

**Short Communication****Hard Tick Species of Livestock and their Bioecology in Golestan Province, North of Iran**

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**Abstract**

**Background:** A survey on tick species composition was carried out in Golestan Province Iran during year 2010–2011. The aim was to determine tick species parasitizing domestic ruminants and their seasonal population dynamics.

**Methods:** A total of 124 sheep, 92 goats, 84 cattle, 74 camels and 12 horses in several villages were inspected for tick infestation. The collected ticks preserved in 70% alcohol and then were identified.

**Results:** The overall 1059 ticks (453 female, 606 male) were collected. The ticks occur on sheep, goats, cattle, camels and horses as 72.1%, 77.3%, 75.8%, 69.3%, and 50% respectively. The frequency of ticks in spring was more than other seasons and the least was observed in winter. In the spring and summer, infestation rate in domestic ruminants were calculated as 100%. Six genus and fourteen hard and soft tick species were identified including *Rhipicephalus sanguineus*, *R. bursa*, *Ixodes ricinus*, *Haemaphysalis punctata*, *H. sulcata*, *H. erinacei*, *H. inermis*, *Hyalomma marginatum*, *Hy. asiaticum*, *Hy. dromedarii*, *Hy. excavatum*, *Hy. anatolicum*, *Hy. detritum*, *Boophilus annulatus* and *Argas persicus*. *Rhipicephalus sanguineus* was the most abundant species in the study area. The largest number of ticks was collected from animal ears and tails. *Haemaphysalis*, *Hyalomma*, *Rhipicephalus* and *Boophilus* occurred in mountainous, forest and plateau areas of Golestan Province but *Ixodes* occurred only in mountainous and forest areas, whereas *Rhipicephalus* and *Hyalomma* were present in coastal areas of Golestan Province.

**Conclusion:** The result of this study is a survey on tick species from domestic animals in Iran and implication of possible prevention measures for diseases transmitted by ticks.

**Keywords:** Ticks, Domestic ruminants, Bioecology, Iran

**Introduction**

Medical and veterinary implications of ticks (Acari: Ixodidae) on human and animals life is very obvious question and proved from many years ago (Hoogstraal 1982). Annoyance and paralysis of livestock also transmission large number of pathogen agents is only some cosmopolitan associated tick problems (Sonenshine 1991, Service 2001). Approximately only 10% of the currently known 867 tick species are also responsible for damage directly due to their feeding behavior

(Oliver 1989) and unavoidability act as vectors of a broad range of pathogens of those hosts. Ruminants are also affected by direct tick damage including tick bite abscesses, anemia, tick induced dermatophilosis. The pioneer work on tick fauna was Delpy L in Iran (Delpy 1936). Later continue by GS Pervomaisky, H Nemenz (Pervomaisky 1948, Nemenz 1953). Subsequently R Abbasian-Lintzen, Z Mazlum, G Maghami and A Rafyi et al. conducted some studies generally on do-

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mestic animals ticks in Iran (Abbasian-Lintzen 1960, Maghami 1968, Mazlum 1971). However certain studies also has been carried out on the ticks of wild animals by NA Filippova et al former presented data for 642 ixodid ticks taken from small-sized mammals mainly rodents in different zoogeographical zones of Iran and the latter studied ixodid ticks parasitizing wild sheep and goats in Iran focusing on maintaining natural foci of many hazardous diseases for human (Filippova et al. 1976). Recently Nabian et al and Rahbari et al published a list of adult ticks collected from domestic animals in North and whole Iran (Nabian et al. 2007, Rahbari et al. 2007a). Telmadarraiy et al. published a list of tick species and their prevalence in the Northwest and the Western part of Iran (Telmadarraiy et al. 2004, Telmadarraiy et al. 2008a, Telmadarraiy et al. 2010). Furthermore there are several reports on epidemiology, distribution, medically importance and acaricide susceptibility of different tick species through in this country (Telmadarraiy et al. 2007b, Vatandoost et al. 2010a). Since thus far only few studies were accomplished on tick fauna in different areas of Iran, it seems to be a gap in our knowledge about distribution of tick species in the Iran. In addition there is lack of finding about the frequency of ixodid tick species from domestic ruminants in Golestan Province. Therefore, this study is aimed to figure out the frequency of ticks on domestic ruminants likewise their seasonal and topological abundance and their host in the aforementioned part of Iran.

## Materials and Methods

### Study area

The present study carried out in different zone of Golestan Province which is located in Northeastern of Iran and geographically located at 36°25'N and 53°51'E on the South-eastern coast of Caspian Sea, a region suitable

for agriculture and animal husbandry. This province geographically divided into three parts: covered forest mountainous parts and plateau areas as well as the coastal plains.

### Ticks

Tick sampling was carried out on all three part of the study area at different time intervals. A total of 124 sheep, 92 goats, 84 cattle, 74 camels and 12 horses in several villages in Golestan Province were examined for tick infestation on the whole body of each animal. The sites of tick attachment were recorded during collection, collected ticks were preserved in 70% alcohol, counted and tick identification done by using the suitable and comprehensive keys including Pomerantzev (1950) and Hoogstraal (1956) (Pomerantzev 1950, Hoogstraal 1956).

## Results

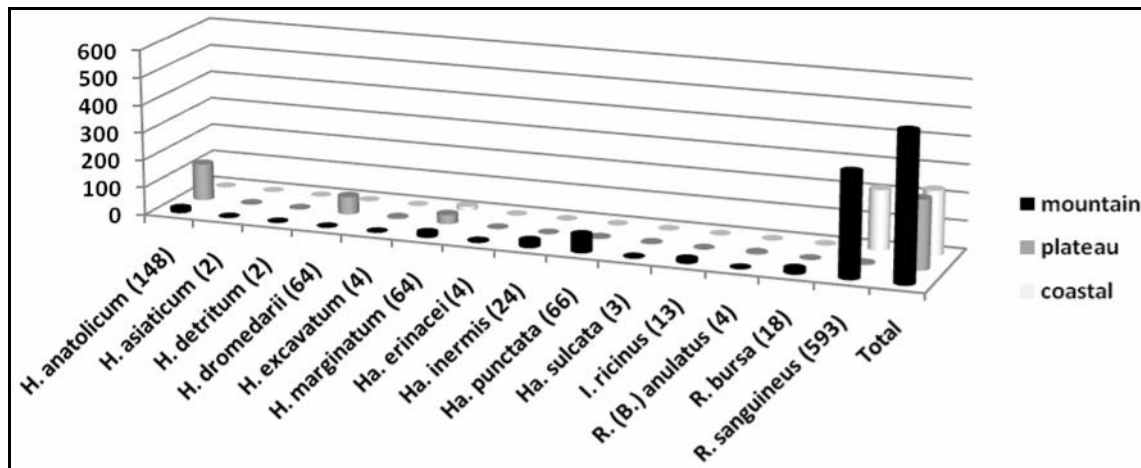
During the study period among several villages the total number of 1009 ticks were collected and identified, the occurrence of ticks on sheep, goats, cattle, camels and horses were 72.1%, 77.3%, 75.8%, 69.3%, 50% respectively. Table 1 show the number of hard tick species in whole study area. The frequency of ticks in spring was more than other seasons and the least was observed in winter. In the spring and summer infestation rate of domestic ruminants was higher than 90% and in autumn and winter was lower than 25%. The mean number of ticks on each animal was high in spring and summer (40–50 ticks per animal) and was low in autumn and winter (3–5 ticks per animal), so the largest number of ticks were collected from animal ears and tails. Fifteen species of ticks were identified based on the morphological characteristics which comprise *Rhipicephalus sanguineus*, *R. bursa*, *Ixodes ricinus*, *Haemaphysalis punctata*, *H. sulcata*, *H. erinacei*, *H. inermis*, *Hyalomma marginatum*, *Hy. asiaticum*, *Hy. excavatum*,

*Hy. anatolicum*, *Hy. dromedarii*, *Hy. detritum*, *B. anulatus* and *Argas persicus* was collected in nests of hen and domestic ruminants. Out of 1059 collected ticks from animal, a significant number of 593 *R. sanguineus* were identified. This species stands out as being the most prevalent tick species comprising 56% of the all ticks collected from domestic ruminants in Golestan Province. The tick species prevalence is shown in Table 1. Latter species was the most abundant tick in both moun-

tainous areas and the coastal plains, as well as *Hy. anatolicum* in the plateau areas. Whereas *I. ricinus*, *R. bursa*, *B. annulatus* and *H. inermis* occurred in mountainous areas and *Hy. dromedarii*, *Hy. asiaticum*, *Hy. excavatum* and *Hy. detritum* occurred in plateau areas only. The species diversity of hard ticks in plateau areas was more than other areas (Fig. 1). The tick species diversity on sheep is highest from the other hosts (Table 2).

**Table 1.** Seasonal abundance of hard ticks in Golestan Province

Species	number (percent)	Season								Total	
		Spring		Summer		Autumn		Winter			
<i>Hy. anatolicum</i>	148(14/7)	0	35	33	24	0	56	0	0	33	115
<i>Hy. asiaticum</i>	2(0/2)	0	2	0	0	0	0	0	0	0	2
<i>Hy. detritum</i>	2(0/2)	0	0	0	2	0	0	0	0	0	2
<i>Hy. dromedarii</i>	64(6/3)	26	24	0	11	0	1	1	1	27	37
<i>Hy. excavatum</i>	4(0/4)	0	2	0	0	0	2	0	0	0	4
<i>Hy. marginatum</i>	64(6/3)	8	21	2	27	0	6	0	0	10	54
<i>H. erinacei</i>	4(0/4)	0	0	0	0	3	0	1	0	4	0
<i>H. inermis</i>	24(2/4)	0	0	0	0	22	2	0	0	22	2
<i>H. punctata</i>	66(6/5)	0	0	0	0	52	11	0	3	52	14
<i>H. sulcata</i>	3(0/3)	0	0	0	0	1	0	1	1	2	1
<i>I. ricinus</i>	13(1/3)	6	0	1	0	6	0	0	0	13	0
<i>R. (B.) annulatus</i>	4(0/4)	0	0	0	0	4	0	0	0	4	0
<i>R. bursa</i>	18(1/8)	0	0	10	8	0	0	0	0	10	8
<i>R. sanguineus</i>	593(58/8)	163	250	88	92	0	0	0	0	251	342
<b>Total</b>	<b>1009(100)</b>	<b>203</b>	<b>334</b>	<b>134</b>	<b>164</b>	<b>88</b>	<b>78</b>	<b>3</b>	<b>5</b>	<b>428</b>	<b>581</b>



**Fig. 1.** Topological preference of hard ticks collected in Golestan Province (the number of specimens presented between two parenthesis)

**Table 2.** The host diversity of hard tick species in Golestan Province

Species number (percent)	Host				
	Cattle	Sheep	Goat	Camel	Horse
<i>Hy. anatolicum</i>	108	0	0	25	15
<i>Hy. asiaticum</i>	1	0	0	1	0
<i>Hy. detritum</i>	0	0	0	2	0
<i>Hy. dromedarii</i>	0	0	0	64	0
<i>Hy. excavatum</i>	4	0	0	0	0
<i>Hy. marginatum</i>	40	0	0	13	11
<i>H. erinacei</i>	3	1	0	0	0
<i>H. inermis</i>	24	0	0	0	0
<i>H. punctata</i>	63	3	0	0	0
<i>H. sulcata</i>	1	2	0	0	0
<i>I. ricinus</i>	7	0	6	0	0
<i>R. (B.) annulatus</i>	4	0	0	0	0
<i>R. bursa</i>	10	5	0	0	3
<i>R. sanguineus</i>	15	359	202	4	13
<b>Total</b>	<b>280</b>	<b>370</b>	<b>208</b>	<b>109</b>	<b>42</b>

## Discussion

In the present study 206 (53.3%) out of 386 livestock was infested with tick. The number of ticks was high in spring and summer (40–50 tick per animal) but low in autumn and winter (3–5 tick per animal, average 21.5–25). Hosseini vasoukolaei et al. (2010) in Ghaemshahr recorded that tick infestation rate of animal and the number of ticks per animal was 24% and 3–5 respectively (Hosseini vasoukolaei et al. 2010). In the study conducted by Rahbari et al. (2007) in four different zoogeographical areas in Iran where the majority of the domestic ruminants in Iran exist the number of ticks per animal (10–20) was low (Rahbari et al. 2007a). In respect of this result to result of the present investigation tick infestation rate of animals was high in our studied area. Through viewpoint of tick infestation of livestock the percentage of tick per sheep, goat, cattle, camel and horse were equal 45.1%, 47.8%, 64.2%, 62.1%, and 50.0% respectively. Tick infestation of cattle, sheep and goat in the study of Rahbari et al. (2007) was equal 62%, 55% and 57% respectively (Rahbari et al. 2007a). In the other study carry out by Davoudi

et al. (2008) in Northwestern parts of Iran 10.16% of cattle and 1.07% of buffaloes were infested by ticks. Thus tick infestation of animals in our studied areas than Ghaemshahr and Northwestern parts of Iran was higher but coincided with the result of Rahbari et al. (2007). These results reveal significant differences concerning tick abundance on different hosts in different geographical areas. In a survey conducted from April 2001 to January 2003 in Tamil Nadu of India from 600 sheep and goat was selected randomly 64.6% sheep and 97.66% goat were infested by ticks (Vathsala et al. 2008) and therefore tick infestation rate of animals in Indian study is higher from tick infestation rate of animals in our country. We observed that infestation rate may be maximized in the spring and summer seasons. This result is in agreement with study of Davoudi et al. (2008) he also sees the highest rate of infestation occur in spring (Davoudi et al. 2008). However Telmadarrai et al. (2004) and Salari Lak et al. (2008) in the Northwestern Iran most of tick collected in the summer and spring respectively (Telmadarrai et al. 2004, Salari

Lak et al. 2008). It may be as a result of that climate condition and flora of Northwestern Iran in summer is similar to climate condition of our studied area in spring. In the studies conducted in Iran and also in our study, the lowest number of ticks were collected during winter, whereas interestingly in Tamil Nadu of India seasonal tick infestation rate of sheep and goat in winter (January to March) was 61% and 97.66% respectively (Vathsala et al. 2008). This could be due to Indian climate conditions in winter agree with climate condition of Northwestern Iran in same season. In the present study, the ticks were obtained in more number from animal ears and tails. The possible factors effect question include temperature and humidity of skin also delicateness of it that cause tick attached and engorged on this sites. Whereas in winter which is colder than other seasons ticks attached the trunk between wool's host which is warmer than ears and tail thus become their preference site in the winter season. In our study, five genera of ixodid ticks including *Rhipicephalus* (60.5%), *Hyalomma* (27.1%), *Haemaphysalis* (10.6%), *Ixodes* (1.3%), and *Boophilus* (0.4%) were collected and *Rhipicephalus* ticks were dominant in the investigated area. In a survey on ticks collected from sheep, in Bahar township of Hamadan Province in the Western part of Iran, the ixodid ticks found were *Hyalomma*, *Rhipicephalus* and *Haemaphysalis* and *Hyalomma* ticks were predominant ticks (Telmadarraiy et al. 2008a). The frequency of *Hyalomma* and *Rhipicephalus* species in a study conducted in Ardabil Province located in the Northwest of Iran, comprising 43.6% and 41.7% of all collected ticks respectively (Telmadarraiy et al. 2010). In the studies performed in West Azerbaijan Province *Hyalomma* ticks were dominant as 63.2% and 61.3% respectively (Davoudi et al. 2008, Salari Lak et al. 2008). In the other study in West Azerbaijan *Rhipicephalus* (42%), *Hyalomma* (41%), *Boophilus* (7%),

*Dermacentor* (7%), and *Haemaphysalis* (3%) were found where *Rhipicephalus* as well as *Hyalomma* were the most prevalent tick species (Telmadarraiy et al. 2004). Thus could not be understand that in the most aforesaid studies *Hyalomma* ticks were the most abundant ticks, but the largest number of ticks that in Northwest of Iran were found belonging *Rhipicephalus* genus and the most abundant species in the study area was *Rhipicephalus sanguineus* which is in agreement with study of Hosseini vasoukolaei et al. (2010). Along with our findings, Nabian et al. (2007) found that *R. sanguineus* is the major species in Mazandaran Province and did not find *R. bursa* (Nabian et al. 2007), but result of our study show eight male and ten female *R. bursa* in contrast with only one female *R. bursa* (Hosseini vasoukolaei et al. 2010). In the study conducted by Rahbari et al. (2007) *R. sanguineus* was the main species in the North of Iran (Rahbari et al. 2007a). From the studies accomplished by Telmadarraiy et al. (2004, 2008) and Davoudi et al. (2008) two species *R. sanguineus* and *R. bursa* were collected from different animals including sheep, goats, cattle, buffaloes and camels (Telmadarraiy et al. 2004, Telmadarraiy et al. 2008a), showing *Rhipicephalus* are concerned to blood of different hosts. According to these studies, it can be concluded that *R. sanguineus* is the tick species with great significance for domestic ruminants in the North of Iran. Razmi et al. (2007) found that *Boophilus* comprising the majority (51.3%) of ticks collected in a study conducted in Mazandaran Province following *Hyalomma* (18.5%), *Rhipicephalus* (16.8%), *Haemaphysalis* (6.3%), *Ixodes* (6.3%) and *Dermacentor* (0.1%) were also present in the study area (Razmi et al. 2007), but in our study *Boophilus* collected with low frequency and never we collected *Dermacentor* species. The ticks of the genus *Ixodes* are the important vectors of Lyme borreliosis in Europe and America commonly collected in Iran with species *I.*

*ricinus* only in the Caspian Sea littoral area (Nabian et al. 2007, Rahbari et al. 2007a, Razmi et al. 2007). In our study *Ixodes* ticks were found with low frequency (1.3%). The most common ixodid tick vector of Human Granulocytic Ehrlichiosis (HGE) in Europe is *I. ricinus* (Rymaszewska and Grenda 2008). In a study by Bashiribod et al. (2004) in Ghaemshahr, 5.1% of all *I. ricinus* ticks examined by molecular methods was shown to be infected with *Anaplasma phagocitophilum* (Bashiribod et al. 2004). In a study by Hosseini Vasoukolaei et al. (2010) 49 out of 323 collected ticks were identified as *I. ricinus*, which is an important vector of tick-borne disease aforesaid and may be considered in the study area, need for further investigation (Hosseini vasoukolaei et al. 2010). In the study undertaken by Nabian et al. (2007) genus *Ixodes* was found with frequency 2.32% (Nabian et al. 2007). Several *Haemaphysalis* species were found in Iran. In the present study, *H. erinacei*, *H. sulcata*, *H. punctata* and *H. inermis* were collected from farm animals, in spite of only *H. erinacei* was reported in study of Hosseini Vasoukolaei et al. (2010) from North of Iran (Hosseini vasoukolaei et al. 2010). Rahbari et al. (2007) in a study completed in three geographical zone of Iran reported 6 species *H. punctata* (3.4%), *H. parva* (0.5%), *H. sulcata* (0.6%), *H. choldokovskyi* (1.7%) (now synonymized as *H. sulcata*), *H. concinna* (0.06%) and *Haemaphysalis* sp. (0.6%) but never reported *H. erinacei* and *H. inermis* (Rahbari et al. 2007b). Interestingly the latter species recorded by Telmadarraiy (2008) in South of Sari in Mazandaran Province (Telmadarraiy et al. 2008b). In respect of much *Haemaphysalis* are three host ticks thus they may be serve as competent vectors of different domestic ruminant thereupon human diseases. In the present work several *Hyalomma* including *Hy. dromedarii*, *Hy. marginatum*, *Hy. asiaticum*, *Hy. excavatum*, *Hy. anatolicum*, *Hy. detritum* were collected

at least in all studied geographical areas. Whereas in a series studies conducted by one of authors (ZT) from year 2004 to year 2010 in Yazd, Ilam, East and West Azerbaijan, Ardabil, Hamadan, Khorasan Jonoobi Provinces as well as South of Sari in Mazandaran Province (Telmadarraiy et al. 2004, Telmadarraiy et al. 2006, Telmadarraiy et al. 2008a, Telmadarraiy et al. 2008b, Nasiri et al. 2010, Salim abadi et al. 2010, Telmadarraiy et al. 2010) various *Hyalomma* species were recognized like present study. Also author with cooperation other (2007, 2009, 2010) studied ectoparasite of rodents including ticks as well as lesser mouse eared bat, *Myotis blyti* (Telmadarraiy et al. 2007a, Kia et al. 2009, Vatandoost et al. 2010b). It is necessary indicate which *Hyalomma* species has critical role for transmission of Crimean Congo Hemorrhagic Fever. With respect to which is three geographic continents including mountainous, littoral and plateau possess Golestan Province species diversity and the number of species found in mountainous, littoral and plateau area comprising 6, 2 and 10 species respectively. Otherwise following ticks genera and species collected respect to three aforesaid situation constitute *R. sanguineus* (69%) in mountainous and (93.5%) in littoral area which is more incident from other species. Beside *Hy. anatolicum* (47.9%) and *Hy. dromedarii* (29%) in plateau area were dominant species. Whereas in a study conducted in plateau area of Yazd Province *Hy. dromedarii* was more prevalent species (55.92 %) while *D. marginatus*, *Hy. marginatum* and *Hy. anatolicum* ticks were collected with very slightly frequency (Salim abadi et al. 2010). In another study directed in Esfahan Province *R. sanguineus* in mountainous and *Hy. anatolicum* in plateau areas were the most abundant ticks respectively (Noaman et al. 2008). It may be concluded that genera of *Rhipicephalus* and *Hyalomma* are as principal genera in mountainous and plateau area respectively. In the present study most of

tick species were collected from cattle, only *Hy. dromedarii* and *Hy. detritum* were found on camel. In addition *Hy. anatolicum* was predominant *Hyalomma* species obtained from cattle and the other tick genera and species including *H. sulcata*, *H. erinacei* (*Haemaphysalis*), *Hy. asiaticum*, *Hy. excavatum* (*Hyalomma*) and *Boophilus* (*Rhipicephalus*) *annulatus* only with low frequency collected from cattle host. Likewise the most number of species collected from two hosts camel and horse including *Hy. dromedarii* and *Hy. anatolicum* respectively.

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## References

- Abbasian-Lintzen R (1960) A preliminary list of ticks (Acarina: Ixodidae) occurring in Iran and their distributional data. *Acarologia* 2: 43–61.
- Bashiribod H, Kazemi B, Eslami G, Bigdeli S, Bandehpour M, Rahbarian N, Ramezani Z (2004) First molecular detection of *Anaplasma phagocytophilum* in *Ixodes ricinus* ticks in Iran. *J Med Sci*. 4: 282–286.
- Davoudi J, Hoghooghi Rad N, Golzar Adabi S (2008) Ixodid tick species infesting cows and buffaloes and their seasonality in West Azerbaijan. *Res J Parasitol*. 3: 98–103.
- Delpy LP (1936) Notes sur les Ixodidés du genre *Hyalomma* (Koch). *Ann Parasitol Hum Comp*. 14: 206–245.
- Filippova NA, Neronov VM, Farhang-Azad A (1976) Data on ixodid tick fauna (Acarina, Ixodidae) of small mammals in Iran. *Ent Obozr*. 55: 467–479.
- Hoogstraal H (1956) African Ixodoidea. I. Ticks of the Sudan (with special reference to Equatoria Province and with preliminary reviews of the genera *Boophilus*, *Margaropus* and *Hyalomma*. United State Navy, Washington DC.
- Hoogstraal H (1982) Bibliography of Ticks and Tick Borne Diseases from Homer (about 800 BC) to 31 December 1981. Special publication NAMRU-3 Medical Zoology Department, Cairo.
- Hosseini vasoukolaei N, Telmadarraiy Z, Vatandoost H, Yaghoobi Ershadi MR, Hosseini Vasoukolaei M, Oshaghi MA (2010) Survey of tick species parasiting domestic ruminants in Ghaemshahr country, Mazandaran Province, Iran. *Asian pac J Trop Med*. 3: 804–806.
- Kia EB, Moghddas-Sani H, Hassanpoor H, Vatandoost H, Zahabiun F, Akhavan AA, Hanafi-Bojd AA, Telmadarraiy Z (2009) Ectoparasites of rodents captured in Bandar Abbas, Southern Iran. *Iran J Arthropod-Borne Dis*. 3: 44–49.
- Maghami G (1968) External parasites of livestock in Iran. *Arch Inst Razi Hes*. 20: 81–83.
- Mazlum Z (1971) Ticks of domestic animals in Iran: geographic distribution, host relation, and seasonal activity. *J Vet Fac Univ The*. 27: 1–32 [In persian].
- Nabian S, Rahbari S, Shayan P, Haddadzadeh HR (2007) Current status of tick fauna in North of Iran. *Iran J Parasitol*. 2: 12–17.
- Nasiri A, Telmadarraiy Z, Vatandoost H, Chinicar S, Moradi M, Oshaghi MA, Salimabadi Y, Sheikh Z (2010) Tick infestation rate of sheep and their distribution in Abdanan county, Ilam Province, Iran, 2007–2008. *Iran J Arthropod-Borne Dis*. 4: 56–60.
- Nemenz H (1953) Ergebnisse der österreichischen Iran-expedition 1949/1950 Ixodidae. *S B Ost Acad Wiss Abt*. 162: 61–63.

- Noaman V, Abdigoudarzi M, Nabinejad AR, Heidari MR, Khalilifard M (2008) Identification of hard ticks of domestic ruminants in two ecological zones of Isfahan Province, Iran. Pajou and Sazan. 77: 88–95 [In Persian].
- Oliver JJ (1989) Biology and systematics of ticks (Acari: Ixodidae). Ann Rev Ecol Sys. 20: 397–430.
- Pervomaisky GS (1948) On the Ixodidae of Iran fauna. Trud Voenno Med Akad Krasnoi Armii. 44: 35–40.
- Pomerantzev BI (1950) Fauna of USSR Arachnida: Ixodid Ticks (Ixodidae). Academy of Sciences USSR, Moscow.
- Rahbari S, Nabian S, Shayan P (2007a) Primary report on distribution of tick fauna in Iran. Parasitol Res. 2(101 Suppl): S175–177.
- Rahbari S, Nabian S, Shayan P, Haddadzadeh HR (2007b) Status of *Haemaphysalis* tick infestation in domestic ruminants in Iran. Korean J Parasitol. 45: 129–32.
- Razmi GR, Glinsharifodini M, Sarvi S (2007) Prevalence of ixodid ticks on cattle in Mazandaran Province, Iran. Korean J Parasitol. 45: 307–310.
- Rymaszewska A, Grenda S (2008) Bacteria of the genus *Anaplasma*-characteristics of *Anaplasma* and their vectors: a review. Vet Med. 11: 573–584.
- Salari Lak S, Vatandoost H, Telmadarraiy Z, Entezar Mahdi R, Kia EB (2008) Seasonal activity of ticks and their importance in tick-borne infectious diseases in West Azerbaijan, Iran. Iran J Arthropod-Borne Dis. 2: 28–34.
- Salim abadi Y, Telmadarraiy Z, Vatandoost H, Chinikar S, Oshaghi MA, Moradi M, Mirabzadeh Ardakan E, Hekmat S, Nasiri A (2010) Hard ticks on domestic ruminants and their seasonal population dynamics in Yazd Province, Iran. Iran J Arthropod-Borne Dis. 4: 66–71.
- Service MW (2001) Encyclopedia of Arthropod-Transmitted Infections of Man and Domesticated Animals. CABI Publishing, New York.
- Sonenshine DE (1991) Biology of Ticks. Oxford University press, Oxford.
- Telmadarraiy Z, Bahrami A, Vatandoost H (2004) A Survey on fauna of ticks in west Azerbaijan Province, Iran. Iran J Public Health. 4: 65–69.
- Telmadarraiy Z, Davari A, Vatandoost H (2006) Ruminant animal ticks and their role in CCHF transmission in Ghaen, south Khorasan Province, Iran during 2005. ICOPA XI11th International Congress of Parasitology, 6–11 August 2006 Gelascoo
- Telmadarraiy Z, Moradi AR, Vatandoost H, Mostafavi E, Oshaghi MA, Zahirnia AH, Haeri A, Chinikar S (2008a) Crimean-Congo hemorrhagic fever: a seroepidemiological and molecular survey in Bahar, Hamadan Province of Iran. Asian J Ani Vet Adv. 3: 321–327.
- Telmadarraiy Z, Ghiasi SM., Moradi M, Vatandoost H, Eshraghian MR, Faghihi F, Zarei Z, Haeri A, Chinikar S (2010) A survey of Crimean-Congo hemorrhagic fever in livestock and ticks in Ardabil Province, Iran during 2004–2005. Scand J Infect Dis. 42: 137–141.
- Telmadarraiy Z, Vatandoost H, Mohammadi S, Akhavan AA, Abai MR, Rafinejad J, Kia EB, Naini FF, Jedari M, Aboulhasani M (2007a) Determination of rodent ectoparasite fauna in Sarpole-Zahab district, Kermanshah Province, Iran, 2004–2005. Iran Journal of Arthropod-borne Dis. 1: 58–62.
- Telmadarraiy Z, Nasirian H, Vatandoost H, Abuolhassani M, Tavakoli M, Zarei Z, Banafshi O, Rafinejad J, Salarielac S, Faghihi F (2007b) Comparative susceptibility of cypermethrin in *Ornithodoros lahorensis* Neuman and *Argas persicus* Oken (Acari: Argasidae) field populations. Pak J Biol Sci. 10: 4315–4318.



Telmadarraiy Z, Chinikar S, Shakeri MA, Vatandoost H, Faghihi F, Faghihi F, Moradi N, Ranjbar E, Motiei M, Hosseine Vasoukolaei N, Aboulhasani M (2008b) Crimean-Congo hemorrhagic fever: A seroepidemiological and molecular survey in Poshete-kooch of Sari, Mazandaran Province Iran. Tropical Medicine and Malaria. International Convention Center Jeju, Jeju Island, Korea. 29th September -03 October 2009

Vatandoost H, Telmadarraiy Z, Sharifi M, Moradi A, Kamali M, Taran M (2010a)

Ectoparasites of lesser mouse bat, *Myotis blyti* from Kermanshah, Iran. Asian Pac J Trop Med. 3: 371–373.

Vatandoost H, Telmadarraiy Z, Sharifi M, Moradi A, Kamali M, Taran M (2010b) Ectoparasites of lesser mouse bat, *Myotis blyti* from Kermanshah, Iran. Asian Pac J Trop Med. 3: 371–373.

Vathsala M, Mohan P, Sacikumar, Ramessh S (2008) Survey of tick species distribution in sheep and goat in Tamil Nadu, India. Small Rumin Res. 74: 238–242.