

Study of the Weight of Eggs from Six Ixodid Species from Brazil

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Eggs from engorged females of six ixodidae species (Ixodes loricatus, Amblyomma rotundatum, A. cajennense, Haemaphysalis leporis-palustris, Boophilus microplus, Dermacentor nitens) maintained in laboratory were counted to calculate the number and mean weight in 1g of eggs from each species. Phylogenetic considerations are discussed based on the results.

Key words: Ixodidae - Amblyomma - Ixodes - Haemaphysalis - Dermacentor - Boophilus - Phylogeny - Brazil

The generally large acarines included in the superfamily Ixodoidea apparently evolved as obligate parasites of Reptilia in the late Paleozoic or early Mesozoic era. During subsequent coevolution with birds and mammals, adaptations of most tick species have been conservative. Structural, developmental, physiological, ethological, and reproductive properties and processes have changed, but chiefly within narrow parameters (Hoogstraal & Kim 1985).

In Brazil, there are 54 known tick species (Aragão & Fonseca 1961). Among the Ixodidae, the genus *Ixodes* (Prostriata, Ixodinae) is represented by 9 species. In the Metastriate line, *Amblyomma* (subfamily Amblyomminae) is the largest genus constituted by 33 species. The Haemaphysalinae (genus *Haemaphysalis*) is represented by only 3 species. The remaining species belong to the Rhipicephalinae. *Boophilus microplus* was introduced in Brazil with cattle by Portuguese in the XVI century. *Rhipicephalus sanguineus* has spread out among the world parasitizing dogs, *Canis familiaris*, which are not the host they coevolved with. Another species, *Dermacentor nitens*, possibly penetrated in South America during Pliocene with the massive invasion of North America mammals across the newly formed isthmus of Panama (Balashov 1994). Among the Argasidae, the genus *Argas* (Argasinae) is represented by *A. miniatus*, endemic in Latin America. The genus *Ornithodoros* (Ornithodorinae) contains 6 species parasitizing mainly bats, although they often feed on humans and other

mammals. The subfamily Otobinae is represented in Brazil by the species *Otobius megnini*.

The mean number of eggs in 1g of eggs is not known for the majority of these species. There are few reports on egg weights for tick species in the literature. Reports from other countries have noticed the following values (eggs/g): *B. microplus*: 20,408.16 (Lahile 1917 cited by Alvarado & Gonzales 1979), 20,000.00 (Drummond et al. 1973), 22,727.27 (Quevedo 1966 cited by Alvarado & Gonzales 1979) *D. nitens*: 15,625.00 (Dunn 1915). From Brazil, there are reports on eggs/g: *H. leporis-palustris*: 14,285.71 (Rhor 1909), *A. cajennense*: 16,400.00 (Prata et al. 1995a), *B. microplus*: 19,685.03 (Alvarado & Gonzales 1979), *D. nitens*: 17,100.76 (Prata et al. 1995b). In this work, the amount of eggs in 1g of eggs was comparatively studied for 6 ixodid species from Brazil, the results were related to the possible origin and evolution of ticks.

MATERIALS AND METHODS

To determine the whole egg output of at least 4 engorged females for 6 ixodid species, the females were collected from naturally infested animals in the Southeast region of Brazil, as follows: *Ixodes loricatus* (Ixodinae) on marsupials *Didelphis albiventris* from Belo Horizonte, State of Minas Gerais (MG). *Haemaphysalis leporis-palustris* (Haemaphysalinae) on rabbits *Sylvilagus brasiliensis* from Caratinga, MG. Two Amblyominae, *A. rotundatum* on toads *Bufo* sp. in Belo Horizonte and *A. cajennense* collected on horses from Pedro Leopoldo, MG. The Rhipicephalinae *B. microplus* and *D. nitens* respectively on cattle and horses from Pedro Leopoldo. All ticks were identified according to specific taxonomic keys (Robinson 1926, Cooley 1946, Araújo & Fonseca 1961, Price 1969).

All engorged females were taken into a BOD

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cabinet at $27\pm 1^\circ\text{C}$ and at least 85% relative humidity (RH). As soon as they completed the egg output, 10 samples of 100 eggs from the egg pool of each species were counted and weighted in a 0.001g precision electronic balance. The values were reported and the mean value for each species was calculated. The number of eggs in 1g of eggs was calculated dividing 100 by the respective mean value. The mean reproductive efficiency value (RE) with the respective standard deviation (SD) was calculated for 12 *A. rotundatum* females and 13 *A. cajennense* females, according to the formula:

$$\text{RE} = \frac{\text{weight of total egg output}}{\text{weight of engorged female}} \times 100$$

RESULTS

The mean weight and respective SD values for 10 samples of 100 eggs for each species and the calculated number of eggs in 1g of eggs are shown in the Table. Twelve *A. rotundatum* females showed a mean RE value of 53.9 (SD = 4.34) and 13 *A. cajennense* females showed a mean RE value of 57.9 (SD = 5.7).

DISCUSSION

It can be seen that there are large variations of number of eggs for different genera and species (*A. cajennense* and *A. rotundatum*). The values now found also show differences with other studies concerning the same species. It suggests natural differences between tick strains, since they are from distinct geographical areas, however some of these differences might be due to the size variability of eggs laid by the same female. Oliver (1989) and Prata et al. (1995a) reported that eggs' size do not remain constant during the oviposition, varying during the course of oviposition period. The egg mass differences reported in the literature for one species is generally slight, supporting some of the differences now observed between different species.

The genera *Amblyomma* and *Ixodes* are cosmopolitan. Species of *Ixodes* are distributed in all climatic zones while *Amblyomma* spp. only in the tropics and subtropics. Evidently, the ancestors of these genera existed before the break up of Pangea in northern (Laurasia) and southern (Gondwana) halves (Balashov 1994). This event is dated to the middle of jurassic (Queen 1983 cited by Balashov 1994). Ticks evolved as obligate parasites of Reptilia in the Paleozoic or early Mesozoic era (Hoogstraal & Kim 1985), or else during the Devonian period, as admitted by Oliver (1989), considering the acarine radiations and the development of a great variety of amphibians that could be hosts to ticks. In that time, tick eggs were of greater size and consequently were laid in less amount per female. Primitive bird and mammal lines greatly diversified, evolved into numerous specialized orders, and replaced reptiles as the dominant land vertebrates in the early Tertiary. Adaptive radiation of ticks also occurred at this time, and ticks coevolved with their hosts (Oliver 1989).

According to Table, 1g of eggs of *A. rotundatum* has a much smaller amount of eggs than the other ticks which seems to be a primitive character that this tick seems to retain since it coevolved with amphibians and reptilia. *A. cajennense* shows a greater number of eggs/g since this species coevolved with mammals and birds. *I. loricatus* also shows a much lower number of eggs when compared with Rhipicephalinae. It is in agreement with Pomerantsev (1948) cited by Balashov (1994), whose hypothesis is that the first hosts of primitive ixodid were monotremes and marsupial, and to which the most primitive subgenera of the genus *Ixodes* are presently associated. According to Hoogstraal and Kim (1985), in the 155 species of the genus *Haemaphysalis*, 17 are structurally primitive species, 4 are structurally intermediate and the remainder are structurally advanced. *H. leporis-palustris* is categorized as a structurally advanced species (subgenera *Gonixodes*) which agrees with the high number of

TABLE

Mean weight and standard deviation for 10 samples of 100 eggs from 6 females ixodid species, and number of eggs in 1g

Ixodid species	Mean weight of 10 samples of 100 eggs (g)	Standard deviation	No. eggs in 1g of eggs
<i>Ixodes loricatus</i>	0.0080	0.00000	12,500.00
<i>Amblyomma rotundatum</i>	0.0115	0.00053	08,695.65
<i>Amblyomma cajennense</i>	0.0053	0.00053	18,867.92
<i>Haemaphysalis leporis-palustris</i>	0.0060	0.00000	16,666.66
<i>Dermacentor nitens</i>	0.0055	0.00000	18,181.81
<i>Boophilus microplus</i>	0.0050	0.00000	20,000.00

eggs/g found for this species in this study. Brumpt, in Nuttal and Warbuton (1915) cited by Hoogstraal and Kim (1985), reports some structurally primitive species such as *H.(A.) inermis* and *H.(A.) kitaokai* whose females deposit less than 25% of the total egg production of most other *Haemaphysalis* spp., which are structurally advanced. According to Balashov (1994), *Dermacentor* originated earlier than the Cretaceous or Paleocene, and the genus *Boophilus* is recent and originated probably in Pliocene. These facts may justify the high number of eggs/g found for *D. nitens* and *B. microplus* in this and other studies. The observed RE values for *A. rotundatum* and *A. cajennense* females are similar to most ixodid females fed on their natural hosts and show that the reproductive efficiency is probably not correlated to egg size and consequently, to the amount of egg output.

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