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Resistance of dogs to *Rhipicephalus sanguineus* and *Haemaphysalis leachi leachi*

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ABSTRACT

It has been shown experimentally from three repeated infestations that dogs were unable to develop effective resistance against dog ticks: *Rhipicephalus sanguineus* Latreille, 1806 and *Haemaphysalis leachi leachi* Audouin, 1826. The number of successive engorged females recovered from dogs at the second and third infestations in both species were not significantly less ($P>0.05$) than the number recovered at the first infestation. There was also no significant difference in body weight, body dimensions (lengths and breadths) ofengorged females, feeding periods, pre-oviposition periods or egg weight. In-depth studies of host-tick vector interaction and examination of immunobiological parameters involved in order to develop strategies for better, cheaper and safer tick control in dogs as an alternative to the use of acaricides is suggested.

Key words: dogs, ticks, *Rhipicephalus sanguineus, Haemaphysalis leachi leachi,* resistance

Introduction

Rhipicephalus sanguineus Latreille, 1806 and *Haemaphysalis leachi leachi* Audouin, 1826 are the most widespread ticks of dogs and known vectors of *Babesia canis* and *B. gibsoni,* the causative agents of canine babesiosis worldwide (ODUYE and DIPEOLU, 1976; KUTTLER, 1988; BOBADE et al., 1989; CRAIG, 1990). *Rhipicephalus sanguineus* is also well known as a vector of other pathogens of dogs, such as *Hepatozoon canis, Ehrlichia canis* (CRAIG, 1990), *Coxiella burnetii* (STEPHEN and ACHYUTHARAO, 1980), spotted group of rickettsiae (BEATI et al., 1996). They have also been reported to infest humans (SADIQ et al., 2001).

The use of acaricides as dips, sprays or washes has been the main method of tick control in both food animals and dogs (TAYLOR, 2001). But because of the cost,environmental pollution, residues in food animals, development of resistance to the

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acaricides and laborious acaricidal treatments, alternative methods of tick control are necessary (TAYLOR, 2001). Host resistance to tick infestation has been used as a basis of control for *Boophilus microplus* in Australia (SUTHERST and UTECH, 1980). In Kenya, AKIKI- RUBAIRE and MUTINGA (1980) noted that feeding readiness of ticks, as an index of resistance, decreased with increased numbers of infestation and they concluded that in the *Rhipicephalus appendiculatus*-rabbit relationship and repeated infestation led to an acquisition of tick resistance, contributed to by immediate hypersensitivity reaction and the non-specific physio-pathological reactions in the skin.

In Nigeria, DIPEOLU and HARUNA (1984) observed that rabbits which were previously unexposed to ticks acquired resistance to larval, nymphal and adult forms of *Amblyomma variegatum*. The degree of acquired resistance was lowest in rabbits exposed to the larval form and highest in rabbits infested with the adult form. These authors also noted that rabbits acquired resistance after first feeding by *Boophilus decoloratus* larvae and that the degree of resistance increased with subsequent feeding.

There is a dearth of information on the resistance of dogs to *H. leachi leachi* and conflicting reports on the resistance of dogs to *R. sanguineus*. While some workers (GARIN and GRABAREV, 1972; THEIS and BUDWISER, 1974; BECHARA et al., 1994; MUKAI et al., 2002) have reported that *R. sanguineus* does not induce resistance in a canine host, INOKUMA et al. (1997) observed resistance of dogs to infestation with *R. sanguineus* but did not advance reasons for their observation.

Further studies are needed to better understand the host-parasite relationship in terms of dog resistance to tick infestation. This experiment was therefore carried out to investigate the resistance by dogs to *R. sanguineus* and *H. leachi leachi* infestation with a view to adding to the existing information on the control of ticks in dogs, apart from the use of acaricides.

Materials and methods

Six tick-naïve young male local dogs from the same litter were used for this study. This was done in order to remove the effects of sex and age on the resistance status of the dogs. The dam had a history of not being infested by ticks prior to the time of this study, and none of the dogs had experienced tick infestation prior to the commencement of this study. The dogs were kept in kennels behind the Department of Veterinary Medicine, University of Ibadan, and maintained on home-cooked diets. A tick colony was established to ensure a continuous supply of unfed adult ticks for the experiment. This was achieved by allowing engorged ticks of both *R. sanguineus* and *H. leachi leachi* to feed on tick-naive New Zealand White rabbits.

On the first day (day 0) of the experiment, three dogs were each infested with ten male and ten female unfed adults of *R. sanguineus* ticks using the ear bag method (INOKUMA

et al., 1997). The dogs were restrained using a modified form of Elizabethan collar. On days 31 and 62, the three dogs were re-infested with a further set of ten male and ten female unfed adults of *R. sanguineus* ticks on each occasion.

The following biological parameters relating to female tick feeding and reproductive performance were recorded during the first, second and third infestations: number of successive engorged females, body weight, dimensions (lengths and breadths) of engorged females, feeding periods and egg weight. This procedure was repeated for *H. leachi leachi* using another set of three dogs and infestation regimes.

Data obtained from the two species of ticks in these studies were compared (analysis of variance; ANOVA) using the SPSS package.

Results

Results for the biological parameters for all three infestations with *Rhipicephalus sanguineus* and *Haemaphysalis leachi leachi* are summarized in Tables 1 and 2, respectively. The numbers of engorged female ticks recovered from the dogs in the second and third infestations were not significantly lower ($P>0.05$) than the number of ticks recovered from first infestation in the two species. Also, there was no significant difference ($P>0.05$) in body weights, dimensions (lengths and breadths) of engorged females, feeding periods and egg weights in both tick species. However, the number of engorged females recovered decreased from first infestation to third infestation in both tick species. Feeding periods also increased from first to third infestation. These results show that dogs did not develop resistance against infestations with adults of *R. sanguineus* and *H. leachi leachi.*

Table 1. Biological parameters of the female *Rhipicephalus sanguineus* ticks recovered during three repeated dog infestations

Parameters	Infestations		
	1st	2nd	3rd
Total number of females introduced	30	30	30
Total number of females engorged	23	20	19
Body mass (mg)	59.47 ± 24.83	53.50 ± 29.78	48.26 ± 30.10
Body length (mm)	7.50 ± 1.44	7.30 ± 1.66	7.07 ± 1.32
Body width (mm)	9.82 ± 2.13	9.71 ± 1.68	9.70 ± 2.29
Feeding period (days)	8.67 ± 2.31	9.32 ± 1.72	10.53 ± 2.52
Pre-oviposition (days)	4.00 ± 0.86	4.22 ± 0.95	4.21 ± 0.79
Egg weight (mg)	20.24 ± 7.40	19.45 ± 7.82	17.60 ± 7.79

Data expressed as mean ± SD

Table 2. Biological parameters of the female *Haemaphysalis leachi leachi* ticks recovered during three repeated dog infestations

Parameters	Infestations		
	1st	2nd	3rd
Total number of females introduced	30	30	30
Total number of females engorged	16	15	13
Body mass (mg)	46.50 ± 28.12	45.71 ± 30.69	41.88 ± 21.36
Body length (mm)	7.06 ± 1.81	6.93 ± 2.12	6.64 ± 1.38
Body width (mm)	9.31 ± 2.02	9.33 ± 2.38	8.81 ± 1.60
Feeding period (days)	10.73 ± 2.91	12.35 ± 2.61	16.21 ± 3.10
Pre-oviposition (days)	6.65 ± 0.96	6.88 ± 1.09	6.80 ± 1.08
Egg weight (mg)	19.06 ± 7.74	17.61 ± 7.47	16.52 ± 6.15

Data expressed as mean ± SD

Discussion

The results of this investigation show that previously unexposed dogs were susceptible to first infestation with unfed adults of *Rhipicephalus sanguineus* and *Haemaphysalis leachi leachi*. More than 67% of female *R. sanguineus* ticks introduced engorged in the first infestation, while about 50% of female *H. leachi leachi* became engorged. There were no significant differences in the number of engorged female ticks during the second and third infestations in both species when compared to their respective first dog infestation. The failure of the remaining female ticks to engorge might have been caused by either the removal of unattached ticks by host grooming activities (WAGLAND, 1975) or there may have been a density-dependent mortality of ticks (SUTHERST and COMINS, 1979), rather than by a pre-existing form of resistance. This agrees with the suggestion of previous workers (HEWETSON, 1971; WAGLAND, 1975; WILLADSEN et al., 1978) that a major component of host resistance was acquired through previous infestations.

A constant finding in this study is the reduction, although not significant, in the engorgement weight of ticks in the second and third infestations. Also, both *R. sanguineus* and *H. leachi leachi* females took insignificantly longer periods to engorge in both the second and third infestations. Hence, there was lack of resistance by the dogs to *R. sanguineus* and *H. leachi leachi,* even after repeated infestations. This observation is at variance with the findings of INOKUMA et al. (1997) who reported that dogs developed resistance to *R. sanguineus* ticks, but could not advance reasons for the observed resistance. The results of the present study however, is in consonance with the observations of GARIN and GRABAREV (1972), RANDOLPH (1979), FIELDEN et al. (1992) and SZABO et al. (1995) who at various times reported that dogs were unable to develop resistance to *R. sanguineus* even after repeated feeding. A possible explanation for the observation in this study could

be that either tick saliva modulates reactions of dogs or that tick antigens presented to the dogs were not immunogenic (SZABO et al., 1995). More studies on host-tick vector interaction and examination of the immunobiological parameters involved are therefore needed to develop strategies that will allow better, cheaper and safer tick control in dogs as an alternative to the use of acaricides.

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SAŽETAK

Trima ponovljenima pokusnim invazijama potvrđeno je da psi nisu razvili djelotvornu otpornost na pasje krpelje *Rhipicephalus sanguineus* Latreille, 1806. i *Haemaphysalis leachi leachi* Audouin, 1826. Broj uspješno presvučenih ženki obje vrste nađenih u pasa u drugoj i trećoj invaziji nije bio značajno manji (P>0,05) od broja ženki u prvoj invaziji. Također, nije bilo značajne razlike u težini, dužini i širini presvučenih ženki, razdoblju hranjenja, dužini razdoblja prije polaganja jaja i težini jaja. Preporučena su iscrpna istraživanja odnosa nositelj - krpelj kao i uključenih imunobioloških pokazatelja radi razvijanja strategije za bolje, jeftinije i sigurnije suzbijanje krpelja u pasa kao alternative za upotrebu akaricida.

Ključne riječi: psi, krpelji, *Rhipicephalus sanguineus, Haemaphysalis leachi leachi*, otpornost