Capybaras, ticks, and spotted fever

Capibaras, garrapatas y fiebre manchada

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Brazilian spotted fever (BSF) is a tick-borne disease, caused by the intracellular bacterium Rickettsia rickettsii, which has been reported in southeastern Brazil since the end of the 1920s (Angerami et al.). Indeed, BSF is the deadliest spotted fever of the world, with fatality rates around 50% during this new century.

The most important vector of R. rickettsii to humans in Brazil is the tick species Amblyomma sculptum, which is also the most important human-biting tick in the country (Krawczak et al., 2014; Labruna et al., 2017).

While A. sculptum is a competent vector of R. rickettsii, only <1% of the ticks are found infected by R. rickettsii under natural conditions (Krawczak et al., 2014; Labruna et al., 2017). These low infection rates are indeed related to three factors inherent to A. sculptum: (i) Larvae, nymphs and adults of A. sculptum are partially refractory to R. rickettsii infection (Labruna et al., 2008; Soares et al., 2012), (ii) Among the R. rickettsii-infected females of A. sculptum, vertical transmission of R. rickettsii usually occurs in <50% of them, and when it occurs, filial infection rate is commonly <50% (Soares et al., 2012), (iii) R. rickettsii-infected females have lower reproductive performance than uninfected females (Soares et al., 2012). Due to these reasons, it is generally accepted the tick population is not able to maintain the bacterium active in the tick population. These amplifier hosts maintain the bacterium in their bloodstream for some days or weeks, at sufficient levels to infect new tick cohorts, amplifying the rickettsial infection among the tick population (Labruna et al., 2013).

Within most of the BSF-endemic areas in southeastern Brazil, the A. sculptum populations are sustained chiefly by capybaras (Hydrochoerus hydrochaeris; Krawczak et al., 2014; Labruna et al., 2017), which are known as the largest extant rodents of the world (Moreira et al., 2013). Besides being a preferential host for all parasitic stages of A. sculptum in BSF-endemic areas, capybaras also act as amplifier hosts for R. rickettsii infection in the tick population (Labruna et al., 2013).

Experimental studies have shown that once infested by a R. rickettsii-infected A. sculptum tick for the first time, capybaras develop a rickettsemia of nearly 10 d, when 20-40% of the uninfected ticks acquire R. rickettsii infection. After this primary infection, capybaras become immune and do not develop a second rickettsemia (Souza et al., 2009; Ramírez-Hernández and Labruna, unpublished data). Therefore, the number of capybaras developing rickettsemia (susceptible animals) in a capybara population depends chiefly on the magnitude of births (Labruna et al., 2013).

Recent studies indicate that the maintenance of R. rickettsii in an A. sculptum population depends on the high reproduction rate of the capybaras; the more
capybara pups are generated in an area, the greater the rate of ticks infected by *R. rickettsii* (Labruna et al., 2013; Polo et al., 2017). One of these studies (Polo et al., 2017) has shown, through mathematical models, that an 80% reduction in capybaral birth rate promotes the elimination of *R. rickettsii* from the tick population in up to 4 years; if this reduction in the birth rate is 90%, elimination can occur in 2 years. Thus, the control of the capybara natality becomes a promising tool for the control and prevention of BSF in humans. Obviously, in conjunction with this, it is essential to use other measures of tick control at the site (vegetation clearance, environmental application of acaracides) and the installation of physical barriers to limit the access of capybaras to some areas of greater human exposure to ticks. In southeastern Brazil, two tick species, *A. sculptum* and *Amblyomma dubitatum*, are commonly seen parasitizing capybaras nearly everywhere this vertebrate is sampled (Pacheco et al., 2009; Pinter et al., 2011). Among these two tick species, only *A. sculptum* is recognized as a vector of *R. rickettsii* to humans. While many studies have reported rickettsial infection in field-collected *A. dubitatum* ticks, all these infections referred to rickettsial agents of possibly non-pathogenicity to humans, such as *Rickettsia bellii*, *Rickettsia sp strain Cooperi*, and *Rickettsia sp strain Pampulha* (Labruna et al., 2004; Pacheco et al., 2009; Almeida et al., 2011). An ongoing study in the state of São Paulo has evaluated tick populations sustained by capybaras in multiple areas endemic or non-endemic for BSF.

While the overall number of ticks was similar between BSF-endemic and non-endemic areas, a notable difference has been observed in the tick species composition. In the BSF-endemic areas, nearly 100% of the ticks belong to the species *A. sculptum*; only <10% were of the species *A. dubitatum*. In contrast, in the non-endemic areas, only about 50% of the ticks were *A. sculptum*, and the other 50% were *A. dubitatum* (unpublished data). Observations of these studies have led to the hypothesis that in order to become a BSF-endemic area in southeastern Brazil, there must be a shift in the tick population composition sustained by capybaras, towards the predominance of *A. sculptum*. However, the reasons for this shift are not known, although it could be an important target to prevent new areas of BSF transmission in the future.

Finally, our statements are valid only for those areas in southeastern Brazil, where *R. rickettsii* is transmitted to humans by *A. sculptum*, and where this tick species is sustained chiefly by capybaras. While this scenario is indeed the most common among all BSF-endemic areas in Brazil, there are other areas in Brazil and other American countries where *R. rickettsii* is transmitted by other tick species, with no role of capybaras; therefore, their epidemiological inferences would be completely different from the ones here presented.

**References**


