Veterinaria Italiana, 2012, **48** (2), 185-191

Investigations into Ixodidae ticks in cattle in Lahore, Pakistan

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Summary

A total of 2 160 cattle, comprising adults and calves of exotic, crossbred and indigenous breeds, were examined for tick infestation between 1996 and 2000. Of these, 1 417 (65.6%) were infested with ticks, with a total of 220 (61%) from exotic breeds, 262 (72%) were crossbred and 172 (48%) were indigenous adult cattle. Calves of exotic, crossbred and indigenous breeds were infested with ticks at the following rates: 246 (68%), 294 (82%) and 223 (62%), respectively. Higher infestation levels were noted with *Rhipicephalus microplus* which affected 912 (64.3%) animals, in comparison to *Hyalomma anatolicum anatolicum* which affected 302 (21.3%). *Rhipicephalus* infestation was more extensive than that with genus *Hyalomma.*

Keywords

Hyalomma anatolicum anatolicum, Infestation, Lahore, Pakistan, *Rhipicephalus microplus*, Tick.

Indagini sulle infestazioni da Ixodidae nel bestiame a Lahore, Pakistan

Riassunto

Tra il 1996 e il 2000 sono stati sottoposti a controlli per le infestazioni da zecche 2.160 capi di bestiame, tra cui bovini adulti e vitelli di razze esotiche così come di razza mista e autoctona. I capi adulti risultati infestati rispetto al campione totale erano 1.417 (65,6%), di cui 220 (61%) appartenenti a razze esotiche, 262 (72%) di razza mista e 172 (48%) di razza indigena. I tassi di infestazione nei vitelli erano i seguenti: 246 (68%) per le razze esotiche, 294 (82%) per la razza mista e 223 (62%) per la razza indigena. Le infestazioni più prevalenti erano causate dalla specie Rhipicephalus microplus *che ha infestato 912 (64,3%) capi rispetto alla specie* Hyalomma anatolicum anatolicum *che ha infestato 302 (21,3%) capi. Nel complesso l'infestazione da* Rhipicephalus *è risultata più diffusa di quella della specie* Hyalomma.

Parole chiave

Hyalomma anatolicum anatolicum, Infestazione, Lahore, Pakistan, *Rhipicephalus microplus*, Zecca.

Introduction

Tick infestation is a serious problem in animals and inflicts significant economic losses among livestock in terms of outbreaks of tick-borne diseases, decreased production and reduced working efficiency of affected animals (19). In countries like Pakistan and India, ticks surpass all arthropods in number and variety of diseases they transmit to humans and domestic livestock (17). Ticks belonging to the genera *Rhipicephalus* and *Hyalomma* are of great importance. *Rhipicephalus microplus* is a common and prevalent one-host tick of cattle which acts as a vector of bovine anaplasmosis and babesiosis. *Hyalomma anatolicum anatolicum* is a three-host tick and acts as a vector of bovine theileriosis in cattle (21). *Hyalomma* is considered an important vector of some

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diseases caused by arboviruses. One of these is Crimean-Congo haemorrhagic fever (CCHF), caused by the CCHF virus that causes considerable concern among public health authorities in Pakistan (26). These diseases pose a major threat to the livestock industries of almost all developed and developing countries, thus confirming the importance of ticks and tick-borne diseases. This study was conducted to record the most important species of the two genera in exotic, crossbred and indigenous cattle.

Materials and methods

Cattle herds maintained on various government and private livestock farms in and around the Lahore District were examined for the purposes of this study. These farms had a previous history of outbreaks of babesiosis and theileriosis. A total of 2 160 cattle were selected, comprising 360 animals of each class of exotic, crossbred and indigenous (adults and calves) breed. Individual animals were examined carefully for tick infestation on different parts of the body including the ears, neck, dewlap, inner and outer thighs, udder, inside lips of vulva and under the base of tail to determine both the preferential points of attachment of ticks and their instars, and their number on the different hosts. The ticks from infected animals were collected and preserved in 70% ethanol for taxonomic studies with the help of different keys described by Wall and Shearer (25). Age and species preference were also noted. To study the age-related susceptibility of animals to infection by different instars of ticks, 360 cattle of each class and the same number of calves of each breed were observed throughout the study period. A total of 360 exotic *Bos* (Friesian), 360 crossbred *Bos* and 360 indigenous *Bos,* were observed to study the selective preference of ticks for these species.

Statistical analysis

Data collected was subjected to statistical analysis using the test developed by Steel and Torrie (22).

Results and discussion

Tick infestation was observed in 61% of exotic adult cattle, 72% in adult crossbred cattle and 48% in adult indigenous cattle. Among the calves, 68% exotic, 82% cross bred and 62% indigenous were infested with ticks. The data showed that among the adult cattle, the crossbred herd was infested more than the exotic species while the indigenous species were the least susceptible. Statistical analysis revealed that a significantly higher susceptibility rate was observed in exotic and crossbred cattle than indigenous species and calves of all species showed higher susceptibility than their adult counterparts. Solomon and Kaaya (20) also compared the resistance in three breeds of cattle against African Ixodidae ticks and reported that the local Arsi breed showed the highest level of tick resistance, compared to Boran × Friesian. Wakelin (23) observed that natural resistance to a variety of vectors and vector-borne micro-organism is found in ruminants and this resistance varies with the breed. Mangold *et al.* (15) reported that exotic and crossbred animals are the least resistant to tick infestation. Ashfaqe *et al.* (4) recorded that crossbred calves showed high levels of tick infestation. Similarly, Kumar *et al.* and L'Hostis *et al.* (13, 14) worked on young stock of different breeds and found that calves were the preferred hosts.

The higher prevalence of ticks in exotic and crossbred animals might be due to their thinner and softer skin, compared to indigenous species which have a thicker skin. Another important factor might be the resistance acquired by indigenous species. Resistance to ticks differs according to breed of cattle (7, 9) and to tick species (8). Resistance to the one-host ticks, *R. microplus*, is proportionally related to the amount of zebu (*Bos indicus*) genes in the breed (6, 18). The magnitude of losses due to these parasites is related to an extent to the degree of resistance of the breed. Tick resistance in a certain breed might vary with the species of infesting ticks (3). The primary immunological host-parasite interface occurs at the skin of the host. In trypanosome infection, the cellular skin reaction has been considered important for immunological priming (2). Skin response to intradermal injection of tick extracts has also been proposed as a method to assess the resistance to ticks in cattle (24). More extensive skin reactions occur in the more resistant animals (11). Moreover, inflammatory cells present at the level of the skin level following a tick bite are believed to be the first effective immune defence to reduce the inoculation rate of tick-transmitted micro-organisms (27).

The host's inflammatory skin response is considered to be a factor which can alter other biological traits of the tick' lifecycle, such as egg hatching, larval and nymphal moulting rates (1, 28). Furthermore, host grooming, stimulated by histamine, is responsible for tick removal (12). On bovine skin, higher concentrations of histamine are found in cattle that are resistant to ticks, in comparison to cattle that are more susceptible to ticks (28). It has been postulated that differences in the capacity to an mount immune response exist among cattle breeds and this might play a significant role in the development of tick resistance (10). The cellular immune response appears to be more effective and stable in modulating resistance to ticks than humoral immunity (16). Keeping the above facts in mind, host-tick resistance can be exploited successfully in cattle breeding programmes as a means which could contribute to the biological control of tick infestation.

Tick infestation was found to be different on the different parts of the body. In adult *Bos* species 460 (43%) *R. microplus* adults and instars were observed on the dewlap, udder, inner and outer thighs whilst *H. a. anatolicum* was observed on the udders of 194 (18.1%) animals. In *Bos* calves 151 (14%) *Hyalomma* adults and instars were observed on the ears, neck, inside thighs and inside lips of vulva while *R. microplus* adults and instars were found on 612 (57%) calves.

The above data showed that the predilection sites of both species were the relatively softer parts of the body; however, site preferences of both species were found to differ from each other (Table I). This parameter proved useful in the rough identification of both genera. The colour of the *R. microplus* male was a yellowish brown. Its body was small, ovate and had a distinct protuberance at the posterior end. The scutum was yellow to yellowish brown and elongated. The eyes were small and inconspicuous. The genital aperture was at coxae II. The adanal shields were long and terminated with a small spur on the postero-median edge. The legs were moderate in size and become thicker from leg I to leg IV. The basis capituli was hexagonal and the posterior margin was straight. The colour of specimens was bluish yellow in females. The scutum was subtriangular and widest at the anterior third. The eyes were distinct and the genital aperture was at coxae II. Two posterior spurs were

Table I
Predilection sites of *Hyalomma anatolicum anatolicum* and *Rhipicephalus microplus* in different hosts

Infested host	Tick species found on host	Predilection sites	No.	Percentage
Bos adult (Friesian, crossbred and indigenous) (*n* = 360 each)	*Hyalomma anatolicum anatolicum* (larvae, nymph, adult)	Udder	194	18
	Rhipicephalus microplus (larvae, nymph, adult)	Dewlap, udder, inner & outer thigh	460	43
Bos calves (Friesian, crossbred and indigenous) (*n* = 360 each)	*Hyalomma anatolicum anatolicum* (larvae, nymph, adult)	Ear, neck, inside thigh and inside lips of vulva	151	14
	Rhipicephalus microplus (larvae, nymph, adult)	Neck, dewlap, inner and outer thigh	612	57

separated by a deep cleft and the basis capituli hexagonal (Figs 1 A & B).

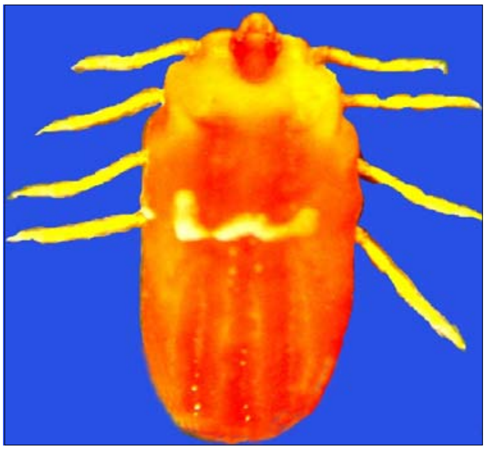
Males of *H. a. anatolicum* were reddish brown and the scutum was a dark reddish brown. It was elongated and oval in shape. The cervical groove was short and shallow, while the lateral groove was short and sometimes distinct. The eyes were circular with deep sockets. The legs were slender and a pale yellow brown. The capitulum had a quadrangular basis capituli narrowing at the posterior end. The body colour of female *Hyalomma* ticks was a yellowish brown to brown. The scutum was slightly longer than wide and was narrowly rounded at the posterior end. Cervical grooves had deep parts that became shallow and extended to postero-lateral margins. The eyes were prominent, circular and had deep sockets. The genital aperture was at coxae II. The operculum was round, knob-like and bulging. The apitulum was long and slender, with the posterior margin of the basis straight (Figs 2 A & B).

Conclusions

Of 360 adults of each class studied, 133 (60.4%) exotic adults were found to be infested by *R. microplus*, 20 (9.1%) by *H. a. anatolicum* and 67 (30.4%) with both. In crossbred adults, 192 (73.2%) were infested by *R. microplus*, 64 (206%) by *H. a. anatolicum* and 16 (6.1%) with both, whilst in indigenous adult cattle 54 (31.3%) were infected with *H. a. anatolicum*, 98 (56.9%) with *R. microplus* and 20 (11.6%) with both.

In exotic cattle calves, the *R. microplus* infestation level was found to be 193 (78.4%), *H. a. anatolicum* 36 (14.6%) and 17 (6.9%) with both, while in crossbred cattle calves, the

A. Dorsal view (2 mm)



B. Ventral view (2 mm)

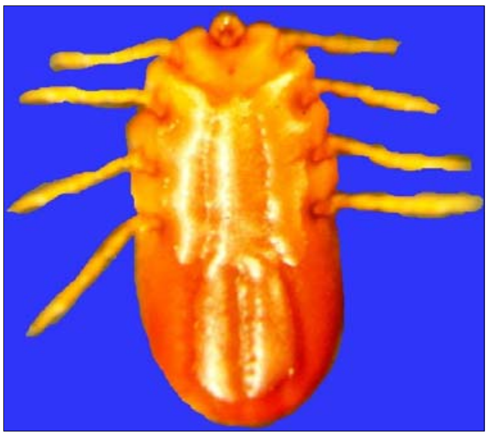
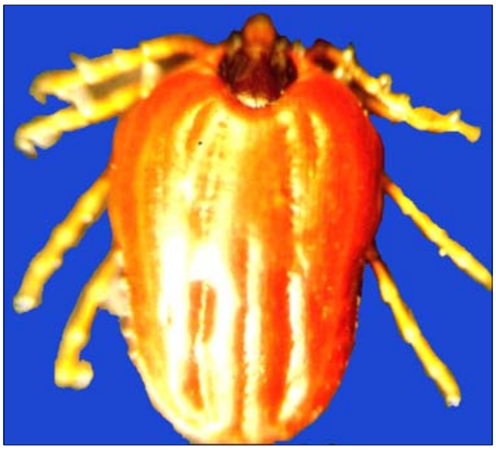


Figure 1
Female *Rhipicephalus microplus*

A. Dorsal view (1.8 mm)



B. Ventral view (1.8 mm)

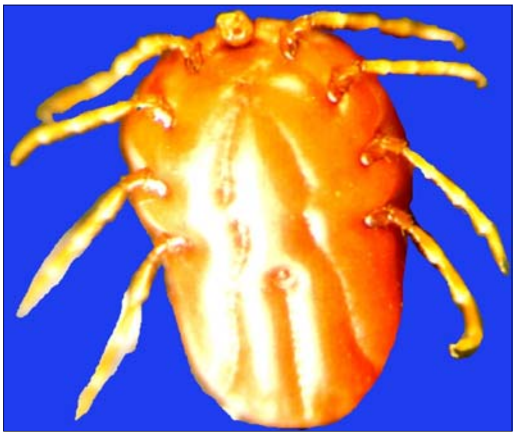


Figure 2
Female *Hyaloma anatolicum anatolicum*

infestation level was found to be (85%) with *R. microplus*, (8.1%) with *H. a. anatolicum* and (6.8%) with both. Indigenous cattle calves infested with *R. microplus* was 90 (40.3%), 70 (31.2%) with *H. a. anatolicum* and 63 (28.2%) with both (Table II). The data showed that the infestation of *R. microplus* was relatively more common in the exotic and crossbred cattle, compared to the indigenous species which were infested more with *H. a. anatolicum* revealing the preference of *R. microplus* for exotic and crossbred species and the preference of *H. a. anatolicum* for indigenous species.

A significantly higher infestation rate with *R. microplus* was observed in exotic adult and crossbred adults compared to indigenous cattle. All calves showed a relatively higher infestation rate of *R. microplus* compared to *H. a. anatolicum*. (Table III). The present findings concur with the studies conducted by Bhagerwal *et al.* (5) who recorded higher percentages of *R. microplus*.

We also observed that with the increase of temperature and humidity, the tick infestation levels also increased accordingly. During the study period from May to September, there was, on the whole, a rise in mean temperature from 34.6°C to 39°C, whilst the humidity increased from 50% to 84%. From October to April, there was fall in the mean temperature from 34°C to 19°C, while the humidity increased from 51% to 86%. The mean percentage infestation range of *H. a. anatolicum* in *Bos* was found to range between 02% and 16% from May to September in study period while infestation from October to April was 07% to 0%. The mean percentage infestation of *R. microplus* in *Bos* was found to vary from 44% to 70% between May and September whilst

Table II
Tick preference for different hosts

Host infected (*n* = 360)	Infested with tick species					
	Hyalomma anatolicum anatolicum		*Rhipicephalus microplus*		Mixed	
	No.	%	No.	%	No.	Percentage
Exotic (adult)	20	9.1	133	60.4	67	30.4
Crossbred (adult)	54	20.6	192	73.2	16	6.1
Indigenous (adult)	98	56.9	54	31.3	20	11.6
Exotic (calves)	36	14.6	193	78.4	17	6.9
Crossbred (calves)	24	8.1	250	85.0	20	6.8
Indigenous (calves)	70	31.3	90	40.3	63	28.2
Total	302	–	912	–	203	–

Table III
Tick infestation in adults and calves

Host infected	Infested with ticks	
	No.	Percentage
Exotic adult (*n* = 360)	220	61[(a)]
Crossbred adult (*n* = 360)	262	72[(a)]
Indigenous adult (*n* = 360)	172	48
Exotic calves (*n* = 360)	246	68[(b)]
Crossbred calves (*n* = 360)	294	82[(c)]
Indigenous calves (*n* = 360)	224	62[(a)]

a) $p<0.001$
b) $p<0.05$
c) $p<0.01$

infestation from October to April ranged between 48% and 11%. The differences of temperature and humidity between May and September are indications of the optimum climatic conditions for the ticks as maximum infestation of the animals took place during these months (Table IV).

Table IV
Effect of mean maximum and minimum temperature and mean humidity on tick population

Month	Temperature		Humidity		*Rhipicephalus microplus* infestation *Bos* (*n* = 1 00)		*Hyalomma anatolicum anatolicum* infestation *Bos* (*n* = 1 800)	
	Max.	Min.	Max.	Min.	No.	Percentage	No.	Percentage
January	19.0	7.1	85.8	51.6	273	15	32	2
February	22.1	10.9	78.8	43.3	284	16[NS]	39	2[NS]
March	27.2	15.2	71.1	38.8	423	24[(a)]	77	4[(a)]
April	33.6	20.3	56.6	27.6	860	48[(b)]	134	7[(b)]
May	38.8	25.0	50.6	24.8	911	51[(b)]	237	13[(b)]
June	39.0	27.2	65.1	40.0	786	44[(b)]	261	15[(b)]
July	35.5	27.5	82.6	61.6	1 259	70[(b)]	294	16[(b)]
August	33.8	26.3	83.8	60.0	1 218	68[(b)]	123	7[(c)]
September	34.6	24.5	81.1	52.0	718	40[(b)*]	75	4[NS]
October	31.3	18.0	79.6	46.5	398	22[NS]	28	2[NS]
November	27.6	13.2	82.3	53.3	197	11[NS]	19	1[NS]
December	23.0	8.5	66.3	52.3	222	12[NS]	–	–

NS not significant
a) $p<0.05$
b) $p<0.001$
c) $p<0.01$

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