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Rhipicephalus sanguineus complex: Review

Larissa Rosa Nogueira[1]; Daniela Gabriel Regianni[2]; Adriano Pinter[3]; Jonas Moraes-Filho[2*]

[1]Medicina Veterinária, Universidade Santo Amaro (UNISA), São Paulo, Brazil.
[2]Mestrado em Medicina e Bem-Estar Animal e Doutorado em Medicina Veterinária em Saúde Única, Universidade Santo Amaro (UNISA), São Paulo, Brazil.
[3]Superintendência de Controle de Endemias (SUCEN), São Paulo, Brazil.

ABSTRACT

OBJECTIVE

The present study aimed to carry out a systematic review in order to analyze available information of the *Rhipicephalus sanguineus* Complex.

METHODS

A bibliographic review was carried out, through a research on public scientific articles databases, between August 2019 and January 2020. Search was filtered for scientific articles published between 2000 and 2020, in the search engines: SCIELO, PubMed and Google Scholar, following the guiding question: *Rhipicephalus sanguineus complex?* and using the descriptors: *Rhipicephalus; Rhipicephalus sanguineus; Rhipicephalus sanguineus complex; Phylogeny Rhipicephalus; Rhipicephalus turanicus,* Hemoparasitosis.

RESULTS

The genus *Rhipicephalus* comprises a group called *Rhipicephalus sanguineus* complex, consisting of 17 species that are morphologically similar and that do not yet have an elucidated taxonomy determination, according to several authors, the tick species in question have their biosystematic state of difficult elucidation, as there are biological and genetic divergences. The present publication review yielded support to the hypotheses that the R. *sanguineus* taxon in America is, in fact, composed by two different lineages, that is nowadays attributed to the R. *sanguineus* species, but, as a matter of fact, the taxonomic status of R. *sanguineus* and R. *turanicus* in the Old World must be defined prior a possible new classification of the New World lineages of R. *saguineus*, therefore the *Ripichephalus* genus ticks in the Americas should all be identified as R. *saguineus* complex.

CONCLUSIONS

Conclude that the R. sanguineus complex encompasses taxonomic, phylogenetic, morphological and biological differences, making its biosystematic state difficult to clarify.

DESCRIPTORS

Rhipicephalus, Rhipicephalus sanguineus complex, Phylogeny, Rhipicephalus turanicus, Hemoparasitosis.

RESUMO

OBJETIVO

O presente estudo teve como objetivo realizar uma revisão sistemática, a fim de entender sobre o Complexo *Rhipicephalus sanguineus*.

MÉTODOS

Foi realizada uma revisão bibliográfica, por meio de busca online entre agosto de 2019 e janeiro de 2020, de artigos científicos publicados entre 2000 e 2020 nas bases de dados de saúde pública: SCIELO, PubMed e Google Scholar, seguindo a questão norteadora: Complexo *Rhipicephalus sanguineus*, e usando os descritores: Rhipicephalus; R*hipicephalus sanguineus; Rhipicephalus sanguineus complex?; Phylogeny Rhipicephalus; Rhipicephalus turanicus;* hemoparasitosis.: *Rhipicephalus; Rhipicephalus sanguineus; Rhipicephalus sanguineus complex; Phylogeny Rhipicephalus; Rhipicephalus turanicus;* hemoparasitosis.

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RESULTADOS

O gênero *Rhipicephalus* compreende um grupo denominado *Rhipicephalus sanguineus* que é extremamente complexo, denominado complexo sanguineus, constituído por 17 espécies que são morfologicamente semelhantes e que ainda não possuem uma taxonomia elucidada, que segundo vários autores, os carrapatos em questão têm sua biossistemática de difícil elucidação, visto que existem divergências biológicas e genéticas. A presente revisão de publicação deu suporte às hipóteses de que o táxon *R. sanguineus* na América é, de fato, composto por duas linhagens distintas, que atualmente são atribuídas à espécie *R. sanguineus*, mas, na verdade, o status taxonômico de *R. sanguineus* e *R. turanicus* no Velho Mundo deve ser definida antes de uma possível nova classificação das linhagens do Novo Mundo de *R. Saguineus*; portanto, os carrapatos do gênero *Rhipicephalus* nas Américas devem ser todos identificados como complexo *R. sanguineus*.

CONCLUSÃO

Conclui-se que o complexo R. *sanguineus* engloba diferenças taxonômicas, filogenéticas, morfológicas e biológicas, dificultando o esclarecimento do seu estado biossistemático

DESCRIPTORS

Rhipicephalus, Rhipicephalus sanguineus complex, Phylogeny, Rhipicephalus turanicus, Hemoparasitosis.

Corresponding author:
Jonas Moraes-Filho
Mestrado em Medicina e Bem-Estar Animal e Doutorado em Medicina Veterinária em Saúde Única, Universidade Santo Amaro (UNISA). Rua Prof. Enéas de Siqueira Neto, 340 — Jardim das Imbuias, São Paulo, Brazil, E-mail: jmfilho@prof.unisa.br
ORCID ID: https://orcid.org/0000-0002-4734-9512

INTRODUCTION

The tick species *Rhipicephalus sanguineus* was first described by Latreille in 1806, as *Ixodes sanguineus*, although lately this description was not long used[1]. It is popularly known as the "red dog tick", a common parasite of domestic dogs, but it was also reported attached to wild animals and humans. It is distributed throughout the world, with reports in America, Europe, Africa, Asia, and Australia[2].

Little is known about the origin of *R. sanguineus*, being described by some authors as an African species and by others as a Mediterranean species, nonetheless it is most likely that the genus *Rhipicephalus* origin is in the African territory, being the most accepted theory today[3].

The genus *Rhipicephalus* comprises a group called *Rhipicephalus sanguineus* complex and the distinction of the species of this group is extremely difficult, consisting of 17 species that are morphologically similar and that do not have an elucidated taxonomy determination. This unsolved issue leads to different approaches in relation to the morphology differentiation, and classification of these ticks as a complex group of closely related species[3]. Species that can be addressed to the complex are: *R. sanguineus, R. turanicus, Rhipicephalus rossicus, Rhipicephalus pumilio, Rhipicephalus leporis, Rhipicephalus schulzei, Rhipicephalus pusillus, Rhipicephalus sulcatus, Rhipicephalus guilhoni, Rhipicephalus moucheti, Rhipicephalus bergeoni, Rhipicephalus camicasi, Rhipicephalus ramachandrai, Rhipicephalus tetracornus, Rhipicephalus ziemanni, Rhipicephalus aurantiacus* and *Rhipicephalus boueti*[4].

The great importance in veterinary medicine, human medicine and economics of this species complex is noteworthy, since they are common vectors of different pathogens that cause diseases in domestic animals and humans[5]. The most important diseases transmitted by the ticks in question are the babesiosis, caused by *Babesia canis vogeli* and Canine monocytic ehrlichiosis, caused by *Ehrlichia canis*. The most common human pathogens are *Rickettsia conorii*, which causes spotted fever described in the Mediterranean area and *Rickettsia rickettsii*, which causes Rocky Mountains Spotted Fever[1].

The present study aimed to carry out a literature review to understand the *Rhipicephalus sanguineus* complex.

METHODS

This study was carried out in the format of a systematic literature review, which allowed a critical analysis of current scientific knowledge of the proposed theme. The steps were: a) definition of the theme and objective; b) definition of the scientific articles selection; c) methodological evaluation of the included scientific articles; d) interpretation of the found information. A bibliographic review was carried out from August 2019 to January 2020, through an search for scientific articles in the public health databases: SCIELO (Scientific Electronic Libary Online), PubMed (National Library of Medicine of the United States, National Institutes of Health) and Google Scholar, looking for articles published between the years 2000 and 2020. The search was based on the guiding question: *Rhipicephalus sanguineus* complex, using the descriptors: *Rhipicephalus; Rhipicephalus sanguineus; Rhipicephalus sanguineus* complex; Phylogeny *Rhipicephalus; Rhipicephalus turanicus*; hemoparasitosis. From the retried articles, only the ones that contained, in the results and discussion part, any piece of information about the *R. saguineus* complex were selected. The main information of each article was then highlight and compare to each other, in order to create a consensus about the *R. saguineus* complex in America.

RESULTS AND DISCUSSION

The research for articles retrieved 77 subjects, amongst those, 61 articles were excluded because they did not address any piece of information in result and discussion sections about the topic of this study; therefore 16 remaining scientific studies that had fit the criteria proposed for this study were used in the present review.

The studies support that in America, there are two different lineages of the tick *R. sanguines s. l.*, they were named the tropical and the temperate lineages as it is better explained later on in this review.

We also present information contained in the selected articles about the pathogens that are known to be vectored by these tick species complex within Brazilian territory, such as the Canine Monocytic Ehrlichiosis caused by *E. canis* that appears to be linked to *R. sanguineus s.l.* of the tropical lineage, as recent experimental studies have been carried out to evaluate the competence of the population of *R. sanguineus s. l.* from South America in the transmission of *E. canis* to dogs, among the results obtained it was seen that ticks from southeastern Brazil (tropical lineage) were competent vectors of this bacteria, while those from Argentina, southern Brazil and Uruguay (temperate lineage) did not shown vectorial competence[6,7,8]. However, regarding the transmission of *Hepatozoon canis*, it was reported that probably it is the temperate lineage of *R. sanguineus s. l.* responsible for the spread of this pathogen[6]. In relation to human public health, *R. sanguineus s. l.* is described as a vector of *R. conorii* and *R. rickettsii*, depending upon to the region in which it is found[7]. Therefore, it is understood that there are distinct populations of *R. sanguineus s. l.* worldwide, varying according to each region and they may or may not be vectors of the microorganisms here described[6].

It is important to note that the parasitism of humans by *R. sanguineus s. l.* in South America was uncommon, but currently, reports of these cases have increased, it is not possible to conclude whether this is happening because of the increase of notification opportunity or whether it is a real increase that have been hypothesized to be possible linked to the climate changes, what may have influenced the behavior of ticks, since higher average temperatures may cause the parasitism by this tick species to intensify. However, once the difficult in the taxonomy of *R. sanguineus s. l.* may lead to misidentification, it could be not possible to determine whether this tick is the main responsible for parasitizing humans, once *R. turanicus*, nowadays, has already been described showing this behavior, even though, in rare conditions[1].

According to the life cycle of *R. sanguineus s. l.*, this ectoparasite remains in the environment for most of their lifespan, it is influenced by environmental and climatic factors, starting the quest behavior only when there is a presence of ideal environmental conditions that indicate the presence of the host[3]. The biology of the tropical lineage and temperate lineage of *R. sanguineus s. l.* were compared in laboratory conditions, it was seen that the weight of the engorged females and the weight of the egg masses of the tropical lineage were significantly different in relation to the tempered lineage. The average feeding period of *R. sanguineus s. l.* from Spain was longer than the that found in ticks from Argentina, Brazil, Cuba and Thailand. The average pre-oviposition period for ticks belonging to Spain, on the other hand, was considered shorter when compared to the others[9]. As seen, even in the life cycle of these tick species there are differences that lead to the reinforce it is in fact a complex of species rather than one single taxon.

It is known that *R. sanguineus s. l.* specimens from tropical zone of Brazil are similar to *R. sanguineus s. l.* and *R. turanicus* specimens from Africa regions. In addition, a significant difference was found in the morphology of Brazilian (Jaboticabal strain) and Argentine (Rafaela strain) *R. saguineus s. l.* ticks, the palps of *R. sanguineus s. l.* females collected from Argentina, are if the chelicerae, while in the Brazilian specimens the length of these structures were unequal[10]. These studies have shown how much the taxonomy of *R. sanguineus s. l.* is still in discussion, because in some countries the specimens are very similar and in others there are morphological differences enough for distinguishing the lineages[10].

On the other hand, among the differences of the mentioned tick complex, we can highlight some distinctions according to the morphology between the species *R. sanguineus s. l.* and *R. turanicus*, which would allow these two species to be set apart. The literature describes that these two species have morphological characteristics that differ one from another in all stages, with immatures having lower morphological variance; adults, on the other hand, have a great variety in their morphology, with differences in characteristics such as: perimeter plate, adanal plate or dorsal punctuation[1]. The specimens of *R. sanguineus s. l.* and *R. turanicus* can be separated, according to the sinuosity of the posterior marginal groove, shape of the adanal plates, shape of the genital opening area and shape of sclerites[11]. These findings confirm the fact that the specimens are similar, but not identical, what allows them to be differentiated and separate in two species, even though the morphological identification demands a specialized taxonomist, what otherwise could end up in a very likely taxon misidentification. Considering that even amongst females and males of *R. sanguineus s. l.* lineages, it is seen morphological differentiations[9,12].

The *R. sanguineus* complex is a group that includes very similar and interconnected tick species. According to several authors, the ticks in question have their biosystematic state that is difficult to elucidate, as there are biological and genetic divergences[3,7]. However, to be able to separate and differentiate the taxonomy and clarify the divergences present in the *R. sanguineus* complex, the authors stated that further studies and research are needed[2].

For a long time, studies have been carried out so that the separation of the *R. sanguineus s. l.* tick species could be analyzed and reestablished. At first, the species *R. sanguineus* as it was called, came further to be called *R. sanguineus sensu strictu*, but over the years and in view of forthcoming research, it was noted that the group under discussion is very complex and not just a single species, having the holotype specimen been lost[3]. Because of these divergences, several reports were made comparing the morphology of ticks *R. sanguineus s. s.* in several countries, confirming that it is not possible to name any population by this nomenclature, and the name *R. sanguineus s. l.* must be assigned until the taxonomy is properly described[2,13]. So, this, was the first measure adopted in view of the complexity of the approach of the *R. sanguineus* group, new research are being carried out in order to properly describe the complex[13].

Phylogenetic analysis of New World *R. sanguineus s. l.* specimens using molecular markers 12S and 16S, in which two lineages were identified. A southern lineage found in Argentina, Uruguay, Chile and Western European countries and another northern lineage obtained from ticks collected in Brazil, Paraguay, Colombia, Argentina, South Africa and Mozambique[13]. Other authors based the separation according to climatic variations, thus describing two lineages: a tropical lineage with ticks collected in Brazil, Paraguay, Colombia, South Africa, Mozambique and north from Argentina; and a temperate lineages comprising ticks from Argentina, Uruguay, Chile, southern Brazil and Italy[4,14,15].

Phylogenetic analysis of DNA sequences has showed that *R. sanguineus s.l.* is a well-defined taxon when compared to other species of the *R. sanguineus* group: *R. turanicus s.s., R. camicasi, R. guilhoni, R. guilhoni, R. sulcatus, R. pusillus, R. rossicus* and *R. leporis*[16]. In addition, *R. sanguineus s.l.* "temperate lineage" found in the New World, including ticks from Argentina, southern Brazil, Chile, Uruguay and the USA; and scientific evidence suggests its presence in Europe (France, Italy, Spain, Switzerland and Portugal), but further studies are needed to determine the exact geographic range of that taxon[12].

Even though the present review demonstrates that there are in fact two different lineages under *R. sanguineus* taxon in America, as a matter of fact, the taxonomic status of *R. sanguineus* and *R. turanicus* in the Old World must be defined prior a possible new classification of the New World lineages of *R. saguineus*, therefore the speciemens of collected in America today identified as *Ripichephalus saguineus* should be rather identified as a species of the *R. saguineus* complex rather than *R. saguineus, R. saguineus s.s. or R. saguineus s. l.*

What can be addressed today, it is that in America there are two distinct lineages of ticks belonging to the *R. sanguineus* complex, which today are called tropical lineage and temperate lineage[1]. Some authors believe that the results found contribute to the development of better guidelines for the identification of the taxonomy of species, and because these vectors are important vector of several pathogens, and the clarification of phylogeny is extremely important for disease control either to animals and humans[14].

In view of all that has been discussed, the *R. sanguineus* complex shows many divergences due to its biosystematic state of difficult elucidation, in relation to its taxonomy, morphology, biology and phylogenetics, as in relation to its life cycle and pathogens transmitted by these vectors. Further studies are needed for these incompatibilities to be fully resolved.

CONCLUSION

Through this review, it was possible to conclude that tick specimens collected In America classified under the *R. saguineus* taxon must be, in fact, receive the classification of a species of the the *R. sanguineus* complex, because the phylogenetic, morphological, and biological unsolved issues, what makes its biosystematic state difficult to clarify. This tick is responsible for transmitting several pathogens capable of causing different diseases in animals and humans, and the elucidation of its taxonomical status is extremely important, so that not only for taxonomic differences to be explained, but also for a better understanding of the transmission and epidemiology of pathogens, making it possible to prevent them. In view of this complexity, numerous studies and research have been done to try to elucidate such divergences and, in some cases, have already been clarified; however, more studies are still needed for this complex to be properly described.

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