IS *Boophilus microplus* THE MAIN VECTOR OF *Anaplasma marginale*? TECHNICAL NOTE

¿Es *Boophilus microplus* el Principal Vector de *Anaplasma marginale?* Nota Técnica

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ABSTRACT

Understanding of *Anaplasma marginale* epidemiology demands the evaluation of several factors, involving not only biological or mechanical vectors, but also physiological events such as host immunity, intrauterine infection of fetus and parasite behavior in the host. The actual role that the one-host tick *Boophilus microplus* plays in the transmission of the ehrlichial *A. marginale* seems to be less important than previously thought.

Key words: *Anaplasma marginale, Boophilus microplus,* transmission.

RESUMEN

La epidemiología de *Anaplasma marginale* involucra la participación de varios factores. Además de la actividad de vectores biológicos y mecánicos, otros aspectos como la inmunidad del hospedador, la infección intrauterina y el comportamiento del parásito en el huésped deben ser considerados. El rol de *Boophilus microplus* en la transmisión de *A. marginale* parece ser menos importante del que tradicionalmente se le atribuyó.

Palabras clave: *Anaplasma marginale, Boophilus microplus,* transmisión

Anaplasmosis is a hemotropic disease affecting bovines and other ruminants, both domesticated and wild. The main signal of the disease is anemia, due to a sharp decline in the packed cell volume. Host immunity has been incriminated as the culprit for massive removal of both infected and non -circulating erythrocytes. The causal agent of the disease is the ehrlichial *Anaplasma marginale* Theiler 1910, an intra-erythrocytical rickettsia. Serological studies performed in Venezuela show that anaplasmosis is endemic to the country and is not related to either area or breed [15, 24]. Other hemotropic agents in Venezuelan bovine herds are the protozoan *Babesia bigemina*, *Babesia bovis* and *Trypanosoma vivax*.

Up to present, the knowledge of the epidemiology of anaplasmosis in Latin America, including Venezuela, is meager [11]. Another problem is that statements from other countries concerning anaplasmosis epidemiology are adopted and transferred to the local situation, unquestioned. Statements such as "anaplasmosis is a tick-borne disease" are true for certain areas where an efficient three-host tick is present, but not for others [17]. The tropical cattle tick, *Boophilus microplus*, is one of the most important ectoparasites affecting the cattle industry in Venezuela. It represents ca. 87% of the total tick burden in both dairy and beef cattle. It is also responsible for an increase in the cost of production due to the high costs of controlling this tick's populations. There is growing concern about the transmission of pathogens into the herds through other hematophagous arthropods, such as blood-feeding flies and ticks. Clinical diagnosis is usually misunderstood due to the similarity of the clinical signs between diseases caused by previously mentioned pathogens such as *Babesia* spp. and *T. vivax*, so accuracy in diagnosis at field is difficult in most of the cases. Therapy is addressed to salvage the sick animals and relies on the use of wide spectrum drugs, such as imidocarb, and more frequently, tetracycline and diminazene, in a combined or separate administration.

A strong belief in the importance of *B. microplus* in bovine anaplasmosis epidemiology has been kept unaltered for a long time in the scientific community and consequently, this idea has been widely accepted.

Although *B. microplus* ticks are present in both tropical and subtropical areas of the world where anaplasmosis is an

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endemic disease, there is not enough information to hold that *A. marginale* transmission relies on that species.

In certain countries, like Argentina and Australia, there is not an unanimous conscious about the actual role of *B. microplus* in anaplasmosis epidemiology. Although there is a similarity between babesiosis and anaplasmosis prevalence in cattle herds in the Argentinean Northwestern [12], tick control in dairy farms of that region elicited a sharp decrease in babesiosis outbreaks, while anaplasmosis outbreaks stayed the same [5]. In Australia, *B. microplus* is considered the only known vector of significance for *A. marginale* [4]; this evidence, however, is based mainly on the lack of anaplasmosis outbreaks outside areas infested with the tick [2].

A. marginale transmission by the one-host tick *B. microplus*, has been successfully accomplished by injecting extracts from both immature and mature stages of the tick into susceptible animals [4]. Another approach relies on the artificial transfer of the infected tick from an *Anaplasma*-infected host to a susceptible host [1]. Authors pointed out that field transmission would be conditional on the tick migration among susceptible hosts. Unlike the three-host ticks, the one-host tick, *B. microplus,* does not engage in detachment - reattachment activity during the moulting process, which decreases migration through the *B. microplus* - bovine system [16]. This fact represents a strong evidence against the actual role of this species in the anaplasmosis transmission.

Field trials dealing with natural *B. microplus* transmission of *A. marginale* in cattle have been performed. These trials involve grazing of susceptible or vaccinated animals in *B. microplus* infected paddocks [7, 8] or along with *A. marginale* infected cattle and carrying *B. microplus* ticks [3]. In the first two experiments, animals became patent. *Babesia* spp. infected the cattle within a three-weeks period after placement in *B. microplus* infected paddocks. This finding agrees with a newly acquired infection and confirms the actual presence of both the parasite (*B. bigemina* and *B. bovis*) and the biological vector of the disease (*B. microplus*) in the paddocks. However, while transovarial infection of *B. microplus* by *Babesia* spp. is a well-documented fact, it does not occur in *A. marginale* infection, despite the fact that this rickettsia invades *B. microplus* tissue [21]. These facts imply that *A. marginale* infection in the experimental animals that were grazing in *B. microplus* infected paddocks resulted from other sources than this tick species.

Intermittent blood-feeding dipterans, like tabanids and stable flies have demonstrated a vectorial ability for disseminating *A. marginale* [9, 19]. Mechanical transmission of this rickettsia by blood-sucking flies was not evaluated in the above field trials, and their presence of them is hard to prevent under field conditions.

There are other arthropods that have been implicated as possible vectors of *A. marginale*. The role of the eye gnat *Hippelates pusio* has been evaluated, showing that it is able to transmit the rickettsia up to three days after ingestion of infected erythrocytes [23]. The transmission of *A. marginale* by the stable fly, *Stomoxys calcitrans,* has been demonstrated [19]. The presence of this fly in cattle herds is overlooked because of its behavior. In fact, the intermittent blood feeding with long resting periods off the host and the fact that they feed primarily on the lower legs can make estimation of its presence difficult. Under these circumstances, it is not unusual to find that cattlemen do not always realize the extent of stable fly infestations to the herd. Also, an overwhelming number of horn flies on the animals can disguise the lower numbers of *S. calcitrans* feeding on bovines. Tabanids have been considered a very important group in anaplasmosis epidemiology by several researchers [9, 10, 13, 22, 23]. Despite the female blood-feeding activity being intermittent, defensive reactions of the host during the blood seeking of female horse flies do increase the chance of pathogen transmission. Experiments performed with *Haematobia irritans*, the most important ectoparasite of cattle in certain countries showed that subspecies *H. irritans exigua* acquires the infection when it feeds on an infected bovine, yet it is not able to transmit the rickettsia to susceptible hosts, even within very short time periods, as few as 20 seconds [2].

Both management practices and physiological events could be involved to some extent in *A. marginale* transmission among cattle, or at least be responsible for maintaining the rickettsia in the herds. For instance, certain practices like the use of non-sterile surgical instruments, needle and obstetrics gloves have been implicated. The role of the transplacental route in anaplasmosis has been evaluated in both natural and experimental infections, which can be considered as a significant component in the epidemiology of the disease [25, 26]. Out of 14 newborn calves, all exhibited *A. marginale* infected erythrocytes at 17 to 30 days old, despite the fact that they were kept in isolation since birth [20]. Anaplasmosis outbreaks in cattle are associated with an enzootic instability condition, which is present when at least 25% of the one-year-old group has not had contact with the parasite as calves [6]. While this condition has a direct relation with vector number in bovine babesiosis (*Babesia* spp. -infected *B. microplus* ticks), the actual dynamic in anaplasmosis is far more complicated. The sole presence of the rickettsia in the herd is not likely to be responsible for the emerging anaplasmosis outbreaks. The persistence of the rickettsia in the infected host seems to be a consequence of the antigenic variation of the parasite observed during *A. marginale* infection [18].

Due to the fact that some ectoparasites impair the host immune response [14], the actual role of *B. microplus* infestation on the bovine immune system and its relationship with bovine anaplasmosis outbreaks deserve further research. Clinical anaplasmosis cases could be likely related to an immunosupression status in carrier animals rather than a consequence of recently acquired infection.

Perhaps, the most important threat in understanding the epidemiology of bovine anaplasmosis is the fact that it has been examined under the same criteria applied for explaining that of the bovine babesiosis in the tropics.

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