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Article

Fauna of ticks (Acari: Ixodidae) and their seasonal infestation rate on *Camelus dromedarius* (Mammalia: Camelidae) in Masileh region, Qom province, Iran

Marzieh Pasalary[1], Masoud Arbabi[2], Shahrookh Pashei[1] and Mohammad Abdigoudarzi[3]

1. *Department of Biosystematics, College of Sciences, Shahid Beheshti University, Tehran, Iran; E-mails: marzieh pasalary@ymail.com, Sp2191@gmail.com*
2. *Agricultural Acarology Laboratory, Agricultural Research Zoology Department, Iranian Research Institute of Plant Protection, Tehran, Iran; E-mail: marbabi18@yahoo.com*
3. *Reference Laboratory for Tick Study, Razi Vaccine and Serum Research Institute, Karaj, Iran; E-mail: M.ABDI@ rvsri.ac.ir*

ABSTRACT
Ticks (Acari: Ixodidae) are obligatory blood feeders and important external parasites of wildlife, domestic animals and humans in tropical and subtropical areas. Ticks primarily transmit different pathogenic organisms to livestock and humans, and secondly harm their animal hosts by decreasing blood protein content and nutrients due to partial exsanguinations, induce allergic reaction and sometimes cause tick paralysis or toxicosis. In this study, ticks have been collected from different body parts of stable kept male and female camels (*Camelus dromedarius*) in monthly intervals from late April 2012 to late March 2013 in Masileh region of Qom province, Iran. All tick have been collected and identified according to male individual characters. Totally, 1265 ticks (42.5% and 57.4% from stable male and female camels respectively) have been collected. Tick identification based on male characters revealed *Hyalomma dromedarii* (40.7%), *H. schulzei* (40.3%) and *H. marginatum* (18.8%). Heavy camel infestation by *H. schulzei* was recorded for the first time from central part of Iran. Different tick infestation rates were recorded during June and January, from zero to 254 ticks. The highest mean number of collected ticks was 9.6 under tail of female camels among five body places during August. Statistical analysis showed a significant correlation between the number of collected ticks and sampling intervals, sex of camels and place of camel bodies. Out of five camel body places, ticks were collected regularly from four body parts. Periodical infestation by *H. dromedarii* under tail, belly, thigh and neck of both camel sexes was found to be longer than for *H. schulzei* and *H. marginatum*. It could be concluded that any control measure for camel tick infestation should be planned before March-April in Masileh region of Qom, Iran.

KEY WORDS: Body parts; camel; ectoparasite; hard ticks; *Hyalomma* spp.

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INTRODUCTION

Ticks are important as they have negative effect on their vertebrate hosts due to blood feeding and severe paralysis and tick toxicosis, irritation, and allergic dermal reactions (Baharsefat and Baharsefat 2003; Champour *et al.* 2016; Mazlum 1971). The economic loss due to tick borne diseases among ruminants in tropical and subtropical areas is calculated to be several billion dollars annually (Jongejan and Uilenberg 1994). There are two million camels in Iran and most of them are distributed in Sistan and Baluchistan and southern part of Kerman provinces. Many tick species have been recorded on one humped camel from Iran, but few species were found largely distributed

in the country. Investigations of the tick fauna, their relative abundance and distribution in North and South Khorasan, and Khorasan Razavi provinces showed that 85.5% of camels were infested by four tick species and *Hyalomma dromedarii,* with 90.7%, was the dominant species during 2012–2013 (Champour *et al*. 2013). Based on tick fauna studies on imported camels from Afghanistan into Zabol city of Iran, it was recorded that 9% of camels were infested by two tick species and 96.7% from 331 collected and recorded ticks were *H. dromedarii* (Najarnezhad *et al.* 2009). In a study on ticks infesting camels in Qeshm Island of Iran, six species were reported and *H. dromedarii* (accounting for 61.9% of the total number of collected ticks) was the dominant species in this Island (Nazifi *et al.* 2011). Different studies on ticks infesting camels in Thar Desert of Sind in Pakistan showed a high rate of infestation among camel females (almost 83.3%) and *H. dromedarii* was found to be the only species widely distributed in that area (Gadahi *et al.* 2013). Studies on the camel tick fauna in Ethiopia showed that *H. dromedarii* was placed in the second rank with 5.9% of total collected ticks and it was found more abundant in rainy months than dry conditions (Zeleke and Bekele 2004). Biology of *H. dromedarii* was studied under laboratory condition and the lowest mortality (13.4% and 9.4% for female and male ticks, respectively) was found under high temperature (45 °C) and dry (35% RH) conditions (Edrees 2010).

Hot and dry condition of Qom region made it a suitable and favorite place for camel production. Since Qom province has been selected by livestock keepers as a place for exchange of their livestock from different parts of the country and for trade, the ectoparasite identification data may be a valuable step for the official sector to make a better decision on controlling livestock ectoparasites.

The aim of this study was to identify tick species and population fluctuations on one humped camel under dry and high temperature condition in Masileh region in Qom province, Iran.

MATERIALS AND METHODS

Tick fauna and their incidence on a fixed herd at stable (of C*amelus dromedarius*) including five selected male and five female camels have been studied in monthly time intervals, from April 2012 to March 2013 in Masileh region of Qom province of Iran. All ticks have been removed from five parts of host body (i.e. under tail, neck, belly, thigh and behind the ear) at monthly interval during one year sampling period. Two groups of five camels based on different sexes were regarded. Ticks have been collected using a pair of tweezers. Collected specimens from each part of the host body were kept individually in 10 ml vials containing 70% alcohol mixed with few drops of glycerin. Identification of ticks was made according to male morphological characters, using valid taxonomic identification keys (Fesharaki *et al*. 2002; Walker *et al.* 2014) and comparing with paratype specimens (kept at Reference Laboratory for Ticks Study at Razi Institute, Karaj, Iran). SPSS software, version 20 (Triple ANOVA) was used for data analysis regarding tick specimens.

RESULTS

Totally, 1265 tick specimens have been collected during twelve sampling time intervals. Identification of ticks was directed according to adult male tick morphological characters. The identified specimens included three species (*Hyalomma dromedarii*, *H. marginatum* and *H. schulzei*) from the family Ixodidae. Distribution of different *Hyalomma* species on *C. dromedarius* removed from five parts of their body at monthly sampling intervals from Masileh region of Qom province during April 2012 to March 2013 is demonstrated in Table 1. It was indicated that 46% and 54% of the identified ticks were collected from male and female camel hosts, respectively. The species *H. schulzei* was recorded for the first time, infesting both camel sexes from Masileh region.

Quantitative data for ticks revealed that 516, 511 and 238 of tick specimens belonged to *H. dromedarii*, *H. schulzei* and *H. marginatum,* respectively. Female *H. dromedarii* were more prevalent on female *C. dromedarius* than the two other tick species (Table 2). Statistical data analysis revealed a significant correlation ($p < 0.001$) between tick infestation and sampling intervals, camel sex and parts of the body of camels infested by ticks. Except for behind the ear part, four other parts of the body were infested by ticks (Table 5). A significant relation between sampling time intervals and tick distribution was observed for both camel sexes ($p < 0.01$). Seasonal infestation by *H. dromedarii* under tail, belly, thigh and neck of both male and female camels was found to be longer than by *H. schulzei* and *H. marginatum* (Table 1). Coincidence of the above mentioned three tick species under camels' tail during hot months of the year (May to September 2013) was observed (Table 1).

Table 1. Distribution of *Hyalomma* species on *Camelus dromedarius* body parts in Masileh region of Qom province at monthly sampling intervals during April 2012–March 2013.

Camel sex	Month	Under Tail			Belly			Thigh			Neck		
Males	March	-	-	D	-	S	D	-	S	D	D	D	D
	April	-	S	-	-	S	D	-	S	D	-	S	D
	May	M	S	-	-	S	D	-	S	D	M	S	-
	June	M	S	D	M	-	D	M	S	D	-	S	-
	July	M	S	D	-	-	D	M	S	D	M	S	D
	August	-	S	D	-	S	D	-	-	D	-	S	D
	September	M	S	D	M	-	-	M	-	D	M	S	D
	October	-	S	D	-	S	D	-	S	D	-	-	D
	November	-	-	D	-	S	-	-	S	D	-	-	D
	December	-	-	-	-	-	-	-	-	-	-	-	-
	January	-	-	D	-	-	-	-	-	-	-	-	-
	February	-	-	-	-	-	-	-	-	-	-	-	-
Females	March	-	S	D	-	-	D	M	S	D	-	-	D
	April	-	-	D	-	S	D	-	S	D	-	S	D
	May	M	S	D	M	S	D	M	S	D	M	-	D
	June	-	S	D	M	S	D	M	S	D	M	S	-
	July	-	S	D	-	S	D	-	S	D	M	S	D
	August	-	S	D	-	S	D	-	S	D	-	-	D
	September	M	S	D	M	-	D	M	S	D	M	S	-
	October	-	S	D	-	-	D	-	-	D	M	-	D
	November	-	S	D	-	S	D	-	S	-	-	S	D
	December	-	-	-	-	-	-	-	-	-	-	-	-
	January	-	-	D	-	-	-	M	-	D	-	-	-
	February	M	S	D	-	-	-	-	-	-	-	-	-

D = *H. dromedarii*, M = *H. marginatum*, S = *H. schulzei*

Table 2. *Hyalomma* specimens collected on one humped camels (male and female) during sampling period in Masileh region of Qom province.

Tick species	Male camels	Female camels	Total
Hyalomma dromedarii	160 (31 %)	356 (69%)	516 (40.79%)
Hyalomma schulzei	268 (52.44%)	243 (47.56%)	511(40.39%)
Hyalomma marginatum	123 (51.68%)	115 (48.19%)	238 (18.81%)
Total	551(43.55%)	714 (56.44%)	1265

Table 3. Analysis of variance of tick data from male and female one humped camels in Masileh region of Qom province.

Source	Df	Mean Square	F value	*P*
month	11	5.236	50.317	0.0001
sex	1	0.660	6.340	0.012
Body section	3	1.149	11.044	0.000
month × sex	11	0.139	1.335	0.203
month × Body section	33	0.192	1.845	0.004
sex × Body section	3	0.132	1.269	0.285
month × sex × Body	33	0.089	0.853	0.703
Error	383	0.104		
Total	479			

Table 4. Analysis of variance of tick data collected from both camel sexes in Masieleh region of Qom province.

Source	Df	Mean Square	F value	*P*
month	11	10.436	50.241	0.000
sex	1	2.234	10.755	0.001
Body sections	3	2.789	13.427	0.000
month × sex	11	0.249	1.198	0.286
month × Body sections	33	0.217	1.045	0.403
sex × Body sections	3	0.158	0.760	0.517
month × sex × Body sections	33	0.071	0.342	1.000
Error	384	0.208		
Total	480			

Table 5. Mean numbers (± SE) of collected ticks from different camel body parts in Masileh region of Qom province.

Month of sampling	Male camels					Female camels				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
March	1.6	-	1.2	1.2	1.6	2.2	-	2	1.6	2.2
April	2.2	-	4.8	4	7.6	1.6	-	7	4	4.4
May	4.2	-	4.6	3.4	5.4	1.8	-	4.2	3.4	6.8
June	4.4	-	5.8	5.4	8	5.6	-	6.4	5.4	8.8
July	2	-	2	1.4	3.4	5.6	-	5.4	3.2	6.4
August	2.6	-	1.6	1.4	2.8	7.6	-	7.4	5.8	9.6
September	3.8	-	3.2	2.4	4	4.6	-	3.2	3.4	5.2
October	1	-	0.6	0.4	1.4	1	-	0.6	0.2	1.4
November	0.6	-	0.6	0.2	0.6	0.6	-	0.8	0.4	1.2
December	-	-	-	-	-	-	-	-	-	-
January	-	-	-	-	0.8	-	-	0.6	-	1.2
February	-	-	-	-	-	-	-	-	-	0.8

1 = Under neck, 2 = Behind ear, 3 = Under thigh, 4 = Under belly, 5 = Under tail

During June and August, the highest mean number of tick incidence under neck, thigh, belly and tail was 4.4, 5.8, 5.4, 8 and 7.6, 7.5, 5.8, 9.6 for male and female camels, respectively (Table 5). It can be concluded that female camels are more preferred hosts than male camels.

DISCUSSION

The Masileh region has got desert type environmental conditions and also it has been situated near a livestock trading center in central part of the country. These situations widely enhance spreading of any arthropod ectoparasite. This study on tick fauna resulted in collecting of 1265 tick specimens belonging to three species of the genus *Hyalomma*. An increasing tick infestation proportional with increasing temperature and dryness from April to June and August was observed on various body parts of female and male camels in Masileh region of Qom (Table 5). In a study on ticks collected from 30 individuals of *C. dromedarius* in Tunisia, 630 tick specimens have been collected and five species were identified (including *Hyalomma impeltatum* and *H. dromedarii* as dominant species with 53% and 45% of all collected ticks, respectively) (Gharbi *et al.* 2013). A study on tick infestation of one humped camels from Qeshm Island in Persian Gulf of Iran showed six species from 912 collected ticks; 61.9% accounted for *H. dromedarii* as dominant species (Nazifi *et al.* 2011). In our study, *H. dromedarii* was found as a dominant species on female *C. dromedarius* comprising 50% of all collected ticks (Table 2). Although numerically both *H. dromedarii* and *H. schulzei* were found to be associated with both camel sexes, there is no difference in the tick attachment on different host sexes. Since *H. dromedarii* adults preferred camels in contrast to larvae and nymphs (Apanakevich *et al.* 2008), there was no record of larval or nymphal attachments in our study. The highest 254 tick specimens were collected during June. Therefore, increasing temperature may have a positive role in tick incidence. Screening of hard ticks on domestic ruminants in Yazd region of Iran revealed a maximum infestation rate of 55.9% and *H. dromedarii* was confirmed to be the dominant species during summer in Iran (Salimabadi *et al.* 2010). Out of five parts of the camel body surveyed for ticks, maximum number of ticks (mean 9.6) was recorded under tail and behind the ear. A study on ticks collected from camels in Pakistan showed that camel nostrils were preferred attachment sites for *H. dromedarii* (Gadahi *et al.* 2013). Some people believe that low camel population density, their breeding environments and the long intervals between drinking water by camels keep them safe from frequent contacts with other animals, thus diminishing the chance of acquiring vector borne diseases (Richard 1979; Schmidt-Nielsen *et al.* 1956).

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مطالعه فون کنه های حیوانی و توزیع فصلی جمعیت آنها روی بدن شتر یک کوهانـه در منطقـه مسیله استان قم، ایران

مرضیه پاسالاری[۱]، مسعود اربابی[۲]، شاهرخ پاشایی‌راد[۱] و محمد عبدگودرزی[۳]

۱. بخش بیوسیستماتیک جانوری، دانشکده علوم زیستی، دانشگاه شهید بهشتی، تهران، ایران؛ رایانامه‌ها: marziehpasalary@ymail.com Sp2191@gamil.com

۲. آزمایشگاه تحقیقات کنه‌های گیاهی، بخش تحقیقات جانورشناسی کشاورزی، موسسه تحقیقات گیاهپزشکی کشور، تهران، ایران؛ رایانامه: marbabi18@ yahoo.com

۳. آزمایشگاه مرجع کنه‌های حیوانی، موسسه تحقیقات واکسن و سرم سازی رازی، کرج، ایران؛ رایانامه: M.ABDI@rvsri.ac.ir

چکیده

کنه‌های حیوانی (Acari: Ixodidae) مهم‌ترین انگل خارجی و تغذیه کننده از خون حیوانات وحشی، اهلی و انسان درمناطق گرمسیری و نیمه گرمسیری‌اند. کنه‌های حیوانی با انتقال بیماری‌های مختلف به دام‌ها و انسان‌ها، ضمن کاهش میزان خون، پروتئین و انرژی آن، سبب واکنش-های حساسیت‌زا و گاهی فلج و مرگ جانور میزبان نیز می‌شوند. در این بررسی نسبت به جمع‌آوری ماهانه تمامی کنه‌های حیوانی از روی قسمت‌های مختلف بدن (زیر گردن، دم، کشاله ران، شکم و پشت گوش)، شترهای نر و مادهٔ نشان‌دار یک کوهانه نگهداری شده، از فروردین تا اسفند سال ۱۳۹۲، در منطقه مسیله استان قم اقدام شد. در مجموع ۱۲۶۵ نمونه کنهٔ حیوانی به ترتیب با ۴۲/۵۳ درصد و ۵۷/۴۷ درصد جمعیت از روی بدن شترهای نر و ماده جمع‌آوری شدند. شناسایی کنه‌های حیوانی براساس مشخصات کنه نر منجر به معرفی سه گونه *Hyalomma dromedarii*، *H. schulzei*، *H. marginatum* به ترتیب با ترکیب جمعیتی ۴۰/۷۹، ۴۰/۳۹ و ۱۸/۸۱ درصد شد. انبوه جمعیت کنه *H. schulzei* برای نخستین بار از این منطقه گزارش می‌شود. توزیع جمعیت کنه‌ها در ماه‌های نمونه‌برداری متفاوت بود و بیشترین تعداد، ۲۵۴ کنه در خرداد و نبود کنه در دی‌ماه روی شترها ثبت شدند. در میان قسمت‌های مختلف بدن بیشترین تعداد کنه ۹/۶ کنه در زیر دم و نبود کنه در پشت گوش شترها مشاهده شد. تجزیه آماری داده های جمعیت کنه درسطح یک درصد بین فواصل و محل نمونه برداری از بدن و شترهای نر و ماده رابطه معنی‌داری نشان داد. به غیر از پشت گوش، فعالیت کنه‌های حیوانی در ماه‌های گرم سال و در دیگر قسمت‌های بدن شترها ملاحظه شد. دورهٔ فعالیت کنهٔ حیوانی *Hyalomma dromedarii* روی بدن شترها طولانی‌تر ملاحظه شد. برای کنترل مؤثر کنه‌های حیوانی شتر در منطقه مسیله قم لازم است پیش از ماه‌های اسفند تا فروردین اقدام صورت گیرد.

واژگان کلیدی: قسمت‌های بدن؛ شتر؛ انگل خارجی؛ کنه‌های سخت؛ *Hyalomma* spp.

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