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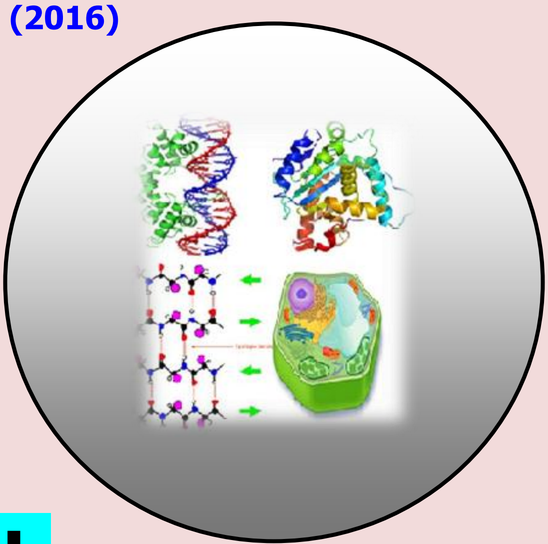

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RESEARCH PAPER

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Tem Studies on Acanthocephalan Parasite, *Echinorhynchus veli* infecting the Fish *Synaptura orientalis* (Bl and Sch, 1801)

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ABSTRACT
Echinorhynchus veli (George and Nadakal, 1978), an acanthocephalid worm infesting the estuarine flat fish, Synaptura orientalis, was collected from the Velilake, Kerala. The parasite was recovered from the intestine of the host fish. The detailed internal morphology was studied with the help of Transmission electron microscope. The study revealed numerous tubular channels in the body wall which enable them to absorb nutrients from the host intestine into the body of the worm. These channels penetrated the glycocalyx through branching to increase the absorptive surface area. The channels extended from glycocalyx to the striped layer with a decrease in diameter and separated by dense material as in the glycocalyx. The felt fibre layer contained channel terminals, looked like ovoidal vescicles of variable size, each filled with a fine, loosely packed granular material. The basement membrane layer was characterized by a dense matrix with nuclei, mitochondria large vesicle-like structures and bundles of filaments.
Keywords: Echinorhynchus veli, Synaptura orientalis, Electron microscope and Filaments.

INTRODUCTION

Cosmopolitan in distribution, acanthocephalid worms are intestinal parasites of terrestrial and aquatic vertebrates. They have a complex life cycle involving vertebrates as definitive hosts and arthropods as intermediate hosts. The present species, *Echinorhynchus veli* infecting the flat fish, *Synaptura orientalis* was reported by George and Nadakal (1978). Worm tegument is the layer in most intimate contact with the host's tissues and body fluids. As such it represents a site where considerable biochemical, physiological and immune interplays take place between the worm and its host. The tegument plays roles in maintaining the parasites' homeostasis, such as the absorption, exchange of nutritive and waste molecules, and the regulation of ionic equilibrium between the interior of the parasites and the surrounding host fluid (Fairweather *et al.,* 1999). The acanthocephalan tegument is a syncytium. The outer surface coat is carbohydrate rich glycocalyx. Closely packed pores at the tegument surface lead to pore canals that branch and reach the basal layer. This fluid filled system of channels is called the lacunar system. The body cavity is a pseudocoel. The pseudocoel contents are accessible to the lacunar system. The function of the lacunar system is unknown although it may play a role in the functioning of the body wall musculature or serve as some kind of "circulatory system."

Details of tegument ultrastructure in different acanthocephalans were studied by many authors; *Moniliformis dubius* (Nicholas and Mercer, 1965), *Moniliformis moniliformis* (Wright and Lumsden, 1968), *Acanthocephalus ranae* (Hammond, 1968b), *Acanthocephalus anguillae* (Taraschewski, 1988), *Telosentis exiguus* (Dezfuli and Giovanni, 1990), *Paratenuisentis ambiguus* (Hehn *et al.,* 2001), *Polymorphus magnus* (Nikishin, 2004), *Dentitruncus truttae* (Dezfuli *et al.,* 2008b), *Echinorhynchus gadi* (Elsayed*et al.,*2008), *Porrorchis indicus* (Abd-El- Moaty and Taeleb, 2011) and *Corynosoma strumosum* (Heckmann *et al*., 2013). The detailed study on the functional nature of the acanthocephalan absorptive surface can be made through electron microscopy and hence this study.

MATERIALS AND METHODS

For Transmission Electron Microscope (TEM) studies, the worms removed from the intestine were immediately fixed in 2% glutaraldehyde in 0.1 M cacodylate buffer, post-fixed in 1% osmium tetroxide in the same buffer for one hour, dehydrated and embedded in an Epon-Araldite mixture. Thin sections were cut on a Reichert Om U2 ultramicrotome with glass knife, stained in alcoholuranyl acetate solution and then in lead citrate and examined with a Hitachi H 7650 electron microscope.

OBSERVATIONS

The TEM images revealed the ultra structural organization of the different layers (Figs. 1-9). Glycocalyx wascharacterized by the presence of parallel channels, immersed in an electrondense, homogenous material (Figs. 1, 2 and 3) and above it a very thin granularelectrondense layer, the epicuticle, the external surface of which appeared more opaque (Fig 4). The distribution of these channels seemed to be rather uniform.

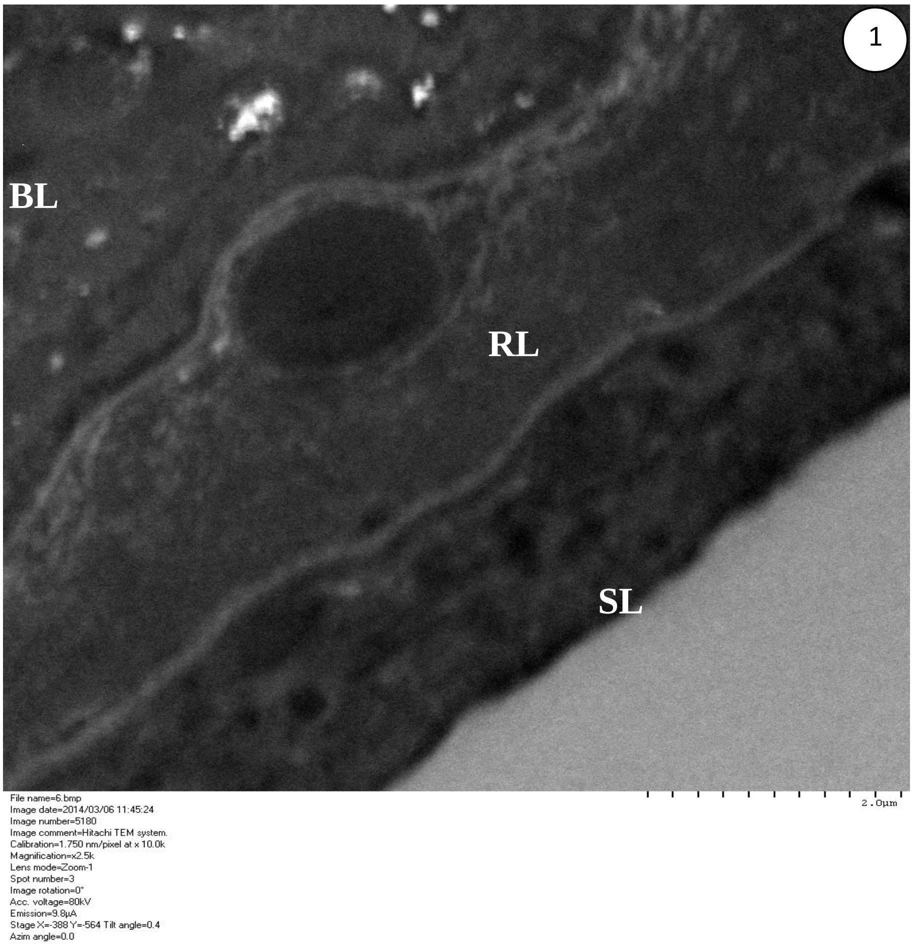

Figure 1. Transmission electron micrograph of *Echinorhynchusveli* showing the tegument.

GC-Glycocalyx SL-Striped Layer
RL-Radial Layer BL-Basement membrane Layer

The channels which characterized the glycocalyx extended to the striped layer with a decrease in diameter and separated by dense material as in the glycocalyx (Figs. 1 and 5). Bundles of fine cytoplasmic filaments were also visible extending from this layer to the basal region to form a ‘skeletal’ network.

The felt fibre layer contains edchannel terminals, looked like ovoidalvescicles of variable size, each filled with a fine, loosely packed granular material. This layer was also characterized by dense and compact matrix with granules and mitochondria (Figs.1 and 6).

The basement membrane layer was characterized by a dense matrix with nuclei, large vesicle-like structures and bundles of filaments (Figs. 1, 7, 8 and 9).

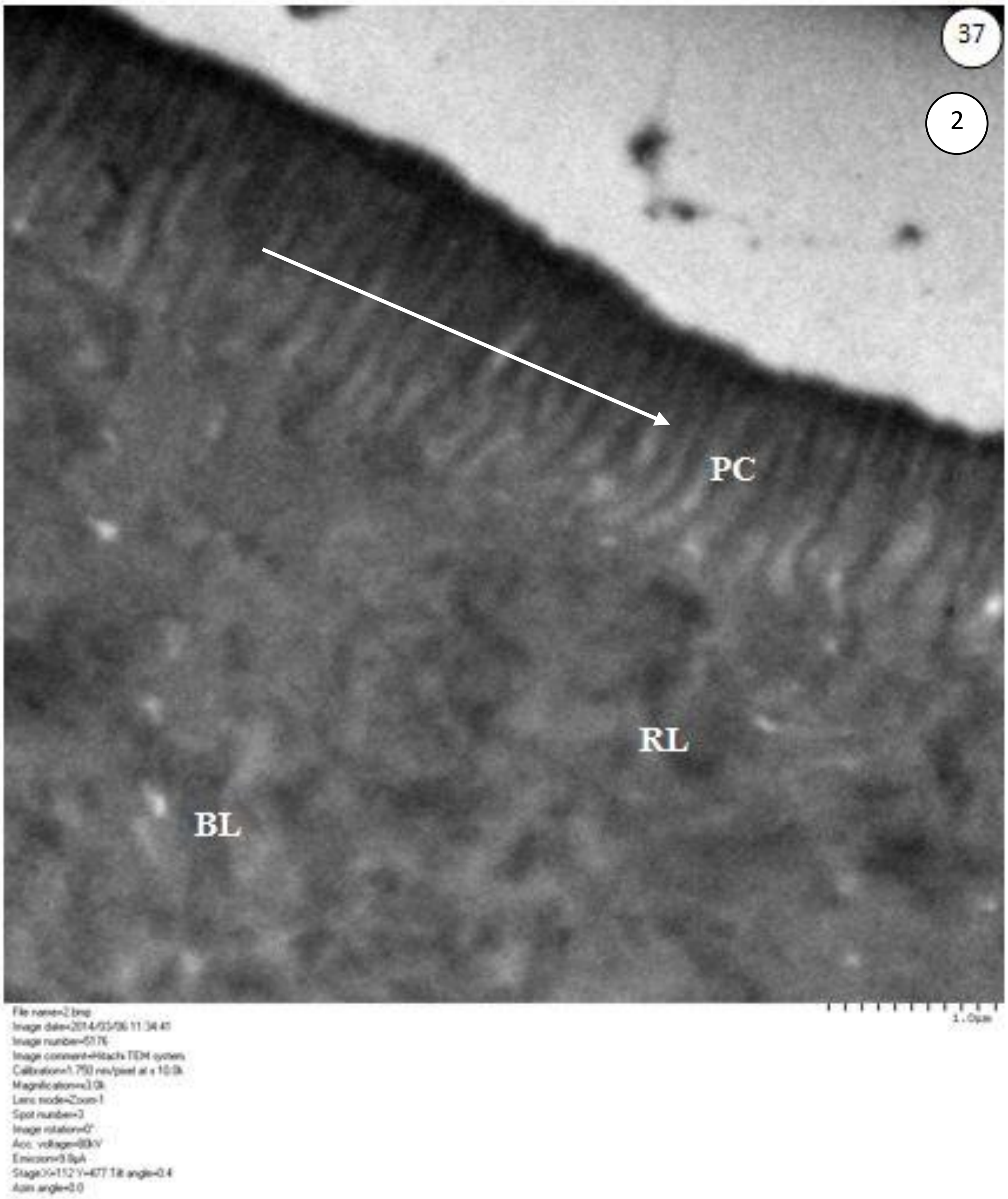

Figure 2. Transmission electron micrograph of *Echinorhynchusveli* showing parallel channels in the glycocalyx, shown by arrow.

PC-Parallel Channel RL-Radial Layer
BL-Basement membrane Layer

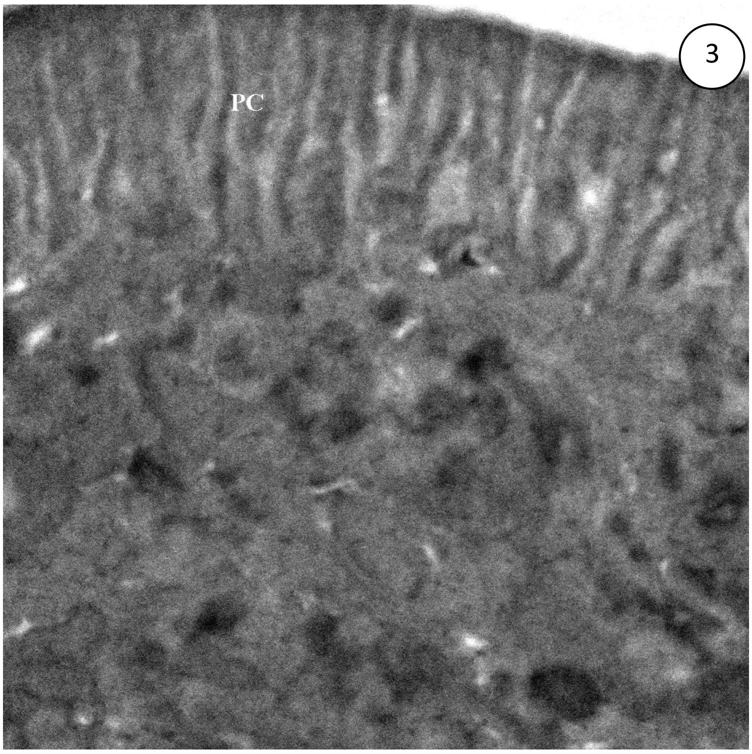

Figure 3. Transmission electron micrograph of *Echinorhynchusveli* showing parallel channels
PC-Parallel Channel

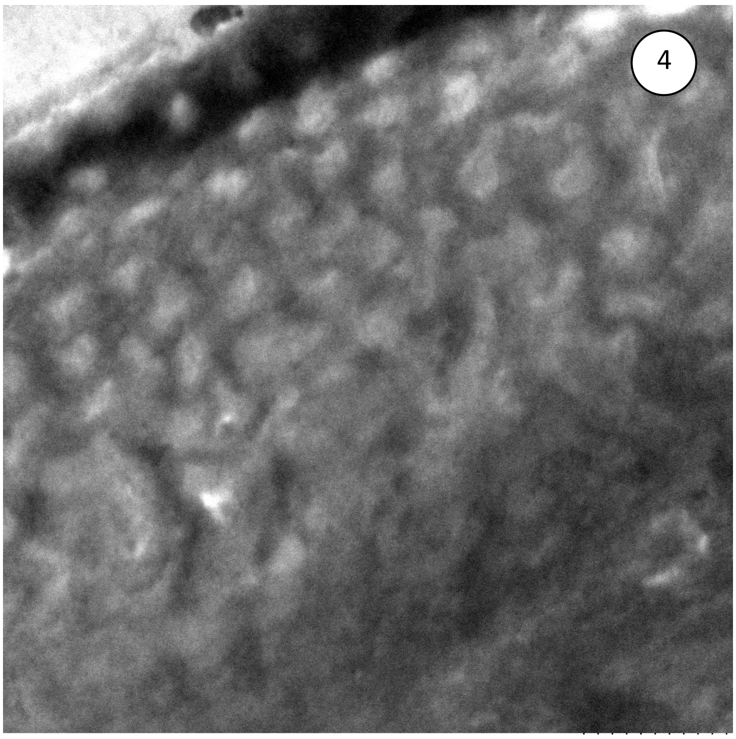

Figure 4. Transmission electron micrograph of *Echinorhynchus veli* showing Glycocalyx layer.

HM-Homogeneous Material

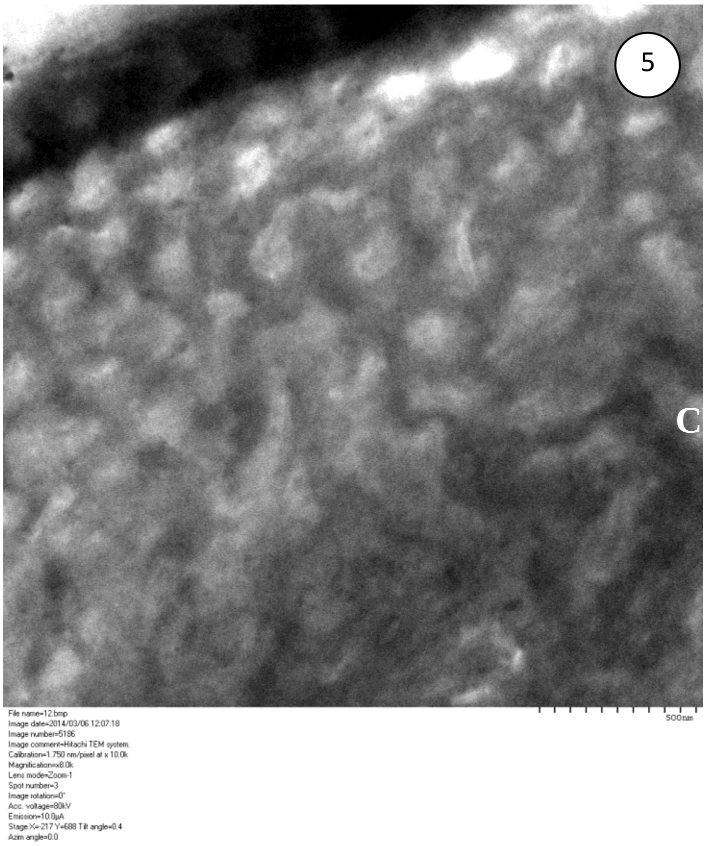

Figure 5. Transmission electron micrograph of *Echinorhynchus veli* showing the striped layer of tegument.

CF-Cytoplasmic Filament

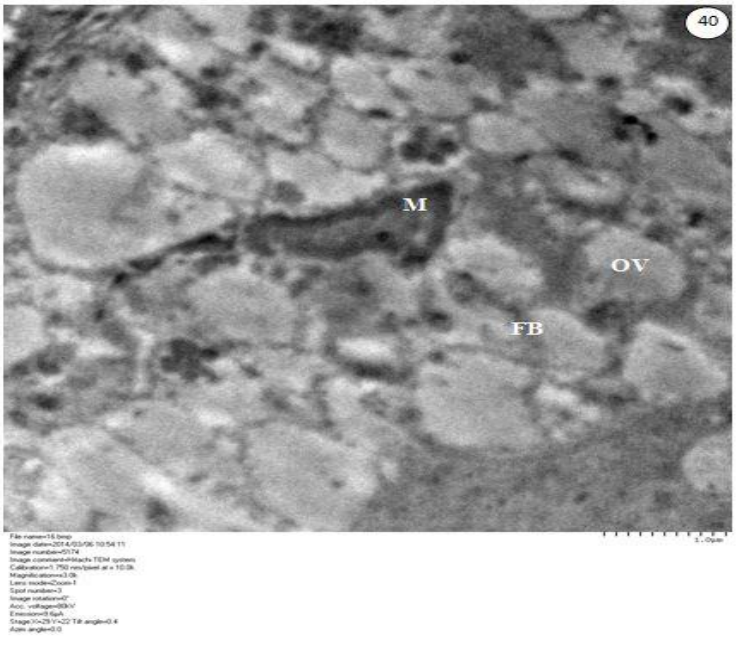

Figure 6. Transmission electron micrograph of *Echinorhynchus veli* showing the felt fibre layer of tegument.

OV-Ovoid VescicleM-Mitochondrion FB-Filament Bundle

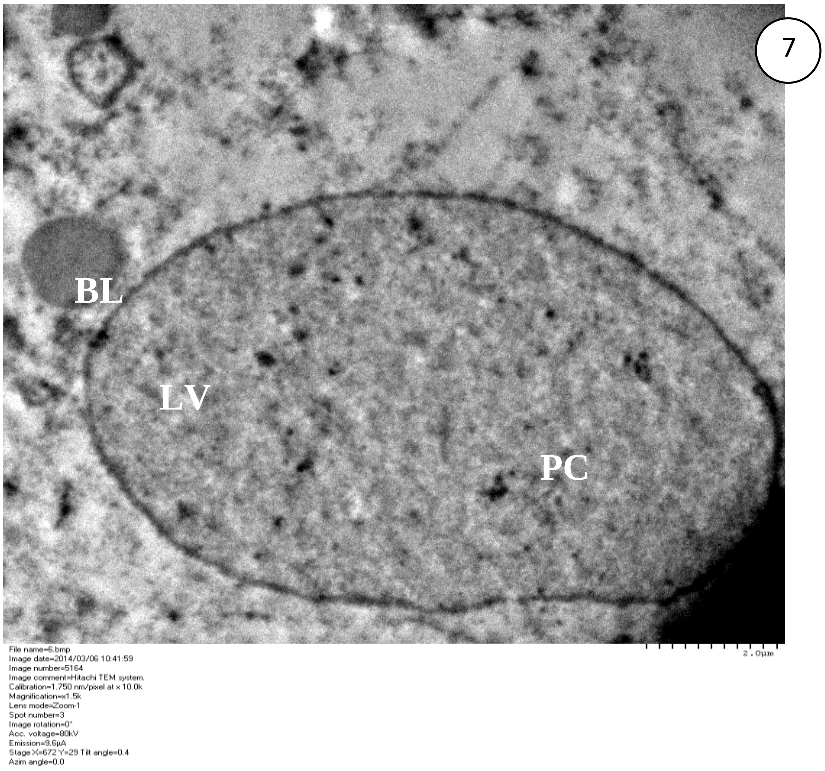

Figure 7. Transmission electron micrograph of *Echinorhynchusveli* showing large vesicle

N-Nucleus LV-Large Vesicle

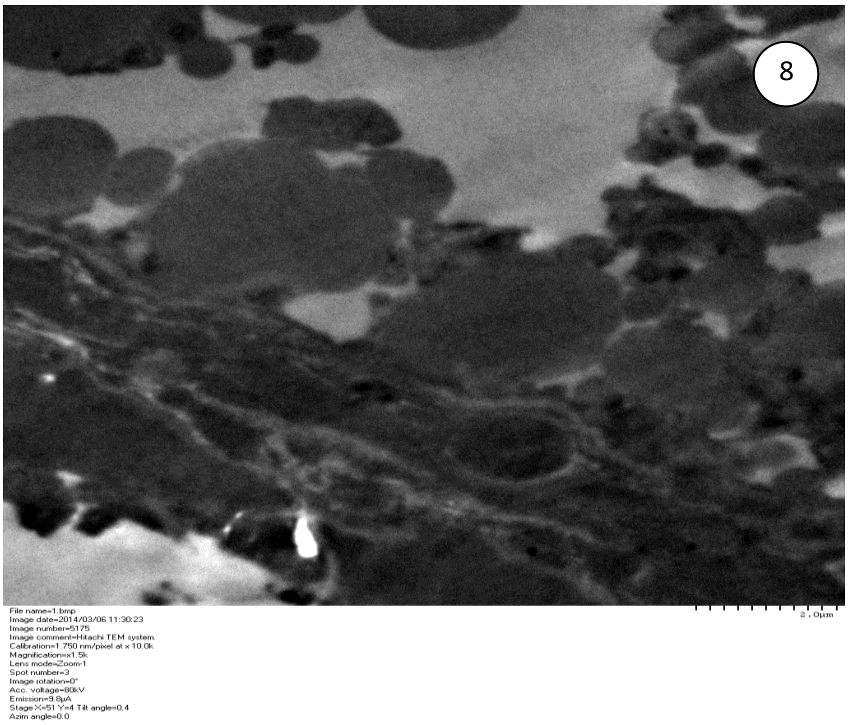

Figure 8. Transmission electron micrograph of *Echinorhynchus veli* showing mitochondria in the matrix

M-Mitochondrion

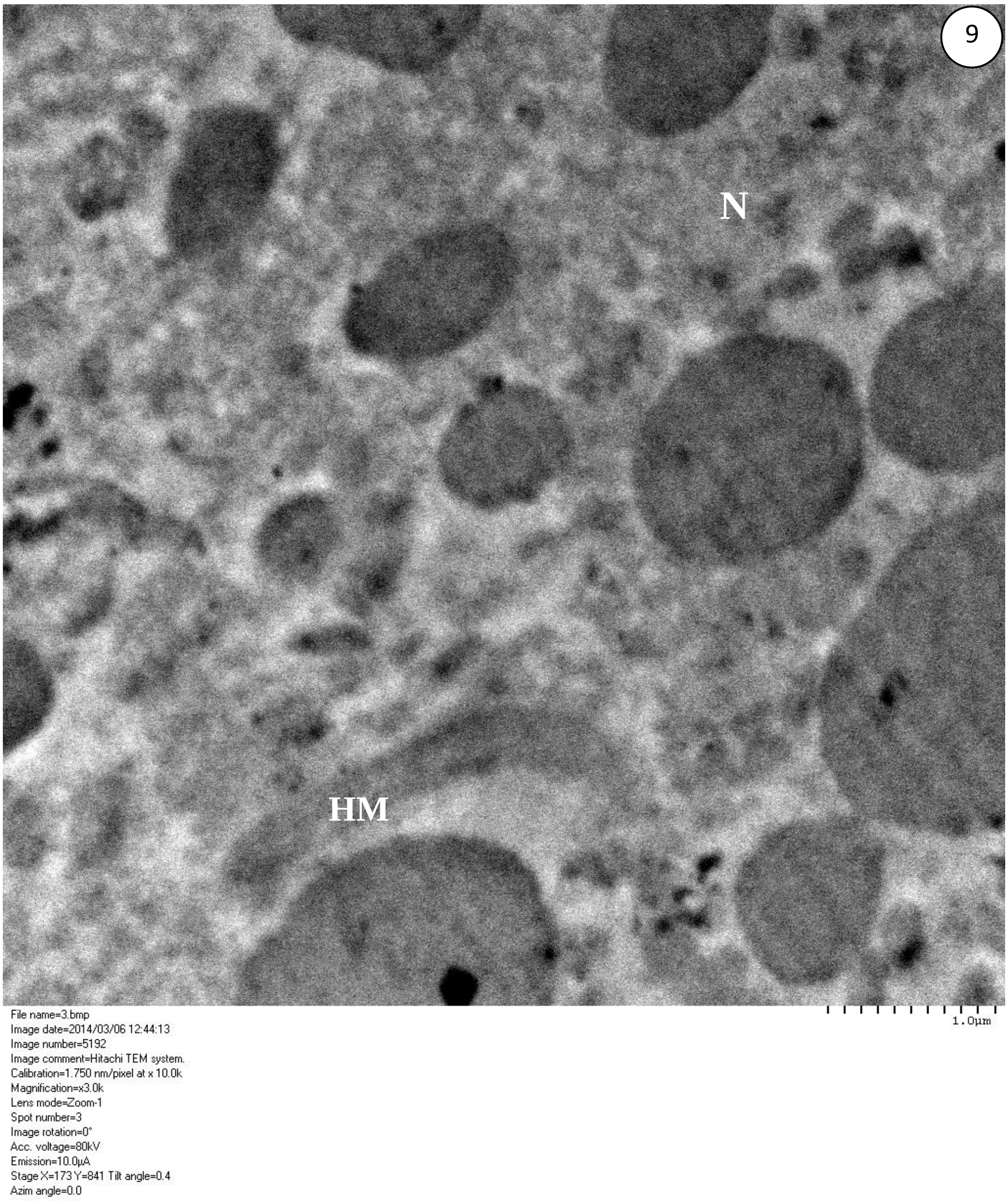

Figure 9. Transmission electron micrograph of *Echinorhynchus veli* showing nuclei in the basement membrane layer of the tegument

N-Nucleus

DISCUSSION

The acanthocephalan body wall is of interest because it is unique in structure and serves a number of functions (Hammond, 1967). Acanthocephalans are pseudocoelomate worms without an alimentary tract and take up nutrients through body wall. Whether the entire body wall, or only part of it serves this function is not known; nor is known whether all classes of nutrients enter through the same area of the body surface.The ultrastructure of the body wall of *Moniliformis dubius* shows a syncytial tegument, overlaid by a tenuous cuticle in the form of a finely fibrous extracellular fringe and is backed by a basement membrane.

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The soft bodied nature of the platyhelminths is due, largely, to the structure of tegument and its lack of sclerotic elements (Tyler and Hooge, 2004). The present ultrastructural studies showed that the outermost region of the tegument (glycocalyx) differs from that of the other species examined so far. This region, variously mentioned as a striped layer in *A.ranae* (Hammond, 1968b), terminal web in *M. dubius* (Byram and Fisher, 1973), streifenzone in *Echinorhynchus gadi* and *A. lucii* (Graeber and Storch, 1978), interdigitating folds in *M. hirudinaceus* and in *M. ingens* (Rothmann and Rosario, 1961),surface coat in *Echinorhynchus truttae* and *Pomphorhynchus laevis* (Hammond, 1968a)and outer dense zone in *Tenuisentis niloticus* (Whitfield, 1984), exhibits in all these species a cytoplasmic matrix, filled with moderately electron-opaque material with tightly packed fine filaments that most probably constitute anintegumental cytoskeleton. The glycocalyxis divided into an outer part, electron dense layer epicuticle, and an inner part having less electron dense matrix cuticle in *E. veli.* In *Telosentis exiguus* (Dezfuli and Giovanni, 1990), the outer most region of the integument is divided into an outer part, with an electron-dense cytoplasmic matrix, and an inner part having clear cytoplasm and variously oriented filament bundles. The body wall appears very well adapted to perform not only structural and protective functions, but also an absorptive function. The plasma membrane in fact penetrates into the integumental syncytium, producing an impressive array of tubular channels. Similar observations were in made in *M.dubius* (Byram and Fisher, 1973) and *E. gadi* (Graeber and Storch, 1978). These parasites, however, lack channels, but possess surface crypts.

ACKNOWLEDGEMENTS

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