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INCIDENCE, SPECIES AND ATTACHMENT SITES OF IXODIDAE TICKS IN CATTLE, SHEEP AND GOATS IN ALGERIA

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Abstract

A four-month survey was carried out to study the incidence and intensity of Ixodidae on cattle, goats, and sheep brought to the slaughterhouse in the municipality of Tadjenanet, in north-eastern Algeria. Of the 448 animals examined, 67 (14.95 %) were infected by one or more ticks. Two hundred sixty-two ticks were collected, and nine species grouped under two genera were inventoried: Rhipicephalus spp. (79.77%) and Hyalomma spp. (20.23%). The tick species collected included Hyalomma anatolicum, Hyalomma excavatum, Hyalomma impeltatum, Hyalomma lusitanicum, Hyalomma marginatum, Hyalomma scupence, Rhipicephalus (Boophilus) annulatus, Rhipicephalus bursa, and Rhipicephalus sanguineus. This is the first time that Hyalomma impeltatum have been reported in the Mila region. The most abundant species was Rhipicephalus bursa (40.84%). The present study provides primary data on the status of ticks in domestic ruminants in the province of Mila.

Key words*: incidence, Ixodidae, sheep, abattoir, Mila, Algeria.*

INTRODUCTION

Ticks are considered a high risk to human and animal health due to their significant role in transmitting pathogens such as bacteria and viruses (Parola & Raoult, 2001). Worldwide, there are more than 900 species of ticks, of which more than 79% are hard ticks (Guglielmone et al., 2014). In Algeria, the presence of 14 species of hard ticks has been counted (Walker, 2003). Several studies on the hard tick species distribution in different regions of Algeria (Yousfi-Monod & Aeschlimann, 1986; Boulkaboul, 2003; Benchikh-Elfegoun et al., 2007; 2014; 2018; 2019; Bouchama & Benia, 2020; Derradj & Kohil, 2021). Also, to detect various pathogens carried by these species of ticks (Leulmi et al., 2016; Boucheikhchoukh et al., 2018; Abdelkadir et al., 2019; Kebbi et al., 2019; Rahal et al., 2020). Either directly or indirectly, significant livestock losses due to the TBD (tick-borne disease) that can be limited to three aspects: (1) deaths; Cordier and Menager (1940) estimated that, without treatment, lethality following a clinical case of tropical theileriosis ranged from 50 to 100 percent, (2) the cost of treatment; theilericide therapy in an adult has been estimated at 100 DT/animal (62 euros) or at least 250,000 DT (dinar Tunisian)/year (155,000 Euros) for the total cases in Tunisia (Darghouth, 2004), and (3); impact on production; Minjauw and McLeod (2003) estimated milk losses at 8.9 ml of milk for every female engorged. Tick control depends mainly on sound knowledge of tick-borne disease epidemiology, relying primarily on chemical therapy and vaccination (Benchikh-Elfegoun et al., 2014). Chemical control remains ineffective due to the poor use by breeders due to their educational level (Gharbi, 2006). Despite all these studies mentioned above, which are considered few given the size of Algeria, the lack of interest in the scientific community, on the other hand, there is only one article, in the state of Adrar (South-West Algeria) concerning animals prepared for slaughter (Bouhous et al., 2011). However, most of the previous studies did not consider the biodiversity of the tick fauna of north-eastern Algeria and comparing the different categories of animals (bulls, sheep, and goats) has not been thoroughly studied to treat and control them appropriately. The key to disease control programmes must be based on sound knowledge of the regional phenology of

ticks and the epidemiology of their transmitted infections (Benchikh-Elfegoun et al., 2014; Gharbi, 2006). Based on this approach, the aims were to give a good idea of the level of tick spread and therapeutic abilities applied by farmers since most of these animals, which are destined for slaughter, especially calves, are well-taken care of, to provide an overview of hard tick diversity, to determine, and compare the incidence and intensity of infestations on domestic animals in the municipal slaughterhouse of Tadjenanet, province of Mila, north-eastern Algeria.

MATERIALS AND METHODS

Study area

The province of Mila (Figure 1), located in the northeast of Algeria, comprises approximately three climate stratus; humid climate zones in the north; the central state climate ranges from sub-humid to semi-arid, and the south is semi-arid, where summers are hot and dry, winters are cold and humid. The Tadjenanet area is located in the south of the state, belonging to the upper plateaus.

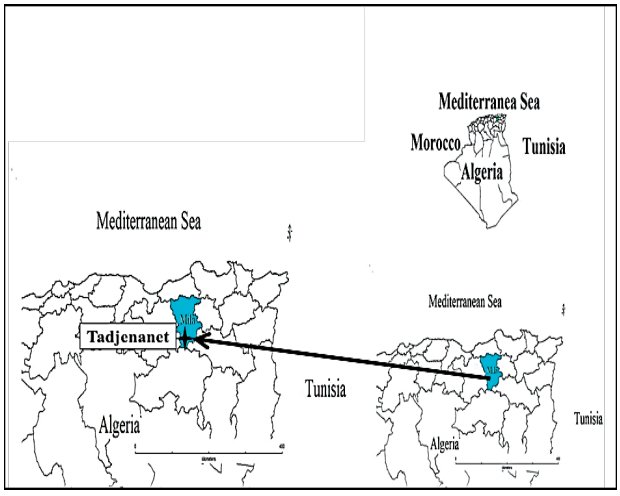

Figure 1. The geographical location of Tadjenanet, Mila Province, northeast Algeria (source; DIVA-GIS)

Animals and collection of ticks

From May 2020 (late spring month) to August 2020 (summer), the outputs for this study were conducted daily except on Mondays and Fridays as a holiday for workers, and the beginning of August coincided with Eid al-Adha, the bigger Eid, which occurs after the yearly Hajj pilgrimage is completed, at the time of Qurbani (sacrifice). Although Eid-ul-Adha has no direct connection to the Hajj Pilgrimage, it is just a day after Hajj is completed and hence has historical significance. Once the animals enter the slaughterhouse, they were carefully previewed to find the adult tick (premortem or post-mortem). Here, all the slaughtered cattle were males considering that Algerian law prohibits the slaughter of cattle females. During this study, 448 animals were examined; cattle (n = 70), goats (n = 196) and sheep (n = 182) of different age groups, breeds and sexes were considered in this study. Information about the animals (type, age and sex) and the site attachment of ticks was collected from each animal. The ticks were collected in labelled vials containing 70% ethanol and identified under the stereomicroscope using the key of Walker (2003).

Statistical analysis

All data were exported to an Excel® spreadsheet for Windows® to estimate species frequency, infestation incidence and intensity averages for females, males in livestock, epidemiological indicators (Bush et al., 1997) as follows:

Infestation incidence (percentage) = 100 × (number of infested animals/number of examined animals)

Tick infestation intensity = the number of ticks/the number of infected animals

The chi-square test was used to compare incidences between males and females as a function of the month, while comparisons of tick infestation intensities, incidences between animals (cattle, goats and sheep) and attachment sites were performed using the ANOVA test with a cut-off value of 0.05 for both tests (Schwartz, 1993).

RESULTS AND DISCUSSIONS

Overall tick infestation

A total number of 262 ticks were collected between spring (May) and summer (June, July, and August) 2020 from 70 (15.62%) cattle (100% males), 196 (43.75%) goats and 182 (40.63%) sheep (Table 1). These ticks belong to 2 genera, namely *Rhipicephalus* spp. (n =

209; 79.77%) and *Hyalomma* spp. (n = 53; 20.23%) and 9 species namely, *Rhipicephalus annulatus* (formerly *Boophilus annulatus*) (n = 9; 3.44%), *Rh. bursa* (n = 107; 40.84%), *Rh. sanguineus* (n = 93; 35.5%), *Hy. anatolicum* (n = 4; 1.53%), *Hy. excavatum* (n = 1; 0.38%), *Hy. impeltatum* (n = 1; 0.38%), *Hy. lusitanicum* (n = 5; 1.91%), *Hy. marginatum* (n = 8; 3.05%) and *Hy. scupense* (n = 34; 12.98%) ($P < 0.001$) (Table 1).

During the study period, a continuous presence of the two types was observed of *Rh. bursa* and *Rh. sanguineus*. Animals examined in August showed a particular infestation pattern, where only the sheep were infested. Indeed, *Rh. bursa* was present in all animals. The same pattern as *Rh. bursa* was observed for *Rh. sanguineus* except in July for cattle. Of the 448 animals examined in this study, 67 were infested (incidence = 14.96% with an intensity of 3 ticks per animal).

A statistically significant association was observed in this study between tick incidence and males and females of sheep and goats during May and June, and only sheep in July ($P < 0.05$). Similarly, a statistically significant association was observed between tick intensity and males, females of sheep and goats only during May and June ($P < 0.05$). No statistically significant association was observed between the incidence and intensity of infestation in animals (cattle, sheep and goats) according to the month ($P > 0.05$) (Table 1). Compared to previous months; the attachment was statistically significantly higher in the ears than in other locations only in sheep (Table 2).

Infestation rate of *Rhipicephalus* ticks

In May and June, goats are more infested than sheep. During June and July all sheep females are infested, whereas only sheep are infested at a shallow rate in August. *Rh. bursa* has been widespread, and the incidence of tick infestation peaks in June on goats males, while *Rh. sanguineus* peaks in goats males in May. *Rh* (*Boophilus*) *annulatus* was absent in June and August. The average intensity was 3 ticks per animal. The highest values were observed in May, especially in goats (Table 1).

***Hyalomma* ticks**

Four species of *Hyalloma* spp.; *Hy. marginatum*, *Hy. lusitanicum*, *Hy. anatolicum* and *Hy. scupense* were found infesting only cattle. *Hy. excavatum* and *Hy. impletatum* were found in goats only in June. Only one *Hy. scupense* specimen was present infesting the cattle in July, with an intensity of 0.5 ticks per bull. 32 *Hy. scupense* ticks collected in cattle in June represent the high infestation rate during this study (Table 1).

Tick infestation rate according to the site of attachment

Two hundred sixty-two ticks were collected from different parts of the body of the animals. Most ticks were found to attach to the entire body surface, mainly on the ears in goats and sheep, while in cattle was the testicles (Table 2).

During this study, nine species of ticks were identified by examining 448 animals. The number of ticks (262 ticks) is lower than the animals examined (448 animals). The same observation was reported in the slaughterhouse of Adrar in the southwest of Algeria (Bouhous et al., 2011). This result is mainly justified because these animals, especially cattle, receive control permanently against ticks. *Hy. impeltatum* and *Rh. sanguineus* were reported for the first time in this region, according to Benchikh-Elfegoun et al. (2014). The results obtained in this study are entirely in accordance with those carried out by Benchikh-Elfegoun et al. (2014) in the same region and with Boulkaboul (2003) in Tiaret Province (Semiarid climate). A statistically significant association was observed in this study between tick incidence and males and females of sheep and goats during May and June, same results being reported by Lihou et al. (2020). All existing ticks are vectors of pathogens where: *Rh. bursa* is the vector of babesiosis in *Babesia bigemina*, and *Babesia bovis* (Walker et al., 2003), *Rickettsia massiliae*, *Anaplasma ovis*, '*Candidatus Rickettsia barbariae*' (Sadeddine et al., 2020b), *Coxiella burnetii* (Abdelkadir et al., 2019); *Coxiella*-like DNA was detected in 81% (26/32) of *R. bursa* (Rahal et al., 2020). *R. bursa* was detected from June 2002 to May 2003, in Taher region (Jijel province) (9.35%)

(Benchikh-Elfegoun et al., 2007), and in Constantine at rate of 22.8% (Benchikh-Elfegoun et al., 2019). This hard tick species; *Rh*. *bursa* is a cosmopolitan tick; in Morocco, this tick was found with a rate of 19.22% (1326/6899) in cattle (Laamari and Kharrim, 2012).

Table 1. Incidence and intensity of adult hard ticks of domestic animalsin Tadjenanet, Mila, north-eastern Algeria

	May					**June**				
Animals category	**Cattle**	**Goat**		**Sheep**		**C**	**G**		**S**	
Species (n; %) Animals	**M**	**M**	**F**	**M**	**F**	**M**	**M**	**F**	**M**	**F**
***Rh. annulatus* (9; 3.44)**	0	1	1	0	0	0	0	0	0	0
***Rh. bursa* (107; 40.84)**	0	14	14	6	0	5	35	4	4	2
***Rh. sanguineus* (93; 35.5)**	0	40	5	9	0	9	9	3	1	9
***Hy. anatolicum* (4; 1.53)**	0	0	0	0	0	4	0	0	0	0
***Hy. excavatum* (1; 0.38)**	0	0	0	0	0	0	0	1	0	0
***Hy. impeltatum* (1; 0.38)**	0	0	0	0	0	0	1	0	0	0
***Hy. lusitanicum* (5; 1.91)**	0	0	0	0	0	5	0	0	0	0
***Hy. marginatum* (8; 3.05)**	0	0	0	0	0	8	0	0	0	0
***Hy. scupense* (34; 12.98)**	0	0	0	0	0	32	0	0	0	0
Tick number (262)	0	55	20	15	0	63	45	8	5	11
Animals examined (448)	15	37	34	18	14	20	37	29	15	6
Animals infested (67)	0	8	3	3	0	7	9	6	3	6
Incidence, %	0	21.62	8.82	16.67	0	35	24.32	20.69	20	100
Overall incidence (14.95)	0	15.39	9.37		35		22.72		42.85	
Intensity (ticks/animal)	0	6.88		5	0	9	5	1.33	1.67	1.83
Overall intensity (3.91)	0	6		5		9	3		1	

	July					**August**				
Animals category	**C**	**G**		**S**		**C**	**G**		**S**	
Species Animals sex	**M**	**M**	**F**	**M**	**F**	**M**	**M**	**F**	**M**	**F**
Rh. annulatus	6	1	0	0	0	0	0	0	0	0
Rh. bursa	0	4	6	11	1	0	0	0	0	1
Rh. sanguineus	0	0	1	5	1	0	0	0	0	1
Hy. anatolicum	0	0	0	0	0	0	0	0	0	0
Hy. excavatum	0	0	0	0	0	0	0	0	0	0
Hy. impeltatum	0	0	0	0	0	0	0	0	0	0
Hy. lusitanicum	0	0	0	0	0	0	0	0	0	0
Hy. marginatum	0	0	0	0	0	0	0	0	0	0
Hy. scupense	2	0	0	0	0	0	0	0	0	0
Tick number	8	5	7	16	2	0	0	0	0	2
Animals examined	19	29	20	55	9	16	5	5	40	25
Animals infested	4	3	2	9	2	0	0	0	0	2
Incidence, %	21.05	10.34	10	16.36	22.22	0	0	0	0	8
Overall incidence	21.05	10.2		17.8		0	0		3.07	
Intensity (ticks/animal)	2.00	1.67	3.5	1.78	1	0	0	0	1	
Overall intensity	2	2		1		0	0		1	

Table 2. Number of adult hard ticks with respect to site of attachment on domestic animals in Tadjenanet (May, June, July, and August 2020)

	Ears	Eyes	Testicles	Anus	Back	Mammals
			Site of attachment			
			Goat			
May	5	0	0	1	0	0
June	6	0	4	1	0	0
Jully	1	0	2	1	1	1
August	0	0	0	0	0	0
Total	**12**	**0**	**6**	**3**	**1**	**1**
			Sheep			
May	1	0	0	0	0	0
June	5	0	2	1	0	0
Jully	7	0	0	0	0	0
August	2	0	0	0	0	0
Total	**15**	**0**	**2**	**1**	**0**	**0**
			Cattle			
May	0	0	0	0	0	0
June	0	0	2	0	0	0
July	0	1	1	0	0	0
August	0	0	0	0	0	0
Total	**0**	**1**	**3**	**0**	**0**	**0**

Rh. (*Boophilus*) *annulatus* (3.43%) is the vector of *Babesia bigemina* and *Babesia bovis* in cattle. It was described in 2011 in Ivory Coast (less than 5%) (Madder et al., 2011). In Algeria, several pathogens as *Theileria annulata*, '*Candidatus Ehrlichia urmitei*', *Theileria buffeli* and *Anaplasma platys* were detected in *Rh*. *annulatus* (Sadeddine et al., 2020), *Rickettsia*-positive (Boucheikhchoukh et al., 2018). *Rh*. *sanguineus* reported at 26.6% (Benchikh-Elfegoun et al., 2019) was also identified in Spain at 0.5% (Toure et al., 2014). In Algeria, *Rickettsia massiliae* and *Anaplasma ovis* were detected in this species (Sadeddine et al., 2020b), *Coxiella*-like DNA was detected in 61% (11/18) of *Rh*. *sanguineus* (Rahal et al., 2020). In this study, *Hy*. *scupense*, a tick that transmits several pathogens such as *Theileria annulata*, was identified in arid regions, particularly in the north. These results are consistent with recent papers (Yousfi-Monod Aeshilmann, 1986; Gharbi et al., 2013; Gharbi and Darghouth, 2014; Benchikh-Elfegoun et al., 2018; Benchikh-Elfegoun et al., 2019). *Coxiella*-like DNA was detected in (1/4) of *Hyalomma scupence* (Rahal et al., 2020). It was detected *Rickettsia*-positive (Boucheikhchoukh et al., 2018). DNA of *Ri*. *aeschlimannii* was detected in 6/20 (30%) *Hyalomma scupence* (Leulmi et al., 2016). *Hyalomma excavum* was also identified in our study; *Coxiella*-like DNA was detected in 36% (8/22) of *Hyalomma excavatum* (Rahal et al., 2020), it is a tick that can host *Rickettsia aeschlimannii*, *'Candidatus Rickettsia barbariae'* and *Coxiella burnetii* (Abdelkadir et al., 2019). This tick was identified in sheep as a vector of *Theileria lestoquardi* in Tunisia (Rjeibi et al., 2016). *Hyalomma anatolicum* was reported in Iran at 38.83% (Biglari et al., 2018). In Iraq, 50 ticks collected from cows were characterised by PCR. The result shows the presence of *Hyalomma anatolicum* (Al-Fatlawi et al., 2018). In Turkey, a study by Aktas showed that 2895 ticks were identified as *Hyalomma anatolicum* and that 11.3% of male ticks and 22.4% of female ticks were positive in *Theileria* (Aktas et al., 2004), and DNA of *Ri*. *aeschlimannii* was detected in 6/20 (30%) *Hyalomma anatolicum* (Leulmi et al., 2016). *Hy*. *impeltatum* is expanding its geographical repartition in Algeria since it was found in the sub-humid region (Guelma) (Derradj et al., 2019; data not published), in Adrar southwest of Algeria (Bouhous et al., 2011). For this tick, it is essential to note that this is the third report from north-eastern Algeria with the detection of *Rickettsia aeschlimannii* in this tick species (Sadeddine et al., 2020). In Tunisia, Bouattour et al. (2000) described it in arid and desert areas. It was also identified in Sudan by Um El Hassan Mustafa in 1983 as the vector of *Theileria annulata*. *Hy. impeltatum* is mainly present in Mediterranean regions, steppes and deserts (Walker, 2003). Other studies are needed to answer what factors could explain its expansion in Algeria. *Hyalomma marginatum* and *Hyalomma lusitanicum* are widespread in the Mediterranean climate (Walker et al., 2003). *Coxiella*-like DNA was detected in (1/3) of *Hyalomma lusitanicum*, in 14% (4/28) of *Hyalomma marginatum* (Rahal et al., 2020). *Hyalomma marginatum* host *Rickettsia aeschlimannii* (Abdelkadir et al., 2019). Benchikh-Elfegoun already described it in 2019 at 11% and 3.9% for *Hy*. *lusitanicum*. The results show that it is abundant in the humid

region (Jijel), but a few specimens were collected in both the sub-humid (Guelma) and semi-arid (Mila) regions (Derradj et al. in 2019; data not published). Their infestation incidences are higher in the humid area (Jijel) and the sub-humid region (Guelma). Both species were reported in previous studies (Benchikh-Elfegoun et al., 2007; 2014; 2019). During this study, the preferred attachment site of tick is the ears which can be explained that the ears touch the ground during grazing. The ears (interior face) provide a good micro-climate for ticks, such as ventilation, temperature, easy access to blood. The presence of ear tags increased infestation rates by larval ticks on mice by 50 to 100% (Ostfeld et al., 1993). Grooming ability, host size, hair length, and possibly other factors may dictate where ticks attach and remain. Dogs ' ears are an essential attachment site for larval lone star ticks, based on the numbers of larvae attached, also cattle ears are similarly attacked (Koch, 1982).

CONCLUSIONS

This study is the first to investigate the diversity of hard ticks on domestic animals in the municipal slaughterhouse of Tadjenanet in the province of Mila, in the northeast of Algeria. A high incidence and intensity was recorded during June, also sheep are the most infested domestic animals during this study. We recommended the utilization of acarcide in/around ears. The study provided new information on hard ticks and domestic animal infestation rates that determine their distribution in north-eastern Algeria. The results suggest that this approach could also be helpful to help control programmes in this region.

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