

Article

Abundance and associated risk factors of ixodid ticks (Acari: Ixodidae) collected from one-humped camels (*Camelus dromedarius*) in Sistan and Balouchestan region, southeast of Iran

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Abstract

The purpose of this study was to determine the frequency, diversity and seasonal distribution of ticks collected from camels (*Camelus dromedarius*) in Sistan and Balouchestan region, southeast of Iran. Totally, 139 camels (74 females and 65 males) were randomly selected from May, 2014 to April, 2015, out of which 75 camels (53.9%) were found to be infested by ticks. Out of the examined ticks, eight species of two genera (*Hyalomma* and *Rhipicephalus*) were identified, namely *Hyalomma dromedarii* (39.5%), *Rhipicephalus sanguineus* (16.1%), *H. anatolicum* (14.1%), *H. excavatum* (11.7%), *H. schulzei* (6.4%), *H. scupense* (5.5%), *R. turanicus* (4.7%), and *H. asiaticum* (2%). The prevalence of ixodid tick infestation was higher in the female camels (60.8%) than the males (46.1%) ($P > 0.084$). The number of the hard ticks found on 1–2 year old female camels (76.9%; 30/39) was higher than on the other age groups ($P < 0.006$). Moreover, the seasonal activities of ticks were higher in spring than in the other seasons (80%; 40/50) ($P < 0.000$). The results of the current study revealed that ixodid ticks infestation was widespread among camels in Sistan and Balouchestan region, with great species diversity. Therefore, special attention should be given for a programmed tick control campaign in the region.

Key words: Camels, hard ticks, *Hyalomma*, Iran, *Rhipicephalus*, Sistan and Balouchestan.

Introduction

Ticks are obligate hematophagous arthropods, which feed on the blood of mammals, birds, and sometimes reptiles and amphibians (Jongejan and Uilenberg 2004; Omer *et al.* 2007). They may cause a range of problems including irritation, tick worry,

blood loss, swelling, tick paralysis, body weight loss, and elevated mortality and susceptibility to other infections (Taylor *et al.* 2007). Within arthropods, ticks are currently considered second only to mosquitoes in their economic importance and transmit more species of pathogenic agents than any other group of arthropods; for example, ticks can transmit the widest range of pathogens, namely zoonotic, that cause Lyme disease, ehrlichiosis, babesiosis, Rocky Mountain spotted fever, tularemia, Q fever, Crimean-Congo hemorrhagic fever, and tick-borne relapsing fever (Radostits *et al.* 2000; Parola and Raoult 2001; Ahmed *et al.* 2007). A review of the literature has revealed that, in Iran, studies on the biology and distribution of ticks were initiated by Dupre in 1810 (Yakhchali *et al.* 2011). Razi Vaccine and Serum Research Institute, Pasteur Institute of Iran, faculties of veterinary, and schools of public health have continued their studies on the tick infestation of animals (Abbasian-Lintzen 1960). Later, Abbasian-Lintzen (1960) and Mazlum (1968) have compiled a list of different tick species collected from domestic animals. Filippova *et al.* (1976) and Hoogstral and Wassef (1979) have studied ixodid ticks parasitizing rodents, wild sheep, and goat in different parts of Iran. In recent years, several studies have been conducted in different parts of Iran on the ticks infesting domestic ruminants (Zarif-Fard and Abdi-Goudarzi 2000; Razmi *et al.* 2002; Nabian *et al.* 2007; Nabian and Rahbari 2008; Nourollahi Fard *et al.* 2012; Yakhchali *et al.* 2012). Although there have been a number of studies on the prevalence of ticks in Iran, to the best of the researchers' knowledge, there is in fact a gap regarding the infestation of camels with tick species, their seasonal distribution, and tick fauna in different parts of Iran. Previous studies conducted in Iran have been considered faunistic and rarely dealt with geographical distribution, seasonal activity of ixodid ticks, and their frequency on both sexes of camels. Therefore, this study was aimed to determine the species diversity, seasonal activity of ixodid ticks, and tick infestation of both sexes of camels in the southeast of Iran.

Materials and Methods

Studied area

This study was conducted in Sistan and Baluchestan region, located in the southeast of Iran between 25° 03' and 28° 31' N and 58° 48' and 63°19' E. This area of 181,785 km² and a population of 2.4 million is surrounded by Khorasan, Kerman and Hormozgan Provinces. Pakistan and Afghanistan confine with the eastern boundaries, while its southern border is on the Oman Sea. The province comprises 3 regions of different geography: the coastal region in the South, a mountainous region in the West and the desert region in the East and North. The studied area receives 120 mm of rain/year and has air temperatures ranging between 0 and 40 °C.

Sample size

According to the Iranian Veterinary Organization, average populations of 150,000 camels were distributed in Iran; the Sistan and Baluchestan region harbors approximately 24% of these camels. The camels were reared traditionally and grazing in the pastures and did not receive treatment against ectoparasites.

From May, 2014 to April, 2015, a total number of 139 camels (74 females and 65 males) of different age groups (less than 1 year old, 1–2 years old, 2–3 years old, and over 3 years old) were inspected for the presence of ixodid ticks. Data pertaining to each of the examined camels were collected and recorded in individual files.

Parasitological procedures

Tick samples (all ticks) were collected from infested camels that grazed in the Sistan and Baluchestan region. After collection, tick samples were separately stored in 70% ethanol, until the species identification. In each season 6 samplings were carried out in the different areas. The collected ticks were transferred into the Parasitology Research Laboratory of Shahid Bahonar University of Kerman, Kerman, Iran. Later, the species were identified under a stereomicroscope based on morphological characteristics using the identification key by Walker *et al.* (2003).

Statistical analysis

For the data analysis, the descriptive statistics for quantitative data was used with 95% confidence interval (95% CI). Moreover, the logistic regression was used to determine the effect of the mentioned risk indicators (age, sex, and season) on the prevalence of infestation. Data were analyzed using Stata software, version 11.2.

Results

Out of the total of 139 camels, 75 (53.9%; 95% CI: 45.3–62.4) were found to be infested by ticks, from which 490 ticks were collected. The frequencies and 95% CI of tick species are presented in Table 1. The favorable tick attachment sites of the animals were ears (59.8%), followed by udders and external genitalia (11.8%), inner thighs (11%), perineum (10.2%), and around the eyes (7.1%). The tick infestation was not significantly higher in female camels (60.8%) than the male ones (46.1%) ($P = 0.072$). The highest number of the hard ticks was recorded in 1–2 year old female camels (76.9%; 30/39) compared to the other age groups.

Table 1. Identified ixodid tick species infesting camels in Sistan and Baluchestan region, Iran.

Tick species	Number of tick	Frequency	95% CI*
<i>Hyalomma dromedarii</i>	194	(39.5%)	35.2- 44.1
<i>Rhipicephalus sanguineus</i>	79	(16.1%)	13.0- 19.7
<i>Hyalomma anatolicum</i>	69	(14.1%)	11.1- 17.5
<i>Hyalomma excavatum</i>	57	(11.7%)	8.9- 14.8
<i>Hyalomma schulzei</i>	31	(6.4%)	4.3- 8.9
<i>Hyalomma scupense</i>	27	(5.5%)	3.7- 7.9
<i>Rhipicephalus turanicus</i>	23	(4.7%)	3.0- 7.0
<i>Hyalomma asiaticum</i>	10	(2.0%)	1.0- 3.7
Total	490	100%	--

*95% Confidence Interval

Table 2. Prevalence of ixodid tick infestation according to the season, age groups, and gender of the examined camels in Sistan and Baluchestan region, Iran.

Season	Number of camels	Number of infested camels	Prevalence (n/N) (%)	Age (year) (%)				Gender (%)	
				<1 N = 29	1–2 N = 39	2–3 N = 34	>3 N = 37	M N = 65	F N = 74
Spring	50	40	80	10 (34.4)	17 (43.5)	5 (14.7)	8 (21.6)	17 (26.1)	23 (31)
Summer	30	21	70	3 (10.3)	8 (20.5)	6 (17.6)	4 (10.8)	8 (12.3)	13 (17.5)
Autumn	27	9	33.3	1 (3.4)	4 (10.2)	2 (5.8)	2 (5.4)	3 (4.6)	6 (8.1)
Winter	32	5	15.6	1 (3.4)	1 (2.5)	1 (2.9)	2 (5.4)	2 (3)	3 (4)
Total	139	75	53.9	15 (51.7)	30 (76.9)	14 (41.1)	16 (43.2)	30 (46.1)	45 (60.8)

Notes: F, female; M, male; n, camels infested with ticks; N, total number of examined camels.

Furthermore, the highest prevalence of infestation was found during spring (80%; 40/50) (Tables 2 and 3).

Table 3. Effect of age group, season, and gender of the examined camels in Sistan and Baluchestan region, Iran using logistic regression.

Variable	Odds Ratio	95% CI*	P value
Sex			
Male	1	--	--
Female	2.2	0.9-5.1	0.072
Age			
<1	1	--	--
1-2	3.5	1.03- 11.9	0.044
2-3	1.4	0.4- 4.6	0.628
>3	1.2	0.4-3.7	0.811
Season			
Spring	1	--	--
Summer	0.6	0.2- 1.7	0.314
Autumn	0.1	0.03-0.3	<0.001
Winter	0.06	0.02- 0.2	<0.001

Discussion

In the present study, we recorded a 53.9% prevalence of tick infestation in camels, which was less than 94% and 85.5% reported by Taddese and Mustefa (2013) and Champour *et al.* (2013), respectively. This discrepancy might be due to the application of acaricides, geographical distribution, climate condition, and management system (Sohrabi *et al.* 2013). In this study, eight species of the genera *Hayalomma* and *Rhipicephalus* were identified and *H. dromedarii* was the dominant tick species in the surveyed area. This finding is in agreement with the results of the studies on the tick fauna in Yazd and Kerman Provinces, near Sistan and Balouchestan Province (Salim abadi *et al.* 2010; Nourollahi Fard *et al.* 2012). *H. schulzei* was found in our study; however, our results are not in consistent with those found in the studies carried out in the northeast of Iran (Champour *et al.* 2013). The results revealed that the diversity of genera and species is depended on the climate, geographical conditions, and temperature (Nourollahi Fard *et al.* 2012; Champour *et al.* 2013). In this study, the preferred attachment sites of the ticks on the camels were ears, inner thighs, udders and external genitalia, perineum, and around the eyes, which could be due to the fact that hard ticks prefer warm, moist, and hidden sites with a good vascular supply, thin skin for feeding, and inaccessibility for grooming (Muchenje *et al.* 2008). The results also indicated that the frequency of ixodid tick infestation in the female camels was higher than that in the males; however, the difference was not statistically significant ($P > 0.084$). This finding was in contrast with the results by Taddese and Mustefa (2013) who reported the tick infestation rate to be lower in male camels with 90.2% than in the females, with 96.8%, which was not statistically significant. This issue may be due to the higher level of prolactin and progesterone, and stress due to pregnancy and lactation, which could make females more susceptible to any infection than males (Kabir *et al.* 2011). In the present study, 1–2 year old camels had the highest infestation rate with hard ticks among all the age groups. Comparison of the older and younger camels in the study by Champour *et al.* (2013) demonstrated no significant difference in the tick infestation ($P > 0.05$). This finding was not in accordance with the results in our study. Several factors, such as innate immunity, nutrition, hormonal level in the host, and

management could influence the tick infestation (Bianchi *et al.* 2003; Kabir *et al.* 2011). The highest infestation rate of the ticks was recorded in spring and the lowest one was observed in winter, which was in agreement with the previous studies (Lak *et al.* 2008; Sofizadeh *et al.* 2014; Ghashghaei *et al.* 2015). Therefore, it can be concluded that geographical conditions, temperature, and altitude affect the prevalence of tick infestation in different seasons (Sajid *et al.* 2009; Yakhchali *et al.* 2012).

The findings of the present study updated the prevalence and seasonal diversity of tick species in the southeast of Iran. The presence of suitable hosts and ideal temperature in the region could contribute to the existence of ticks and tick-borne diseases. In addition, the results revealed that a variety of tick species was present in this part of the country, which are the vectors of numerous pathogens causing diseases such as anaplasmosis, babesiosis, theileriosis, Crimean-Congo hemorrhagic fever virus, Q fever, and relapsing fever in ruminants and humans. In general, further studies are needed to estimate the economic impact and epidemiology of tick-borne diseases and to determine the involvement of wildlife in the circulation of tick-borne pathogens.

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فراوانی و عوامل خطر مرتبط با کنه‌های سخت (Acari: Ixodidae) جدا شده از شترهای تک کوهان در منطقه سیستان و بلوچستان، جنوب شرق ایران

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چکیده

هدف از انجام این مطالعه تعیین فراوانی، تنوع و انتشار فصلی کنه‌های جمع‌آوری شده از شترهای یک کوهانه در سیستان و بلوچستان در جنوب شرق ایران بود. در مجموع از ۱۳۹ نفر شتر (۷۴ شتر ماده و ۶۵ شتر نر) به صورت تصادفی از اردیبهشت ۱۳۹۳ تا فروردین ۱۳۹۴ نمونه‌برداری به عمل آمد، که در مجموع ۷۵ شتر (۵۳/۹ درصد) از شترها آلودگی با کنه داشتند. از مجموع کنه‌های آزمایش شده ۸ گونه از دو جنس (*Rhipicephalus* و *Hyalomma*) تشخیص داده شدند. کنه‌ها شامل *H. anatolicum* (۱/۱۶/۱)، *Rhipicephalus sanguineus* (۳۹/۵)، *Hyalomma dromedarii* (۱۴/۱)، *R. turanicus* (۵/۵)، *H. scupense* (۶/۴)، *H. schulzei* (۱۱/۷)، *H. excavatum* (۱۴/۱) و *H. asiaticum* (۲) بودند. فراوانی آلودگی با کنه‌های سخت در شترهای ماده (۶۰/۸) بیشتر از شترهای نر (۴۶/۱) بود ($P > 0.084$). همچنین فراوانی کنه‌های سخت در شترهای ۱-۲ ساله ماده (۷۶/۹) بیشتر از سایر گروه‌های سنی بود ($P < 0.006$). افزون بر این، فعالیت فصلی کنه‌ها در فصل بهار (۸۰٪) بیشتر از سایر فصول بود ($P < 0.000$). نتایج مطالعه حاضر نشان داد که آلودگی به کنه‌های سخت در بین شترهای سیستان و بلوچستان گسترده بوده و از تنوع گونه‌ای برخوردار است. بنابراین، توجه ویژه‌ای باید برای برنامه‌ریزی در جهت کنترل کنه‌های منطقه مبذول شود.

واژگان کلیدی: شترها، کنه سخت، *Rhipicephalus*، *Hyalomma*، سیستان و بلوچستان

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