2 weeks after deeping were not considered. In the monthly sampling done about 4 weeks after deeping, the prevalence of infestion was 50% (Table 1). Tick resistance to Cypermethrin has been reported in various studies (Abbas et al., 2014; Kaladj, 2007).

There are several methods to treat external parasites of domestic animals. However, regardless of the different methods of treatment, farmers should become familiar with the proper use of these acaricide. In addition, the regular examination of ticks in animals for resistance to various acaricide should be placed on the agenda of veterinary organization and research centers (FAO, 2002).

In this study, the mean intensity of ticks removed from the adult animals (ewe) was significantly ($p< 0.01$) less than that of lambs. It appears that feeding of tick on the host causes some immunological responses in the host that finally results in the reduction of the population of ticks in ewe compared to lamb. It is noteworthy that the reduction in the number of ticks in ewe as compared to the lamb was due to the reduction of the male population, and the difference observed in female ticks was not significant in ewe and lamb. However, studies on questing ticks in the open space attached to the host have shown that the number of ticks that are divided into male and female ones is the same (Bowman & Nuttall, 2008; Estrada-Pena et al., 2004; Sonenshine, 1991). Also, reports have indicated that metasetriata male ticks remain on the host longer than the female ticks. The male ticks attach to the host in the proximity of the female ticks for mating; then, they are separated and start blood feeding and get ready for remating (Bowman & Nuttall, 2008; Stich et al., 2008). In the current study, there was an equal ratio between the male and female ticks only in the first month of their activities; however, in the remaining months, the male ticks were always more than the female ones. This is due to the start of the activities of the ticks in April when the number of male and female ticks was equal; after a while, the blood-fed female ticks got separated and male ticks remained on the host, and therefore the number of male ticks increased. Despite the high number of male ticks in each host in comparison with the female ones, the total number of male ticks removed from ewe was significantly less than the lamb. The difference were observed in the male tick population is statistically significant ($p< 0.01$).

Suggestions: 1. Regarding the high number of female ticks as opposed to male ones in the ewe compared to lamb, and the possible relationship with secretion of some proteins by the male ticks in *D. marginatus*, *D. raskemensis* and *H. marginatum*, it is suggested that in future studies these proteins get separated and examined and their possible role in immunity be investigated.

2. According to the study done, it is recommended that spraying the animal in the countryside in the chest area be administered monthly. In the winter, due to higher risk of affecting more areas of the body, deeping the animal with the amounts mentioned is recommended. In addition, it is recommended not to save materials and replace the use of acaricide at the proper time.

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