Acquisition of immunity in cattle against the blue tick, *Boophilus decoloratus*

Y. Rechav\textsuperscript{a}, F.C. Clarke\textsuperscript{a} and J. Dauth\textsuperscript{b}

Departments of\textsuperscript{a}Biology and \textsuperscript{b}Chemical Pathology, Medical University of Southern Africa, P.O. Box Medunsa 0204, South Africa

(Accepted 12 September 1990)

ABSTRACT


It is well known that ixodid ticks have the ability to induce immunity in their host. We demonstrate, for the first time, that the tick *Boophilus decoloratus* induced immunity in its bovine host, since the mean weight of engorged females fed on naive animals dropped from 201.5 mg, to 173.7 mg and 155.3 mg, for females fed on calves previously exposed once and twice, respectively, to *B. decoloratus* infestations. Ticks which had been transferred from one individual host to another one were able to complete their feeding period on a sensitive host. Such ticks were significantly heavier (97 245.2 mg) than those fed on a naive (\$ 201.5 mg) host for the entire normal feeding period. A negative correlation between the mean weight of the engorged female ticks and the level of serum gamma globulins in the host was also demonstrated.

INTRODUCTION

The tick *Boophilus decoloratus*, restricted to the savannas of Africa South of the Sahara, is a vector of *Babesia bigemina* and *Anaplasma marginale* (Walker et al., 1978). The economic importance of this tick, the need for control, and the remarkably difficult and expensive requirements in achieving such control are also well documented (Walker et al., 1978).

A one-host tick (larval, nymphal and adult stages feed in sequence on the same individual host), *B. decoloratus* spends about 21 days feeding on its host prior to drop-off of engorged females (Walker et al., 1978). Eight days after the commencement of this feeding period, the level of the serum gamma globulin in the host is increased (Clarke, unpublished data, 1989). These facts indicate that the adults of *B. decoloratus* which are released as larvae on naive animals might complete their blood meal on an already immune host. The first objective of this study was to find out, if a transfer of ticks from one individual host to another, seven days after the commencement of feeding
and before an increase in the level of gamma globulin in the host occurred, would produce heavier ticks than when fed for the entire 21 days on naive calves. The second enquiry was whether the mean weight of the engorged \textit{B. decoloratus} female ticks and the level of gamma globulins in the host's serum could serve as indicators for evaluating the immunity status of the bovine host.

**MATERIALS AND METHODS**

Experimental ticks were collected from cattle and reared in the laboratory. Twenty-thousand, five-week-old unfed larvae were released into bags glued to the backs of each of eight two-month-old Jersey calves kept in experimental cages. Blood from the jugular vein of each calf was collected and analysed. Serum protein electrophoresis (SPE) was done on cellulose acetate membranes (Helena Laboratories, Beaumont, Texas) using a barbital/sodium buffer with a pH of 8.6 (Helena Laboratories). The membranes were scanned with an Appraise Densitometer (Beckman Instruments Fullerton, California) and were separated into the following fractions: albumin, alpha 1 ($\alpha_1$), alpha 2 ($\alpha_2$), beta ($\beta$) and gamma ($\gamma$) globulins. The densitometer automatically calculated the albumin and globulin ratios. Total protein levels were quantitated with an Astra 8 automated analyzer (Beckman Instruments) using the Biuret rate method. (Rechav et al., 1980, 1989; Rechav and Dauth, 1987). Ferrated ticks still attached and prior to moulting were scraped off the backs of the hosts with a pair of watchmakers' forceps and, together with epidermal tissue, transferred to similar bags placed on the secondary hosts. After moulting, the ticks attached immediately to their new hosts, thus allowing constant feeding on sensitive animals. Any feeding ticks that might also have been removed together with the ferrated ticks, failed to re-attach. The ticks were divided into four groups: Group A were fed for seven days on one calf, followed by seven days on a second calf, and then transferred to a third calf for completion of the normal 21-day feeding period; Group B were fed seven days on one calf and then completed the other 14 days on a second calf; Group C fed 14 days on one calf and then completed the remaining seven days on a second calf; and Group D were fed to the entire 21 days on the same individual calf (Table 1). Completion of the first infestation in Group D was followed by two more consecutive infestations on the same calf. In addition, a control group was established which consisted of uninfested calves from which blood samples were taken for comparison with calves on which Groups A, B, C and D were fed. Ticks from each group fed on two calves from which blood samples were taken at various intervals. Blood samples were also obtained from a control group, not infested with ticks for the duration of the experiment. The engorged females were weighed on an electronic balance (Sartorius 1800).