



# A Survey for Ixodid Ticks of Domestic Goats *Capra hircus* (Linnaeus, 1758) in Baghdad City, Iraq with Notes on Important Identification Characters

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**Abstract** | The domestic goat *Capra hircus* is considered an important economic animal throughout Iraq. The ixodid ticks are obligate ectoparasites that resulted in serious harm to the animal host. They parasitize the head, the ears, the inside of limbs, and the belly. Examination of 276 domestic goats for ixodid ticks in Baghdad city collected during the period between January to June 2019 showed that infestation prevalence was 24.64% with a significant difference in prevalence between male and female goats according to the statistical analysis. The results revealed the presence of *Hyalomma anatolicum*, *H. turanicum*, *Rhipicephalus (Boophilus) annulatus*, *R. sanguineus*, and *R. turanicus*. The tick species *R. turanicus* was the most frequently recovered off goats (81.64%). The identification characters for each species were provided.

**Keywords** | *Capra hircus*, Domestic goat, Ixodid ticks, *Hyalomma*, *Rhipicephalus*

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## INTRODUCTION

The domestic goat *Capra hircus* Linnaeus, 1758 is an important economic animal throughout Iraq. It is believed that this animal was domesticated in the Zagros Mountains, the eastern border of Iraq around 10000 ya (Zeder and Hesse, 2000) with relatively good resistance to the adverse conditions (Alkass, 2012). According to data related to 1999, there were 1.3 million goats raised in Iraq (Magid et al., 2003). This animal is raised mainly for its milk and meat (Juma and Alkass, 2005).

Ixodid ticks are hematophagous obligate ectoparasites which resulted in serious harm to the animal host. They are exophilic organisms and seek the host outdoors. They parasitize the head, the ears, the inside of limbs, the abdomen, and the perianal regions (Dimanopoulou, 2017).

From the human health point of view, ticks represent

important ectoparasites because they act as the arthropod vectors, transient, reservoirs of different disease agents that threat man and domestic and wild animals health (Hashemi-Fesharki et al., 1994; Cumming, 1998; Fritz, 2009; Bursali et al., 2010; Adang et al., 2015; Liyanaarachchi et al., 2015; Pavlović et al., 2016; Banafshi et al., 2018). This process is controlled by the chances of the encounters between susceptible hosts and the infected ticks and also by the tick prevalence in the environment (Fritz, 2009). The free street-wandering herds of goats are not uncommon and are known to feed on garbage within Baghdad city. Moreover, weekly Friday's animal markets are well known to the Baghdadi's. This situation puts the goat-ticks and their potential pathogens in close contact with the people living nearby.

Some previous studies on tick fauna of domestic animals in Iraq dealt with tick parasites of domestic goats including (Hoogstraal and Kaiser, 1958; Robson and

Robb, 1967, 1968a, b, c, 1969a, b, c; Shamsuddin and Mohammad, 1988; Abdul-Rassoul and Mohammad, 1988; Mohammad, 1996; Tuama et al., 2007; Muhaidi and Alkubaisy, 2010; Hasson and Al-Zubaidi, 2012; Zangana et al., 2013; Shubber et al., 2014; Mohammad, 2015, 2016). These studies were carried out either in rural areas and/or suburban regions in different parts of Iraq but none in Baghdad city.

The present work deals with the determination of species spectrum, prevalence, and intensity of the ixodid ticks that parasitize the domestic goats in street-wandering herds, local animal markets and abattoirs in Baghdad city.

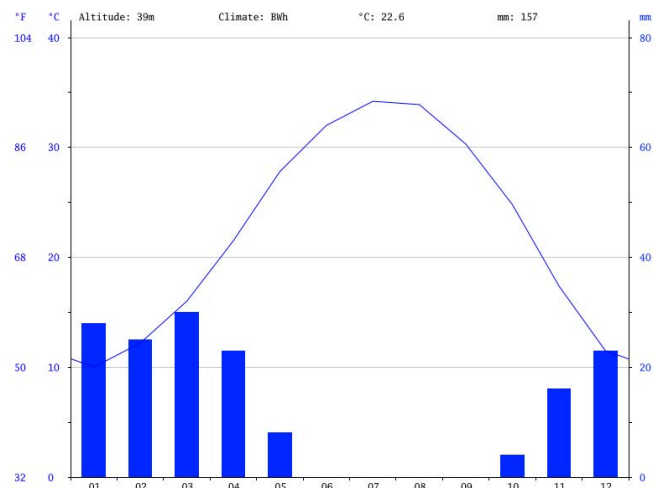
## MATERIALS AND METHODS

### STUDY AREA

Baghdad city is the capital of the Republic of Iraq, located in the Tigris alluvial plain in central Iraq and lies on 39 m asl. The coordinates are: 33° 18' 46.0980" N and 44° 21' 41.3568" E (Figure 1). Its climate is generally hot and arid receiving 100-175 mm of rain annually between November and March. The temperature touches 50°C during the summer. According to (NCCI, 2015) average high temperatures: 15.5°C (January) to 44°C (July), and average low temperatures: 3.8°C (January) to 25.5°C (July). The mean annual temperature of Baghdad city is 22.6 °C. This climate is considered to be a hot desert climate (BWh) (Figure 2) according to the classification of Köppen-Geiger (Climate-Data.org, 2019).



**Figure 1:** Map of Iraq showing the situation of Baghdad city in central Iraq.



**Figure 2:** The climate chart of Baghdad city showing monthly mean temperature (continuous line) and precipitation (bars). (from Climate-Data.org, 2019).

### TICK SAMPLING

A total of 276 goats (108 males and 168 females) were examined for ixodid ticks in Baghdad city during the period between January to June 2019. The main sources of the animals are street-wandering herds, the animal markets, and the abattoirs in Baghdad city. The recovered ticks were carefully removed by hand with the aid of a forceps and cotton rinsed in methyl alcohol, examined under dissecting microscope, cleaned from the debris and the remaining host tissue, transferred into plastic vials contain 70% methyl alcohol for preservation and labeled including host name, place of collection, date of collection, and infestation location on the animal.

### TICK IDENTIFICATION

Adult ticks identification to a species level was determined by the authors using the identification keys provided by (Mohammad, 1996; Apanaskevich, 2013; personal communication; Shubber, 2014). The immature ticks (larvae and nymphs) of *Hyalomma anatolicum* and *Rhipicephalus turanicus* were identified to the specific level following Snow (1971) and Ioffe-Uspensky (1997) respectively, while the species identity of *Rhipicephalus annulatus* by its unique shape and structure of the head. The important identification traits of the species reported in the present study are presented in Table 1 which is mainly quoted from Dr. Dmitry A. Apanaskevich, Assistant Curator and Associate Professor, United States National Tick Collection, The James H. Oliver, Jr. Institute for Coastal Plain Science, Georgia Southern University, Statesboro, Georgia, U.S.A. in a personal communication on Jan. 21<sup>st</sup>, 2013 based on Iraqi specimens sent to him by the first author.

### STATISTICAL ANALYSIS

The results of tick infestation in male and female goats were

analyzed with the Pearson Chi-Square test, and Microsoft spps  $\chi^2$ .

## RESULTS AND DISCUSSION

The present study can be distinguished from other tick studies carried out in Iraq in that it is the first study devoted to tick fauna that parasitizes only domestic goat *Capra hircus* restricted to urban settlements of Baghdad city.

Ixodid tick infestation has a clear effect on livestock performance including host fitness, transmission of TBDs, and allergies which contribute to animal wasting and weak. These factors affect milk and meat production in livestock (Eskezia and Desta, 2016). Growth retard and weight loss are frequently documented consequences (Abdallah and Mustafa, 2018).

Table 2 shows that the number of tick-infested goats was 68 (28 males and 40 females). Total infestation prevalence was 24.64%. The number of recovered ticks was 305 comprising 160 males, 118 females, 20 nymphs, and 7 larvae. The present infestation prevalence is comparable to 20.28%, 22.72% reported by Hasson and Al-Zubaidi (2012) and Shubber et al. (2014), respectively but is widely different from 53% and 56.3% of Muhaidi and Alkubaisy (2010) and Mohammad (2016), mainly because these studies were carried out in vast rural areas in the middle and south of Iraq. The type of the environment in which present collection was done, is a highly transformed urban environment due to the socio-demographic activities within Baghdad city. Rizzoli et al. (2014) and Kowalec et al. (2017) highlighted the effect of biotope transformation in cities on host infestation with ticks.

Prevalence of tick infestation (Table 2) in female goats (40 of 276: 14.49%) is higher than in males (28 of 276: 10.15%). Kabir et al. (2011) and Gopalakrishnan et al. (2017) found the same result and attributed the cause to differences in immune status and the management system. Stresses of pregnancy and lactation may represent another cause. Statistical analysis for the tick infestation data of male and female goats showed a significant difference in tick prevalence between the two sexes of domestic goats ( $\chi^2=305.000a$ , P value = 0.000 > 0.05). However, it is found that 28 out of 108 (25.93%) of males and 40 out of 168 (23.81%) of females were infested with ticks. Statistical analysis with Chi square spps test revealed significant differences at P=0.05. Gopalakrishnan et al. (2017) reported a same situation without giving any explanation for this sex bias. It may be related to smaller sample size of males compared to females in the present study.

The mode of infestation is; single 54, double 14. This result

contradicts with Shamsuddin and Mohammad (1988) who found common mixed infestations on domestic animals in natural habitats of Iraq. This denotes the impact of environmental modification.

The intensity was calculated to 4.49 ticks per goat. This is rather far from 1.4 of Robson and Robb (1967), 16.6 of Robson et al. (1968b), and 6.8 of (Mohammad, 2016). These wide differences because of sampling from widely different habitats within Iraq.

Table 3 shows the results on the tick's infestation sites on the goat body. It would show that the ear represents 86.56% of total cases followed by belly (7.21%), testes (3.61%), and udder (2.62%). Statistical analysis using  $\chi^2$  showed significant differences between ear and belly infestation locations in male and female goats (P value=268 at 0.05 level). This is in agreement with Fatemian et al. (2018) who examined domestic goats in two Iranian cities.

In the present study, five species of ticks were recovered from the domestic goat (Table 2 and Figure 3). They are; *Hyalomma anatolicum*, *H. turanicum*, *Rhipicephalus annulatus*, *R. sanguineus* and *R. turanicus*. This tick fauna resembles those reported earlier in Iraq, including Robson and Robb (1967) and Robson et al. (1968b). The absence of *R. turanicus* from Iraqi literature before 1988 is because, as suggested by Shamsuddin and Mohammad (1988), that it was misidentified with the closely related *R. sanguineus* and many earlier records of *R. sanguineus* were actually *R. turanicus* which infests both wild and domestic animals.

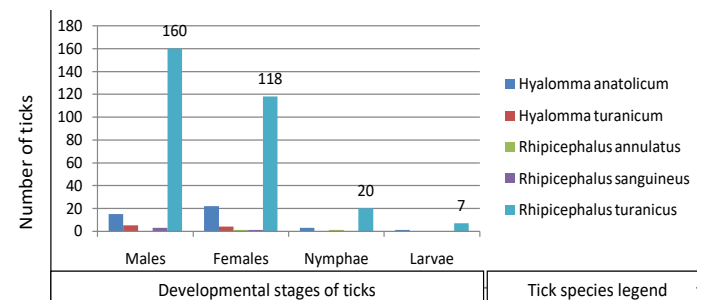


Figure 3: A histogram comparison of domestic goat infestation with 5 species of ixodid ticks including numbers of males, females, nymphs, and larvae.

*Rhipicephalus turanicus* is the most frequent species with prevalence of 81.64% (Table 2). This result is in accordance with the findings of Hasson and Al-Zubaidi (2012) and Mohammad (2016) in Iraq and also with Diab et al. (1987) and Alanazi et al. (2018) in neighboring Saudi Arabia. This species is of medical and veterinary importance in transmitting *Bartonella* spp., *Coxiella burnetii* and *Rickettsia* spp. (Ioffe-Uspensky, 1997; Satta et al., 2011) or as a vector of babesia, theileria, rickettsia, and Q fever (Alanazi et al., 2018).

**Table 1:** The important identification traits of tick species recorded in this study.

Tick species	Traits of male tick	Traits of female tick
<i>Hyalomma anatolicum</i>	Small, pale, narrow and the legs often poorly pigmented. It is with straight adanal plates.	With broad U-shaped genital aperture with strongly bulging preatrial fold. Legs have rather reticulated coloration.
<i>Hyalomma turanicum</i>	Scutum quite densely punctated, long marginal grooves, numerous setae around spiracular plates, legs with incomplete dorsal spots, and rings.	Broad U-shaped genital aperture with strongly bulging preatrial cuticular fold, numerous setae around the spiracular plate, legs with incomplete dorsal spots, and rings.
<i>Rhipicephalus annulatus</i>	Hypostome and palp short, festoons absent, and eyes rather difficult to see.	Hypostome and palp short, festoons absent.
<i>Rhipicephalus sanguineus</i>	The dorsal prolongation of the spiracular plates is thin and the adanal plates are narrow without median denticle.	The dorsal prolongation of the spiracular plate is thin and the genital aperture is broad U-shaped.
<i>Rhipicephalus turanicus</i>	The dorsal prolongation of the spiracular plate is thick, and the adanal plates are narrow with median denticle.	The dorsal prolongation of the spiracular plate is thick and the genital aperture is narrow.

**Table 2:** Tick species, sex, number of goat hosts, and tick phase-host association.

Tick species	Host sex	no. of infested goats	% infested host	No. Male ticks	No. Female ticks	No. Nymphs	No. Larvae	Tick total no.	% of total
<i>Hyalomma anatolicum</i>	Male	2	0.72	8	4	0	0	12	3.934
	Female	6	2.17	7	18	3	1	29	9.508
	Total	8	2.89	15	22	3	1	41	13.44
<i>Hyalomma turanicum</i>	Male	1	0.36	3	2	0	0	5	1.639
	Female	2	0.72	2	2	0	0	4	1.311
	Total	3	1.08	5	4	0	0	9	2.95
<i>Rhipicephalus (Boophilus) annulatus</i>	Male	2	0.72	0	1	1	0	2	0.656
	Female	0	0	0	0	0	0	0	0
	Total	2	0.72	0	1	1	0	2	0.656
<i>Rhipicephalus sanguineus</i>	Male	1	0.36	3	1	0	0	4	1.31
	Female	0	0	0	0	0	0	0	0
	Total	1	0.36	3	1	0	0	4	1.31
<i>Rhipicephalus turanicus</i>	Male	22	7.97	57	38	8	3	106	34.754
	Female	32	11.59	80	52	8	3	143	46.885
	Total	54	19.56	137	90	16	6	249	81.64
Total		68	24.64	160	118	20	7	305	

**Table 3:** Distribution of males, females, nymphae and larvae of tick infestation on domestic goat body.

Infestation site	Male ticks		Female ticks		Nymphal ticks		Larval ticks		Total tick number			% of total ticks recovered
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀	
Ear	59	86	38	68	7	6	-	-	104	160	264	86.56
Belly	10	3	3	1	-	3	-	2	13	9	22	7.21
Testes	1	-	1	3	2	1	3	-	7	4	11	3.61
Udder	-	1	2	2	1		2	-	5	3	8	2.62
Total	70	90	44	74	10	10	5	2	129	176	305	100

*Hyalomma anatolicum* is one of the key species infesting livestock throughout Iraq (Robson et al., 1969a, b; Shamsuddin and Mohammad, 1988). It represents 16.06%

of the total number of ticks. This result agrees with the findings of (Banafshi et al., 2018; Muhaidi and Alkubaisy, 2010; Mohammad, 2015) but in disagreement with

(Shubber et al., 2014) who found this species ranked first. It may be attributed to the fact that *R. turanicus* infests both wild and domestic animals while *H. anatolicum* infests domestic animals only. This tick species is known to be one of the vectors of Theileriosis and Babesiosis in Iraq (Hooshmand-Rad and Hawa, 1973; Tarish, 1982; Hadi and Al-Amery, 2012).

*Hyalomma turanicum* comprises 2.95% of the total tick number. This result differs from 6% reported by (Mohammad, 2016) for the same host because his specimens were collected from diverse rural sites in the middle and south of Iraq. It infests a wide range of hosts in Iraq (Hasson, 2012; Shubber et al., 2014; Mohammad, 2016; Shanan et al., 2017). Jalil and Zenad (2016) found it contributes to the transmission of bacterial pathogens to their hosts.

The cattle tick *Rhipicephalus annulatus* comprises 0.66% of total tick number. This result agrees with Robson et al. (1969c), Tuama et al. (2007) and Mohammad (2016). It was reported from a wide range of domestic animals (Mohammad, 2016). The present finding may be understood in view that this species often preferred cattle hosts, hence the name "cattle tick". It should be put in mind also that the local animal markets are crowded with a large number of livestock. This situation allows the accidental transfer of ticks between different animal species regardless of whether it could establish infestation or not. Jalil and Zenad (2016) suggested that this tick engages with bacterial transmission to their hosts.

Three males and one female of *Rhipicephalus sanguineus* representing 1.31% of the total tick number (Table 2) were recovered from only one male goat. This figure is different from 6.53% of Banafshi et al. (2018) in goats from the Iraq-Iran border area. The two studied areas are completely different habitats from urban settlement to a wild rural area. Ioffe-Uspensky (1997) mentioned that this tick is a vector of rickettsial diseases. Monfared et al. (2015) pointed out that it transmits *Anaplasma* sp., *Rickettsia rickettsii*, *Coxiella burnetii*, *Ehrlichia* sp., and *Leishmania infantum*. Otranto et al. (2019) found that this tick is responsible for *Hepatozoon canis* and *Babesia* spp. infections in domestic and wild carnivores in Iraq.

## CONCLUSION

The tick fauna of the domestic goat freely wandering in Baghdad city comprised two genera *Hyalomma* and *Rhipicephalus* and five species *H. anatolicum*, *H. turanicum*, *R. (Boophilus) annulatus*, *R. sanguineus*, and *R. turanicus*. *Rhipicephalus turanicus* was the most prevalent tick species. The preferred attachment site for ticks was the ears, followed by the belly, and then testes or udder. Results on

prevalence were attributed to collection sites which are highly transformed urban environments.

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## AUTHORS CONTRIBUTION

The authors contributed equally to the manuscript, but the concept of the present work was suggested by Professor Mohammad K. Mohammad.

## CONFLICT OF INTEREST

The authors have declared no conflicts of interest.

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