Fine Structure of the Fat Body and Nephrocytes in the Life-Stages of *Dermacentor variabilis*

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ABSTRACT


The fine structure of the fat body and associated nephrocytes of the American dog tick, *Dermacentor variabilis* (Say), was described in unfed larvae, unfed nymphs, and in unfed and fed adults of both sexes. The fat body consisted of one type of cell, the trophocyte. Morphological changes that occurred in the trophocytes of both sexes were dependent on feeding. The ultrastructure of feeding male trophocytes was distinct from trophocytes of feeding females. In the feeding female, the trophocyte developed an ultrastructure characteristic of cells that produce secretory proteins. A type of scalariform cell junction was found associated with rough endoplasmic reticulum of the trophocytes. Nephrocytes were closely associated with trophocytes but were not part of the fat body. Nephrocyte ultrastructure was unaltered throughout the life-stages we examined, except at the end of oviposition. Organelles in the nephrocytes were not randomly distributed, but were found in distinct regions of the cytoplasm. Slit diaphragms at the surface of the nephrocytes were extracellular specializations that had a periodic ultrastructure.

INTRODUCTION

In the American dog tick, *Dermacentor variabilis* (Say), a fat body is present in each life-stage: larva, nymph, and adult (Obenchain and Oliver, 1973). The fat body is located just inside the epidermal layer of cells and between the organs. These two regions are known respectively as the peripheral fat body and the central fat body (Obenchain and Oliver, 1973). In females, the fat body, especially the peripheral fat body, proliferates during and after feeding (Obenchain and Oliver, 1973). In the hard ticks *Rhipicephalus sanguinuis* and *Dermacentor variabilis* both the fat body and the midgut produce the female-specific protein vitellogenin (Coons et al., 1982, 1986, 1988; Tarnowski and Coons, 1988). However, in the soft tick, *Ornithodoros moubata*, only the fat
body produces vitellogenin (Chinzei and Yano, 1985). These studies used a combination of various immunological techniques and some electron microscopy. Vitellogenic fat body cells in *R. sanguinius* have large amounts of rough endoplasmic reticulum, Golgi bodies and secretory granules, an ultrastructure characteristic of secretory cells (Coons et al., 1982). Nephrocytes are present in *Hyalomma asiaticum* (Amosova, 1983). Their ultrastructure is very similar to nephrocytes found in insects (Crossley, 1985). Nephrocytes are commonly associated with the fat body and with body organs such as the heart and ovaries. We studied only those nephrocytes associated with the fat body trophocytes.

The objectives of this study were to describe the ultrastructure of the fat body and the closely associated nephrocytes in unfed larvae and nymphs, and fed adults, of *D. variabilis*. We also described a scalariform type of cell junction found in the fat body. Part of this study has been presented at a scientific meeting (Coons et al., 1986).

**MATERIALS AND METHODS**

**Ticks**

Ticks used in this study were either from a laboratory colony maintained at Memphis State University, or were collected from dogs at the city animal shelter. We obtained similar results from colony ticks and wild-type ticks. All ticks were maintained in an incubator at 85% r.h., with a dark/light cycle of 12/12h. Ticks were fed on rabbits as previously described by Coons and Kaufman (1988). The rabbits had not been previously exposed to tick infestations, and they were used as a host only once. Mated and unmated female ticks were fed in the same way. Ticks were sampled by hand-removing them from the rabbits, or after they had detached from the rabbit as in the case of completely fed mated females. With unmated fed females, no males were present on the rabbits during feeding and we examined the reproductive system of each female for signs of mating. Unmated female ticks were fed for 12 to 13 days, which was as long or longer than was required for mated female ticks to complete feeding and naturally detach. The unmated female ticks did not enter the rapid-engorgement phase of feeding and had to be hand-removed from the host. Following removal from the host, ticks were held at room temperature in glass petri dishes until sampled. Some of the unmated females were held in the laboratory until they began to oviposit. We sampled at least three ticks at each feeding and postfeeding period.

**Electron microscopy**

Tissues were routinely fixed in situ at room temperature (22°C) for 1–2 h in 2.5% glutaraldehyde in either 0.1M cacodylate or 0.2M Millonig’s phosphate