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Life cycle of the tick *Amblyomma parvum* Aragão, 1908 (Acari: Ixodidae) and suitability of domestic hosts under laboratory conditions

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ABSTRACT

Amblyomma parvum is a widespread Neotropical tick found on several domestic animals and is known to harbor a *Rickettsia* species of yet unknown pathogenicity. However its life cycle on, and suitability of, several of these hosts has not been described. In this work the biology of *A. parvum* is presented when fed on seven domestic hosts (chicken, dog, rabbit, horse, guinea pig, cattle and goat). The complete life cycle of the tick varied from 96.8 to 102 days. Highest engorgement weight of larvae was from ticks fed on horses and that of nymphs from guinea pigs. Highest larval yield was from guinea pigs and that of nymphs from horses. Engorged female and egg mass weights, yield and conversion of female weight to eggs rates were the highest in dog ticks and the lowest in goat ticks. The highest egg hatching rate was seen in ticks from dogs and the lowest in ticks from cattle. Overall it was seen that dogs were the best host for adult *A. parvum* ticks, and guinea pigs for immatures. Horses were also shown to be a good host for all tick stages. It can thus be affirmed that *A. parvum* is a host generalist tick, and its distribution is probably determined by environmental requirements rather than by hosts.

1. Introduction

Ticks are considered major hazards to both human and animal health. In fact, several emerging and reemerging diseases have ticks as the infectious agent vector (Piesman and Gern, 2004; Estrada-Peña et al., 2007; Labruna, 2009). Many times tick-borne disease endemic areas as well as epidemics are associated to tick populations expanded by human activities. Therefore recognition of the potential for tick populations to expand with ongoing human activities is an important and basic step for tick-borne disease preventive measures.

Exogenous tick species brought to Brazil with colonization disseminated throughout the country and became well known pests to animals as is the case of *Rhipicephalus* (*Boophilus*) *microplus* and *Rhipicephalus sanguineus*. At the same time environmental alterations privileged and allowed for the geographical expansion of a few tick species from the Neotropical fauna as well. For example, it has been postulated that substitution of rain forests with more open vegetation, such as pastures or savannah like vegetation, favored the tick *Amblyomma cajennense* (Estrada-Peña et al., 2004; Labruna et al., 2005a; Szabó et al., 2009a). Thus it is possible that other tick species may or are also expanding.

Amblyomma parvum is a Neotropical tick with a wide geographical range being found from Argentina to Southern Mexico (Guglielmone et al., 2003). It is also a species that is known to bite humans (Guglielmone et al., 2006) and has recently been found to harbor a *Rickettsia* species of yet unknown pathogenicity (Pacheco et al., 2007). In recent review, Nava et al. (2008a) observed that records on this tick species were overwhelmingly from dry areas. If proven

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such ecological association, *A. parvum* would benefit from loss of rainforests within South America as did *A. cajennense*. In fact, it is not known if *A. parvum* populations are expanding but this tick species has been repeatedly found on domestic animals (Guglielmone et al., 1990; Szabó et al., 2007; Nava et al., 2008a). Such findings, however, may indicate accidental infestation rather than host suitability.

We herein present data on the development of *A. parvum* larvae, nymphs and adults released on several domestic hosts to evaluate the suitability of each to this tick species. Such data provides additional information on the potential of this tick to expand in rural regions should requirements for hosts be regarded.

2. Materials and methods

2.1. Hosts and location of experiments

Experiments were conducted in the Federal University of Uberlândia, Minas Gerais State Brazil. Overall seven hosts species were used for infestations; dogs (*Canis familiaris*), rabbits (*Oryctolagus cuniculus*), horses (*Equus caballus*), bovines (*Bos taurus taurus*), goats (*Capra hircus*), guinea pigs (*Cavia porcellus*) and chicken (*Gallus gallus*). Ovine infestation was also tempted, however local reactions to both ticks and feeding chamber precluded gain of reliable data. Rodents and chicken were tick bite naïve at the beginning of experiments whereas dogs, horses, goats and bovines had been previously infested with ticks occurring in domestic and rural environment such as *R. sanguineus*, *A. cajennense*, *R. microplus* and *Dermacentor nitens*. Experimental infestation of dogs and horses occurred at the teaching Veterinary Hospital, bovines and goats were infested in experimental farms of the University and rodents and chicken in the Ixodology Laboratory. Rabbits and guinea pigs were used because they are usual laboratory hosts for ticks moreover Caviidae rodents were shown to be important hosts in nature for immature of ticks, at least in Argentina (Nava et al., 2006). Dogs, horses, goats and bovines are also known to be infested under natural conditions (Nava et al., 2006, 2008b; Szabó et al., 2007). Chicken represented birds in the experiments and were used to roughly evaluate the likelihood of birds disseminating immature of this tick species. Infestations of different host species were not done at the same time and different tick batches were used for each host species.

All experiments were evaluated and approved by the Animal Experimentation Ethics Committee of the Federal University of Uberlândia. Permits and Approvals are on file in the office of M.P.J.S.

Parasite: ticks used for experimental infestation were from a laboratory colony with parasites originated from host-seeking ticks in Moenda da Serra farm, Araguapaz municipality, Goiás State, Brazil (Szabó et al., 2007). Ticks used for experiments ranged from 5th to 12th colony generation and were maintained by feeding on rabbits as described before (Szabó et al., 1995).

Experimental infestations: six animals of each host species were infested. Ticks were restricted to the host by feeding chambers glued to the hosts as described elsewhere (Szabó et al., 1995). Such procedure was essential to standardize infestations performed on so many different host species. Immature stages were fed on one and adults on a second feeding chamber. Each Dog, rabbit and guinea pig was infested with 200 larvae, 20 nymphs and four adult couples. Chicken was infested with 30 larvae and 20 nymphs each and was not infested with adult ticks. Horses, cattle and goats were infested with 200 larvae, 30 nymphs and six adult couples. Feeding chambers were inspected every day and engorged and detached ticks collected. Larvae and nymphs were collected and weighed in daily batches whereas engorged females were handled individually. Ovipostion, molting and hatching of ticks occurred at 27 °C and 85% of relative humidity and scotophase. The following biological parameters of ticks were observed: tick yield, engorged female (FW), larval, nymphal and egg mass weights (EW), feeding, pre-oviposition and egg incubation periods, molting rate and molting period of immatures, egg hatching and egg production efficiency rates (EPE). Egg mass was weighed 20 days after tick detachment. The engorging period was assumed to be the time that elapsed since the release of ticks on the hosts till their detachment, partially or fully engorged; pre-oviposition, the time from detachment until beginning of oviposition; incubation period the time from the starting of egg laying till the first egg to hatch; and molting period time interval between detachment from host and first tick to molt from the daily batch. The egg hatching rate for each tick was obtained by the mean value of visual evaluation performed by three persons separately. The egg production efficiency rate was calculated as follows:

$$EPE = \frac{EW \times 100}{FW}$$

Host species suitability (number of ticks produced/host): to compare the suitability of the various host species to ticks, mean tick numbers produced by each host species was calculated. Tick numbers produced were determined considering that one, two or all tick stages fed on the same host species. Tick numbers were calculated as follows:

Mean number of unfed adult ticks obtained from one engorged female: 1 × mean adult tick yield × mean egg mass weight × mean number of *A. parvum* eggs/mg × mean egg hatching rate × mean larval yield × mean larval molting rate × mean nymphal yield × mean nymphal molting rate.
Mean number of larvae produced by one engorged female: 1 × mean adult tick yield × mean egg mass weight × mean number of *A. parvum* eggs/mg × mean egg hatching rate;
Mean number of nymphs obtained from 100 larvae: 100 x mean larval yield x mean larval molting rate.
Mean number of unfed adults obtained from 10 nymphs: 10 × mean nymphal yield × mean nymphal molting rate.
Mean number of unfed adults obtained from 100 larvae: 100 × mean larval yield × mean larval molting rate × mean nymphal yield × mean nymphal molting rate.

2.2. Number of A. parvum eggs per milligram of egg mass

Number of eggs was counted in 10 samples of 10 mg each of *A. parvum* egg mass.