Original Article

Seasonal Activity of Ticks and their Importance in Tick-Borne Infectious Diseases in West Azerbaijan, Iran

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Abstract

Background: West Azerbaijan is considered as a main region for domestic animal breeding. Due to importance of herd as a main host and ticks as a vector of relapsing fever and CCHF, a comprehensive study was undertaken in the region.
Methods: Outdoor, indoor collection as well as ticks stick to the animals' body were collected and identified. The study was conducted during the whole seasons in 2004-2005.
Results: During four seasons a total of 2728 ticks of two families (Ixodidae and Argasidae) were collected comprising 7 genera of 5 hard ticks and two genera of soft ticks including *Haemaphysalis, Hyalomma, Rhipicephalus*, *Boophilus* and *Dermacentor*. The soft ticks were *Ornithodoros* and *Argas*. These 7 genera included 18 species. The main species were *Haemaphysalis inermis, H. punctata, H. sulcata, H. numidiana, H. concinna, Hyalomma marginatum, Hy. anatolicum, Hy. detritum, Hy. dromedarii, Hy. asiaticum, Hy. schulzei, H. aegyptium, Rhipicephalus bursa, R. sangiuneus, Dermacentor marginatus, Boophilus annulatus, Ornithodoros lahorensis,* and *Argas persicus*. Frequency of ticks during different seasons was different. A pyrethroid insecticide, cypermethrin, which is widely used for tick control was tested against soft ticks. The test method was based on WHO recommendation. At the LD_{50} level *A. persicus* needs more concentration than *O. lahorensis.*
Conclusion: *Ornithodoros* and *Argas* are the more prevalent soft ticks in the region**.** Distribution and prevalence of hard ticks was varied in different seasons. Results of this study will provide a clue for vectors of tick-borne diseases in the region for local authorities for implementation of tick control.

Keywords: Tticks, Iran, Borrelia

Introduction

Ticks are important to human and veterinary medicine, they act as vectors of bacterial, protozoal, rickaettsial, spirochaetal and viral diseases of humans, domestic stock and companion animals. As ectoparasites with irritating bites, they cause extensive harm to their hosts due to blood loss, damage to the skin and anorexia leading to reduction in growth. They are considered as agents of 'tick paralysis' in man and animals, probably due to the secretion of toxic substances in their saliva. Lesions can be caused by ticks (dermatophilosis) in cattle, goats and sheep. Ticks and tick-borne diseases affect animal and human health worldwide and are the cause of significant economic losses. Approximately 10% of the currently known 867 tick species act as vectors of a broad range of pathogens of domestic animals and humans are also responsible for damage directly due to their feeding behavior (Jongejan and Uilenberg 2004).

There are several works on biology, distribution, systematics of hard and soft ticks in Iran (Janbakhsh and Ardelan 1970, Abbassian-Lintzen 1960, Brumpt 1935, Deply 1936, Baltazard et al. 1952, Maghami 1968, Mazlumi 1968). The aim of this study was to find fauna of hard & soft ticks (families: Ixodidae

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& Argasidae) in West Azerbaijan Province and susceptibility level of soft ticks to currently used insecticide, cypermethrin.

Material and Methods

Study area

West Azerbaijan Province is located in North West part of Iran (37.5528 ° N 45.0759° E, Fig. 1). In the study area the total numbers of 20 villages were selected randomly and survey conducted in these villages.

Tick collection

Tick collection were carried out in animal, human dwelling and poultry shelter from cracks, crevices, ceiling and floor in 30 min. Ticks were collected, from animal body of sheep, cow, goat, calf and buffalo. After collection they were transferred into the holding tubes. All the specimens were identified by morphological characteristics.

Susceptibility of soft ticks to cypermethrin

The susceptibility of different strains of soft ticks including, *A. persicus* and *O. lahorensis* to cypermethrin by topical application method was determined. The *O. lahorensis* strains were collected from Bijar, Kurdistan province, Takab, Western Azerbaijan Province and Meshkinshahr, Ardebil Province respectively. The *A. persicus* strains were collected, from Khoramabad, Lorestan Province, and Takab, Western Azerbaijan Province, in 2004 from Iran and tested with cypermethrin. Mortality data from the replicates were pooled and the dose-response was assessed by probit analysis, using appropriate statistical package.

Results

During the study period among 20 villages the total number of 2728 ticks were collected and identified. Table 1 shows the number of soft and hard ticks in whole study area. From the table it can be concluded that the frequency of ticks in spring was more than other seasons, the least was observed in summer. Table 1 indicate the number of soft and hard ticks separately, the population of hard ticks in winter was lower than other seasons, in contrasts the hard ticks was more prevalent during autumn.

In spring all 18 species of hard and soft ticks were collected (Table 2). Among 881 specimens *A. persicus* has the highest prevalence. In spring *Hyalomma* was more prevalent than other hard tick genus. The species of *Hy. anatulicum* had the highest frequency among hard ticks.

In summer only 8 species of ticks were collected. In spring *A. persicus* also considered the most prevalent species. Out of 16 species of hard ticks only 6 species were collected, mainly comprise the genus *Hyalomma*. During the summer which is hot season in the region the distribution of all collected ticks was normally equal. From Table 3 it can be concluded that the different species of *Hyalommma* is active and soft ticks also present.

During autumn a total of 628 ticks were collected and identified. They belong to the families of Ixodidae and Argasidae and soft ticks *O. lahorensis* and *A. persicus*, among which the *H. concinna*, was more prevalent (Table 4). The pattern and occurrence of ticks during winter was different, *O. lahorensis* had the highest activities. Among 744 collected ticks, this species comprises 78% of all species, remaining (22%) includes *H. inermis, H. punctata, H. sulcata, A. persicus, H. concinna* (Table 5).

In the topical application bioassay, the average LD_{50} of *O. lahorensis* Bijar, west Azerbaijan, Meshkin shahr, and *A. reflexus* Lorestan, and West strains were 0.03, 0.04, 1.7, 0.7 and 1.7 µg/ticks, respectively and the steep slopes of dose-response curves indicated that the field populations of these soft tick strains were homogenous in response to cypermethrin.

Table 1. Total number of collected ticks in different seasons in West Azerbaijan, Iran

Season	Spring		Summer		Autumn		Winter		Total	
	Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft
	(427)	(454)	(159)	(316)	(486)	(142)	(92)	(652)	(1164)	(1564)
No. collected	881		475		628		744		2728	

Table 2. Distribution of ticks in spring in West Azerbaijan, Iran

Species	Number		total
	Male	Female	
1-*H. inermis*	5	40	45
2- *H. punctata*	7	10	17
3-H. sulcata	3	38	41
4- H. numidiana	18	9	27
5- H. concinna	1	28	29
6- Hy. marginatum	37	31	68
7- Hy. anatulicum	47	53	100
8- Hy.detritum	10	13	23
9- Hy. dromedarii	23	36	59
10- Hy. asiaticum	5	16	21
11- Hy. schulzei	2	4	6
12- Hy. aegyptium	0	1	1
13- R.bursa	5	6	11
14- R. sangiuneus	1	2	3
15- D. marginatus	1	1	2
16- B. annulatus	0	1	1
17- O. lahorensis	-	-	110
18- *A.persicus*	-	-	317
Total			**881**

Table 3. Distribution of ticks in summer in West Azerbaijan, Iran

Species	Number		total
	Male	Female	
1- Hy.marginatum	22	7	29
2- Hy. anatolicum	37	12	49
3- Hy. detritum	19	7	26
4- Hy. dromedarii	4	2	6
5- Hy. asiaticum	11	10	21
6- Hy. schulzei	14	14	28
7- O. lahorensis	-	-	41
8- *A.persicus*	-	-	275
Total			**475**

Table 4. Distribution of ticks in autumn in West Azerbaijan, Iran

Species	Number		Total
	Male	Female	
1-*H. inermis*	15	14	29
2- *H. punctata*	22	17	39
3-H. sulcata	1	1	2
4- H. numidiana	6	31	37
5- H. concinna	43	334	377
6- Hy.marginatum	2	0	2
7- O. lahorensis	-	-	37
8- *A. persicus*	-	-	105
Total			**628**

Table 5. Distribution of ticks in winter in West Azerbaijan, Iran

Species	Number		Total
	Male	Female	
1-*H. inermis*	77	0	77
2- *H. punctata*	9	0	9
3-H. sulcata	3	0	3
4- H. concinna	3	0	3
5- O. lahorensis	-	-	582
6- *A. persicus*	-	-	70
Total			**744**

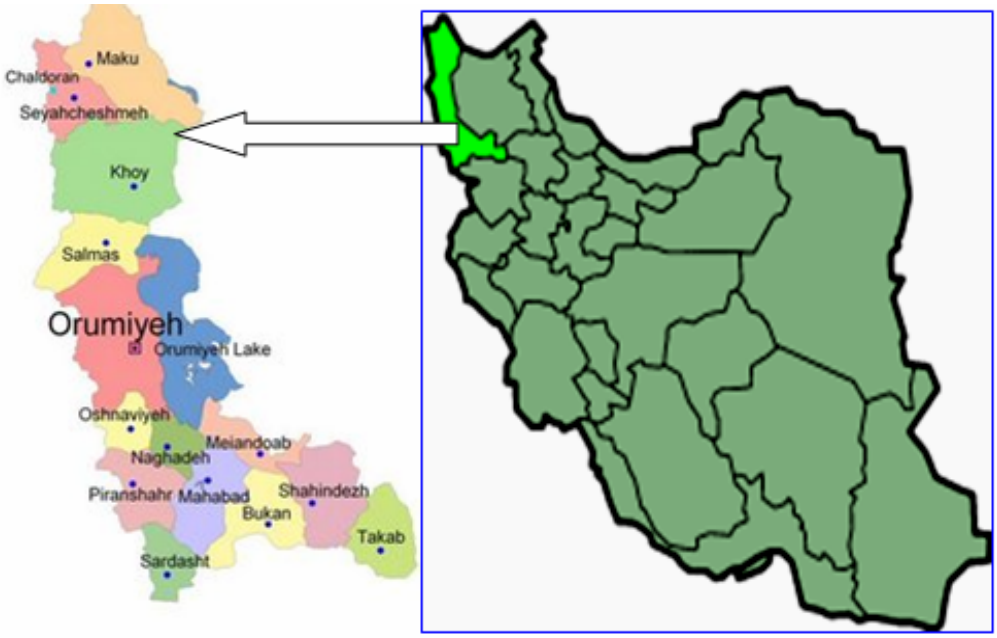

Fig. 1. Study area in West Azerbaijan Province, Iran

Discussion

Among soft ticks the two genus *Ornithodoros* and *Argas* exhibit the more prevalence in the region. The host preference of hard ticks is mainly observed on sheep, poultry, cow and goat, respectively. The soft ticks, *Ornithodoros* was mainly on sheep, calf and cow, respectively. Hen was found the most favorable host for *Argas*.

The hard ticks were more prevalent during spring and autumn but soft tick mainly occurs in winter. Genus *Hy. anatulicum* and *Hy. dromedarii* in spring, *Ornithodoros* in autumn, *Hy. detritum* and *Hy. marginatum* in summer were more prevalent. *Hy. schulzei* was found mainly in spring. In soft ticks genus *Argas* had minimum activity during winter. The ranking order of hard ticks in terms of frequency during the year was *Haemaphysalis, Hyalomma, Rhipicephalus, Dermacentor* and *Boophilus. Dermacentor* and *Boophilus* had the lowest frequency in the area which is collected only in spring.

Tilecoo (1997) in Takab of West Azerbaijan Province, found *O. tholozani*. In another study Piazak et al. in 1991 found that the genus *Hylaomma, Rhipicephalus, Haemaphysalis*, and *Boophilus* live in some parts of West Azerbaijan which is parallel to our results, they also emphasized that genus *Dermacentor* was active during the spring.

Tavakolli et al. (1987) carried out a similar study in Lorestan Province and found that genus *O. lahorensis* was active during the winter which is parallel to our study, but *Dermacentor* life time occurs mainly in spring. From the results it can be concluded that the variation among genus was wider in West Azerbaijan than Lorestan Province. He was not able to collect *Boophilus*. In similar study in adjacent province to the West Azerbaijan, of the 1,421 ticks collected from Adrebil, northwestern Iran, 45.9%, 40.3% and 13.8% were of the *O. lahorensis, O. tholozani* and *A. persicus* species, respectively. The prevalence of ticks was the highest in Khandabil village. The ticks collected from three villages were found to be infected with *Borrelia* (Arshi, et al. 2002). A case of meningitis from Borreliasis is found in Ardebil Province (Majidpour, 2003). Telmadarraiy et al. (2004) described the fauna of ticks in west Azerbaijan and found 15 species of hard and soft ticks. Vatandoost et al. (2003) conducted a survey in a Borreliasis foci of Iran in Hamadan Province and reported that the *A. persicus, A. reflexus, O. tholozani, O. canestrinni* and *O. lahorensis* were present in the region. *O. tholozani* was found infected by *Borrelia persica*. (Agighi et al. 2007) explained the situation of Borreliasis in Qazvin Province. They found that *O. tholozani* was infected with *B. persica* and *O. erraticus* by *B. microti*. In a similar study a total of 5938 soft and hard ticks were collected from different habitats, mostly human dwellings and stables of Semnan Province. The rate of infection among *O. tholozani* ticks by *Borrelia persica* was 36.6% (Nekoui, 1999).

In our study we were not able to collect the Borreliasis vectors, i.e. *O. tholozani* and *O. erraticus*, found in disease foci in Iran.

Robinson & Spradling (2006) cited the main important tick borne disease transmitted by different ticks in Iran and neighboring countries of Caucasus region. They referred to Bunya fever by different species of *Haemaphysalis* specially *H. punctata*; Crimrean-Congo Hemorrhagic fever by the bite of *Hy. marginatum, Hy. anatulicum, Hy. detritum, Hy. dromedarii, Hy. schulzei, Hy. impleltatum, Hy. asiaticum and O. lahorensis*; Dhori Virus fever transmitted by the bite of *Hy. dromedarii, Hy. marginatum* and *D. marginatus*; Boutanneuse by the bite of *R. sangiuneus, Dermacentor* spp, *Haemaphysalis* spp, *Hyalomma* spp, and *Boophilus* spp; Astarakhan Fever by the bite of *R. pumilio*; tick-borne relapsing fever transmitted by *O. tholozani, O. erraticus* and *O. asperus*; Lyme disease which its primary vector is *Ixodes ricinus* and *I. persulcatus* and other I*xodes* species. Tick-

Borne Relasping fever (TBRF) is a notifiable disease in Iran. In the last ten years a total of 1415 cases have been reported from the entire country. The highest prevalence was observed in year 2002 with incidence of 0.41/ 100.000 population. Ardabil Province was the first ranked infected area (625 out of 1415). The ranking order of prevalence was seen in Hamedan, Zanjan, Kurdestan and Qazvin provinces, respectively (Dr. Masoumi Asl, Ministry of Health, personal communication).

From our results it can be concluded that nearly main species which are emphasized earlier (Robinson & Spradling 2006) are exist in the study area, in addition *O. tholozani* play an important role in relapsing fever transmission in adjacent region. The possibility of contact between human, animal and ticks in this area may creates a high risk of acquiring different diseases such as Bunya fever, CCHF, Dhori Virus and Boutanneuse. Both soft ticks (Argasidae) and hard tick (Ixodidae) play an import role for transmission of disease to human (Gray, 2002; Cunha, 2000). Our recent work in Ardebil Province indicated the presence of virus in the genera of *Hyalomma, Rhipicephalus and Ornithodoros.* Around 50% of host animals were IgG positive to the CCHF virus (unpublished documents). We propose further serological and molecular works for clarification of infectivity of ticks, host and reservoir for disease transmission cycle confirmation. It is found that cypermethrin is effective against soft ticks which is mainly find in whole seasons, so that application of pyrethroid insecticides with periodically monitoring of insecticide resistance is recommended for tick control in the region as indoor residual treatment. For control of hard ticks which are more prevalent in autumn and spring dipping method could be an appropriate measure for this purpose.

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