Faunistic Study of Hard Ticks (Ixodidae) of Domestic Ruminants in the Southern Khorasan-e-Razavi in Comparing with other Regions of the Province in 2012 Iran

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Abstract

Crimean-Congo fever is a hemorrhagic viral disease transmitted by ticks; however that it is a Zoonosis disease of both human and animals but it also is also a threat to human health. The disease is an endemic of African, European and Asian countries. The objective of this study was to determine the species and distribution of ticks infesting domestic ruminants in Gonabad city in one year and to determine tick species of CCHF vector to investigate also the treatment of the infested ruminants. This is a cross-sectional study performed in 2012 in cluster random sampling method in rural and urban areas of Gonabad city. The written informed consent was obtained from the owners of the ruminants. Hard ticks (Ixodidae) from three types of domestic ruminants (goats, sheep and cows) were carefully collected by sampling using forceps. Then the collected specimens were counted and preserved in alcohol 70% in glass vial and were shipped to laboratory for further studies. The determinations of ticks were performed by using a stereo-microscope (Zeiss) according to the identification keys. 612 ticks were collected during the summer, 6.4% from the goats, 3.7% from the sheep and 89.9% from the cows. 71.5% of the ticks were from Hyalomma anatolicum excavatum, 25.6% from Hyalomma anatolicum anatolicum and 2.7% from Hyalomma lusitanicum species. 57% of the ticks were females and 43% were males. Considering wide prevalence of Hyalomma species that is from the most important carriers of Crimean-Congo fever, surveillance programs in the villages or areas infested with the species is much necessary and then health care measurements should be considered for cattle slaughtering.

Keywords: Tick, hyalomma, khorasan, Iran.
Introduction

Ticks are small arachnids in the Ixodida order. Along with mites, they constitute the subclass of Acarina. Tick species are widely distributed around the world. The presence or absence of them is highly dependent on local microclimate conditions (Anderson and Magnarelli, 2008). However, they tend to flourish more in countries with warm and humid climate, since they require certain amount of moisture in the air to undergo metamorphosis, and for low temperatures, they inhibit their development from egg to larva (Nuttall, 1905).

Ticks are also ectoparasites (external parasites), or important ectoparasites in public and animal health that live by hematophagy on the blood of mammals, birds, and sometimes reptiles and also amphibians. The ectoparasites have broad geographic distribution, and can be found in all the regions of the world. The ectoparasites are also divided into four families namely: Ixodidae, Argasidae, Nutalliellidae and Laelaptidae. The first two families are the most important that are 878 species in total (Anderson and Magnarelli, 2008).

Ticks are vectors of some numbers of the diseases (Kakar, Kakarsulemankhel, 2008; Golzardi, 2006) and they transmit many dangerous diseases to human and animals therefore, they are a significant threat to animals and humans’ health (Walker et al., 2007). About 866 species have been identified in the world so far (Hooshmand-Rad and Hawa, 1973). Hyalomma anatolicum anatolicum is the most common tick vector of bovine and ovine tropicalileriosis and Crimean-Congo hemorrhagic fever in Iran (Khalaj et al., 2007).

The studies performed by the office of the UN Food Agriculture organization (FAO) show that approximately 80% of the 1.28 billion populations of the world’s cows are at risk of ticks’ bites (Raoult and Roux, 1999). The Ticks with transmitting different pathogenic agents such as: hemorrhagic fever, tick relapsing fever, fever of Crimean-Congo (CCHF), Botonoz (BF), Omsk hemorrhagic fever (OHF), Russian spring-summer encephalitis (RSSE), Colorado tick fever (CTF), Lyme disease, Rocky Mountain spotted fever (RMSF), Q fever, Babesiosis, Trylosis, Tularemia, and Tick paralysis are of special significance.

Hard ticks (Ixodidae) are distinguished from the soft ticks (Argasidae) by the presence of a scutum or hard shield. Both of Ixodidae nymphs and adults have a prominent capitulum (head) which projects forwards from the body. Hard ticks (Ixodida) are called hard ticks for the presence of that scutum or hard shield under their capitulum (head) (Parola and Raoult, 2001; Brumpt, 1935).

Both male and female ticks live through hematophagy (blood-feeding behavior) and they feed 0.5-2 ml blood in each bite. In the life cycle, larval ticks’ blood feeding is 3-5 days, nymphal 4-8 days and for the adult 5-20 days on their hosts and then they detach from the host after full feeding. Nymphal stage for hard tick is 1 and it is 8 stages for soft tick. The hard ticks mate once in their lifetime and or to say their life cycle takes at least one year to be completed and up to 2,000 to 20000 eggs are laid on the ground near ruminants’ stable. Hard ticks (Ixodida) live in three stages of development: one host, two hosts and three hosts. Initial research on biology and distribution of ticks in Iran started from 1810 A.D that Dupre conducted in Iran. Then, this study was continued by Razi and Pasteur institutes in Iran in collaboration with the faculty of veterinary medicine and school of public health of Tehran University.

Brumpt published an article on soft ticks of (Argasid) Ornithodoros genus in 1923. Then, Deplly, 1936; published an article in 1936 about hard tick genus from Hyalomma family. Mazloom also presented an article on geographical distribution and seasonal activity of ticks in Jahanbakhsh and Ardalan, 1971; (WHO, 2001; Ebadi, 2011). This study was also performed on some suspected cases of CCHF in the city of Gonabad, Iran to determine tick species, their distribution and the vectors of the disease in the city.

Materials and Methods

This study is a cross-sectional study. The cluster random sampling method was used in rural and urban areas of Gonabad city during two seasons...
of spring and summer in 2012. 10% of the animals were surveyed in each urban and rural area.

Field Study
Gonabad and Bajestan cities with an area of 10,000 km² are located at 34.35° North latitude, 58.68° East longitude and about 1098 meters altitude above the sea level with a hot and dry climate in Iran, its rainfall at the latest 20 years has been 140 mm in average and the cities are prone to tropical diseases prevalence including vector born diseases of arthropods due to neighboring to South Khorasan and Sistan Baluchistan provinces (Figure 1a, b).

Survey Animals
During the survey of tick fauna in 2010, visited 30 herds in different topographic and in three different geographical regions with emphasis on different climatic zones in the spring and summer (hot, dry, and rainy seasons), and in a situation where the majority of domestic ruminants were grazing. In each locality, herds were regularly inspected at least in two villages during each visit. In total, 30 flocks including 80 cattle, 200 goats, and 500 sheep were selected randomly and examined individually for tick infestation. Tick sampling was performed by examining the whole body including ears, abdomen, at the base of the mane, inside the tuft of the tail, and in inter-digital spaces, feet, pre-anal regions, milk gland area, and the back of the animal at different time intervals. The sampling was usually done early in the mornings. With Forceps sampling; hard ticks (Ixodidae) were collected after removing tick capitulum (head) from the ruminants' skin and care was taken enough to make certain that the capitulums were not left behind in the process of sampling. The collected specimens were counted and preserved in 70% ethanol in glass vial and transferred to laboratory date-labeled such as: (sampling location, type of ruminants, and collecting date) of ticks for further studies. The stable soils were also screened for collecting of ticks.

The information including location, type of animal, the numbers of ticks were recorded from each animal individually and the dates of collection were recorded on each label.

Tick Identification
The determination of ticks based on taxonomic and structural differences of the species and different sexes were performed by a stereo-microscope (Zeiss) according to the identification keys (Walker et al., 2007) and were counted and recorded in the related forms.

Fig. 1: Geographical location of collected Ticks in Gonabad city, Iran (a), Geographical location of Gonabad in Iran (b).

Ethical Considerations

The study was approved by the ethics committee of Gonabad University of Medical Sciences. The ruminants’ owners were informed of the study aims and that it is anonymous. Then, all of them agreed to participate willingly and voluntarily in the study. After all were informed of the study objectives and they were assured that the information would remain confidential, then, we performed the study.

Results

In total 612 ticks were collected from 5 rural areas and 1 urban area in Gonabad. The local distribution was as it is shown in Figure 1. The most collected ticks from cows’ body were 10 and 2 from goats and sheep’s body. The average environmental temperature was 35° c and the moisture was 35%.

The frequency of the collected ticks from the ruminants was 89.9% of the cattle, 6.4% of the goats and 3.7% of the sheep(Table1). 57% were females and 43% were male ticks(Table3). 6 of the collected female ticks were in gravid stage. The tick’s abundance or density showed a significant difference in different seasons of the year and the most numbers of the collected ticks were collected in August.

71.5% of the ticks were from Hyalomma anatolicum excavatum spiceman, 25.6% of Hyalomma anatolicum anatolicum, and 2.7% from Hyalomma lusitanicum. 34.8% of collected Hy.an.excavatum from cattle was male (Fig.3) and 36.7% were females (Fig.2) 11% of
Hy. an. anatolicum ticks were male (Fig. 5a) and 14.6 were females (Fig. 5b). The collected ticks from Hyalomma lusitanicum spiceman were 9% males and 1.8% females.

The number six villages surveyed, the highest, was collected from the village Marandiz, livestock was high, and the minimum number of the metropolitan area is Beidokht (Table1).

Was the highest, where fishing, cattle ticks in the groin, the sheep, the tail (3) and Goat, the ears (5), respectively (Table2). 70.4% ticks caught the cow was Hy. an. excavatum. The greatest abundance, Hy. an. anatolicum The cattle, and, less frequently, on the sheep (Table3).

A survey was carried out to investigate the frequency of hard tick species (Acari: Ixodidae) on sheep in Khorasan Razvi province. A total of 812 ticks were collected from the sheep of different areas of Khorsan azavi province and five species were identified as follows: Rhipicephalus turanicus (59.23%), Hyalomma marginatum turanicum (25.73%), Hyalomma excavatum (14.8%), Hyalomma anatolicum (8.3%), and Dermacentor niveus (4.8%). The frequency of tick infestation in southern parts was greater than in northern parts of the province. R. turanicus and H. m. turanicum were dominant ticks in the province.

<table>
<thead>
<tr>
<th>Regions</th>
<th>Beimoreh</th>
<th>Mohammadabad</th>
<th>Beidokht</th>
<th>Zibad</th>
<th>Marandiz</th>
<th>Motrabad</th>
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<td>9</td>
<td>4</td>
<td>14</td>
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<td>7</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Goat</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>9</td>
<td>4</td>
<td>14</td>
<td>34</td>
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<tr>
<th>Collected area</th>
<th>Ruminants</th>
<th>Ear</th>
<th>Mammals</th>
<th>Perineum</th>
<th>Groin</th>
<th>Tail</th>
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<tr>
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<tr>
<td>Goat</td>
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<td>28.6%</td>
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<table>
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<th>Species hard Tick</th>
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<td>Hy. an. excavatum</td>
<td>Cattle</td>
<td>Sheep</td>
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<tr>
<td></td>
<td>M</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>38</td>
</tr>
<tr>
<td>Hy. an. anatolicum</td>
<td>Cattle</td>
<td>Sheep</td>
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<tr>
<td></td>
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<td>11</td>
</tr>
<tr>
<td></td>
<td>F</td>
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<tr>
<td>Hy. lusitanicum</td>
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</tr>
<tr>
<td>Total</td>
<td>98</td>
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</table>

Abundance, ticks, caught in the spring and summer, there was a significant difference, and was most abundant in the summer month Agu (Fig6).
The Hyalomma ticks species with worldwide spreading are observed in Africa, India and Asia. Tick belongs to the big family of Ixodidae and it was reported for the first time in 1844 by Koch (Koch, 1844). At present Hyalomma has 3 subgeniuses Hyalomma, Hyalommina and Hyalommasta. Hyalomma lusitanicum is a very characteristic tick with a combination of exceptionally large punctuations and white enamel on the legs. The enamel may also be visible on the scutum and conscutum (Walker et al., 2007).

It is larger and more robust in appearance than Hyalomma anatolicum anatolicum and Hyalomma detritum detritum which occurs in the same areas. Hyalomma lusitanicum is more similar to Hyalomma anatolicum excavatum but it has very short lateral grooves and the central festoon is not often visible. Hyalomma marginatum rufipes is also large as Hy. lusitanicum but is distinguished by having dense setae around the spiracles. Hyalomma lusitanicum has been reported as a field vector in Spain of Theileria annulata protozoa, causing theileriosis in cattle. The tick also transmits the bacterium Coxiella burnetii to human causing Q fever (Walker et al., 2007).

Hyalomma anatolicum excavatum is closely similar to Hy. a. anatolicum. Since the females are very similar, it is important to compare the males with females to separate these two sub-species. The males of Hy. a. excavatum have a distinctive depressed area in the posterior scutum with steep sides. They have a distinctive formation of the festoons such that the paracentral festoons are joined anteriorly to form an arch; also the central festoon is pale. The close similarity of the two sub-species has caused some confusion in naming of the anatolicum complex and binominal names like Hy. anatolicum and Hy. excavatum occur in the literature. Cattle, sheep, goats, camels, horses and donkeys are the hosts of adult Hy. a. excavatum. Hyalomma a. anatolicum is adapted to areas of Mediterranean and steppe climates of North Africa and to steppe and desert climates elsewhere in its extensive range in two continents. In Africa, it ranges from Ethiopia across into North Africa where it occurs in Algeria, Libya and Egypt. It extends as far south as northern parts of central Sudan, but it does not appear to be well established in south of the Sahara. It is also found in other parts of the Mediterranean basin and Turkey and extends eastwards into the Middle East, Southern Russia, Iran, India and China (Hoogstraal, 1956).

The ruminants (goat and sheep) are mainly grassing animals in farming areas or pastures in spring and summer time that are from important factors of tick infesting. Ruminants’ entrance also from the areas in which tick abundance is more prevalent, such as Sistan Baluchistan province and

![Graph showing the frequency of collected ticks based on month in 2012.](image)
neighboring countries such as Afghanistan can be effective in tick prevalence in the city of Gonabad. Kaiser and Hoogstraal, 1963; conducted a study on the fauna of Hyalomma ticks in Afghanistan. Mondal et al., (1995) conducted a survey in Bangladesh on ticks and the study showed highly abundance of Hyalomma tick over there. Yukari and Umur (2002). did a study on species of ticks in Turkey and found different species of Hyalomma on cattle, sheep and goats. Even though limited studies have been performed in Khorasan-e-Razavi province on hard ticks (Ixodidae), but the kinds of tick species had not been paid attention and considered in these two cities. In a study performed in Khorasan-e-Razavi province on sheep’s ticks, 5 species of R. turanicus, H.m.turanicum, H. excavatum, H. anatolicum and D. niveus were diagnosed in north and south of the province that H.m.turanicum tick had the most abundance in the southern cities (Razmi et al., 2011). In Rahbari et al., (2007) study conducted on hard ticks in 4 different geographical regions of Iran, he reported Hyalomma schulzei, Hyalomma dromedarii, Hyalomma a. an, H.a. excavatum and Hyalomma detritum from Khorasan province that most of its area was located in desert area.

For this purpose, a total of 426 tick specimens were collected from 217 infested camels in southeastern of Iran during the activity seasons of ticks (April 2009 to March 2010). The collected species from camel were Hyalomma dromedarii (84.7%), Hyalomma marginatum (8.7%), Hyalomma anatolicum excavatum (5.4%), and Hyalomma anatolicum anatolicum (1.2%) (Fard et al., 2012).

Many research have been performed on hard tick (Ixodida) especially Hyalomma ticks species. A total of 2388 cattle and 442 shelters from two provinces (Elazig and Malatya) endemic for tropical theileriosis in the east of Turkey were studied for Hyalomma tick populations from July 1993 to July 1995 in Elazig and from May 1998 to January 1999 in Malatya. Four thousands, five hundred and eighty one (4580) of 7455 Hyalomma ticks were collected from cattle; the other ticks (2874) were collected from shelters. All of the ticks collected from shelters were Hyalomma anatolicum anatolicum. Two thousands, eight hundred and ninety five (63.1%) of 4581 Hyalomma ticks collected from cattle were H.a. anatolicum. 23.8% (1047/4581), 11.7% (536/4581) and 0.6% (3/4581) of Hyalomma ticks were Hyalomma anatolicum excavatum (Aktas et al., 2008). Most of the studies performed are in accordance with our studies and have reported the tick species, its prevalence and ruminants’ infestation.

A survey was carried out to investigate the prevalence of hard tick species (Acari: Ixodidae) on cattle and sheep in southeastern of Iran. A total of 972 ticks were collected from 280 infested cattle and 1,207 ticks were collected from 632 infested sheep during activating seasons of ticks in Nabian and Rahbari (2008). The species collected from cattle were Hyalomma marginatum marginatum (50.92%), Hyalomma anatolicum excavatum (25.61%), Hyalomma anatolicum anatolicum (8.12%), Hyalomma asiaticum asiaticum (1.85%), and Rhipicephalus sanguineus (13.47%) while the species collected from sheep were R. sanguineus (36.37%), H. marginatum marginatum (30.65%), H. anatolicum excavatum (19.05%), H. asiaticum asiaticum (10.52%), Hyalomma detritum (3.14%), and Dermacentor marginatus (0.24%). The results show that, H. marginatum marginatum, H. anatolicum excavatum, and R. sanguineus are dominant tick species in the surveyed area (Dehaghi et al., 2011).

Another study was carried out to determine the status of tick infestation of cattle in the Kayseri region in Turkey. Eight hundred and sixty-six cattle and their barns in 12 localities were examined during the period of June 2000-November 2001, where 188 (21.7%) of which were infested by ticks. A total of 1,585 ticks consisting of Rhipicephalus turanicus (2.27%), R. bursa (2.14%), R. sanguineus (0.94%), Hyalomma marginatum (17.16%), H. anatolicum excavatum (24.73%), H. a. anatolicum (19.62%), Dermacentor niveus (1%), Boophilus annulatus (16.71%), Ornithodorus lahorensis (0.25%), Hyalomma sp (Ica et al., 2007).

The study showed that tick infestation was present in cattle, sheep and goats in Gonabad region, the tick species differ according to the season. Since the sub-species of collected tick were vector of Crimean-Congo fever disease in the region, then it is recommended to perform
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serological studies on infection of domestic animals to disease virus in this city. Considering also the summer time, animals' farmers are necessarily advised to spray ruminants stable once or twice depending on the type of available acaricide and the ruminants in the region should be passed through the dip for treatment.

Acknowledgements

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References


