Influence of temperature on the attachment of *Rhipicephalus sanguineus* ticks on rabbits

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**INTRODUCTION**

The impact of climate on the vector’s behaviour of the worldwide brown dog tick, *Rhipicephalus sanguineus*, is a cause of concern. This tick has become the most widespread tick throughout the world due to its specialised feeding on domestic dogs. In addition to the dog’s pathogens, *Babesia canis* and *Ehrlichia canis*, *Rh. sanguineus* is known to transmit two life-threatening rickettsial diseases to humans, Mediterranean spotted fever (MSF) caused by *Rickettsia conorii* in the old world, and Rocky Mountain spotted fever (RMSF) caused by *Rickettsia rickettsii* in America [1]. *Rh. sanguineus* also transmits *Rickettsia massiliae*, a worldwide emerging pathogen with a single documented case of infection [2].

*Rh. sanguineus* lives in peridomestic environments shared with dogs but is known to have a low affinity for humans, particularly in temperate countries. Hosts other than dogs are usually only infested when dogs are present to maintain a tick population. However, in 2003, 22 *Rh. sanguineus* were found attached to an alcoholic homeless person who died of MSF in Marseille. This heavy infestation was associated with the highest summer temperatures noted in France during the past 50 years [1]. Also, the cases of MSF recognised in Oran, Algeria, in 1993 peaked in 2005 together with the hottest summer of the past decades [3]. More recently, maximum temperature levels during the previous summer were associated with increases in MSF incidence in Sardinia [4]. In this work we have tested the influence of increased temperatures on the attachment of *Rh. sanguineus* larvae, nymphs and adult ticks on a rabbit, an unusual host.

**MATERIALS AND METHODS**

We used colonies of uninfected *Rh. sanguineus* ticks originating from southern France that have been maintained in our laboratory in an incubator at 25°C with 80% relative humidity since 2004 [5]. The same rabbit is used for a maximum of three blood meals of *Rh. sanguineus*, whatever the stage. For all stages (100 larvae, 80 nymphs and 20 adults), two batches were used. One was maintained the night before the test at room temperature (25°C; group 25), and the other was maintained at 40°C for 4 days before the test (group 40). The relative humidity (80% RH) was the same for both groups with a day/night photoperiod of 16:8 (L:D) h. Two New Zealand White rabbits (*Oryctolagus cuniculus*) were used for attachment of ticks. Ticks were placed in each of two cloth ear bags, which were secured with elastoplast to the ear of each rabbit [5]. The number of attached ticks was compared between conditions 1, 2, 5, 7, 10, 20, 24, 30 and 48 h after infestation, respectively. The GraphPad Prism™ v 2.0 program (La Jolla, USA) was used to perform the statistical analyses, and the unpaired t-test was employed.

**RESULTS**

The percentage of attachment of adults from group 40 was significantly higher than from group 25 at H2, H4, H10, H24 and H30 (p <0.05). The peak of attachment of adults of group 40 was at H5 (68.6%) and of group 25 at H21-H24 (55%). The peak attachment of nymphs was reached at H2 (70%) with group 40 and at H5 (77%) with group 25 (t-test, 2 h p <0.0001). After 10 h (H10), 88.75% of nymphs of group 40 and 75% of nymphs of group 25 were attached (p <0.05). When larvae were tested, 70% of larvae from group 40 were attached to rabbit at H1, compared with 30% from group 25 (p <0.0001) (Fig. 1).

**DISCUSSION**

We have demonstrated herein that *Rh. sanguineus* readily bites an unusual host when exposed to
higher temperatures. Indeed, our tick colonies are not considered as being adapted to feed on rabbits, as any attempt to feed these ticks more than three times on the same rabbit is unsuccessful (Parola, personal data). The peak of attachment rates was reached 5 h after infestation (68.6%) for adults, 2 h after (70%) for nymphs, and after 1 h (70%) for larvae kept at 40°C. In Europe and North Africa, although *Rh. sanguineus* starts to be active in May and June, most cases of MSF are diagnosed during July and August [1]. Various theories have been proposed to explain this discrepancy. According to our results, this is probably linked to an increased aggressiveness and propensity of *Rh. sanguineus* to bite hosts in warmer conditions. Therefore, we suggest that the seasonal peak of MSF depends on an increased affinity of the tick to humans during the warmest months. *Rh. sanguineus* has spread globally between 50°N and 35°S because of its ability to survive in human home sites. Based on the present investigation, we predict that increased temperature will lead to an increased period of activity of *Rh. sanguineus* and an increased aggressiveness and proclivity to bite unusual hosts including humans, and that increased incidence of *Rh. sanguineus*-transmitted diseases will be observed.

**REFERENCES**