

STICHOSOME ULTRASTRUCTURE OF THE FISH NEMATODE *CAPILLARIA PTEROPHYLLI* HEINZE, 1933

ŽD'ÁRSKÁ Z* & NEBESÁŘOVÁ J.*

Summary:

The stichosome (posterior glandular esophagus) of *Capillaria pterophylli* Heinze, 1933 consists of large gland cells (stichocytes) and luminal epithelium with cuticular lining. Both structures are enclosed in a reticulum of muscle cells. The stichocyte cytoplasm contains small cisternae of rough endoplasmic reticulum, Golgi complexes, one kind of electron dense secretory granules, mitochondria and a branching system of intracellular collecting ducts without filament bundles around them.

KEY WORDS : Nematoda, *Capillaria pterophylli*, ultrastructure, stichosome.

Résumé :

ULTRASTRUCTURE DU STICHOSOME DE *CAPILLARIA PTEROPHYLLI* HEINZE, 1933, PARASITE DE POISSON
Le stichosome (partie postérieure glandulaire de l'œsophage) de *Capillaria pterophylli* Heinze, 1933 est formé de grandes cellules glandulaires (stichocytes) et d'un épithélium revêtu de cuticule entourant la lumière œsophagienne. Ces deux structures sont enfermées dans un réseau de cellules musculaires. Le cytoplasme du stichocyte contient des petites citernes de reticulum endoplasmique rugueux, des complexes de Golgi, un seul type de granules de sécrétion denses aux électrons, des mitochondries et un système ramifié de canaux collecteurs intracellulaires qui ne sont pas entourés de faisceaux de filaments.

MOTS CLÉS : Nematoda, *Capillaria pterophylli*, ultrastructure, stichosome.

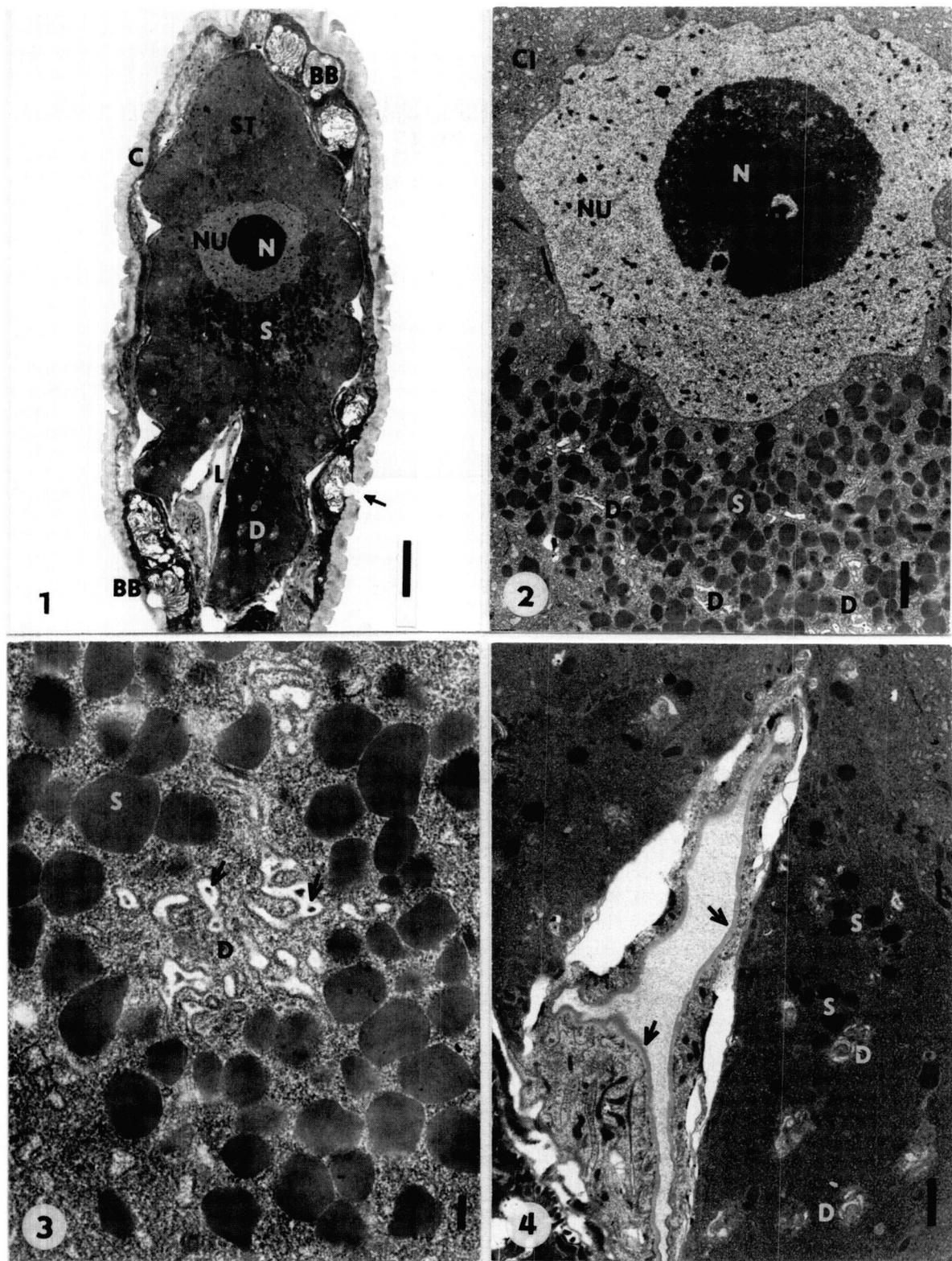
The present paper, describing the ultrastructure of the stichosome of *Capillaria pterophylli* Heinze, 1933, completes our studies on the ultrastructure of this nematode (Žd'árská & Nebesářová 1999, 2000). The esophagus of the superfamily *Trichinelloidea* Ward, 1907 (1879) consists of two distinct parts, the anterior muscular part and posterior glandular part termed the stichosome. The stichosome is an exocrine organ. The main component of the stichosome are large glandular cells, the stichocytes. Stichosome ultrastructure has been studied earlier in the family Trichuridae by Sheffield (1963) in *Trichuris muris* (Owen, 1835) and *T. vulpis* Froelich, 1789, and by Wright (1972) in *Trichuris myocastoris* Enigk and *T. vulpis* Froelich, 1789; in the family Trichinellidae by Bruce (1970), Despommier (1974), Despommier & Müller (1976) and Takahashi *et al.* (1992) in *Trichinella spiralis* (Schrank, 1788); in the family Capillaridae by Wright (1972) in *Capillaria hepatica* Bancroft, 1893, 1933 and by McDarby *et al.* (1987) in *Capillaria catostomi* (Pearse, 1924). From the family Cystoospiidae only histological data are available of two species of *Dioctowittus* Chabaud & Le Van Hoa, 1960 (Bain & Ghadirian (1967)).

In the recently accepted conception of Moravec (1982, 1987) of a new systematic arrangement of nematodes of the family Capillariidae, *Capillaria hepatica* (Bancroft, 1893) does not belong to the genus *Capillaria* s.s., but to the genus *Calodium* Dujardin, 1845, and *Capillaria catostomi* (Pearse, 1924) to the genus *Pseudocapillaria* Freitas, 1959. Therefore, in the new systematic arrangement, our study represents the first description of the stichosome ultrastructure in the genus *Capillaria* s.s.

MATERIALS AND METHODS

Female and male specimens of *C. pterophylli* Heinze, 1933 collected from the intestine of an angel fish *Pterophyllum scalare* (Lichtenstein, 1823) were rinsed in saline, fixed in 3 % glutaraldehyde in 0.1 M phosphate buffer (pH 7.2) at 4° C for two hours, postfixed in 1 % OsO₄ at 4° C for two hours, dehydrated in an ethanol series and embedded in Durcupan via acetone. A series of ultrathin sections of the whole stichosome (from the first stichocyte to the last one encircled by two pseudocoelomocytes) were cut using a Reichert Jung Ultracut E ultramicrotome, double-stained with uranyl acetate and lead citrate and viewed in a transmission electron microscope JEOL 1010 operated at 80 kV. Semi-thin sections were stained in toluidine blue.

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Figs 1-4. – Stichocyte of *C. pterophylli*. Fig. 1. Oblique TEM section through the body of *C. pterophylli* in the region of the stichosome. The stichosome fills the entire pseudocoelom. The stichocyte (ST) surrounds the lumen (L) of the esophagus. NU: nucleus, N: nucleolus, S: dense secretory granules, D: collecting ducts, BB: bacillary band gland cells, arrow: pore of BB, C: cuticle, scale bar = 5 μ m. Fig. 2. Detail of Fig. 1. NU: nucleus, N: nucleolus, S: secretory granules, D: collecting ducts, CI: small cisternae of rough endoplasmic reticulum, scale bar = 1 μ m. Fig. 3. Detail of Fig. 2 (bottom right). Collecting ducts (D) contain electron dense secretory material (arrows). S: secretory granules, scale bar = 200 nm. Fig. 4. Lumen of the esophagus lined by a thin cuticle (arrows) connected with a thin epithelial layer. D: collecting ducts, S: secretory granules, scale bar = 1 μ m.

RESULTS

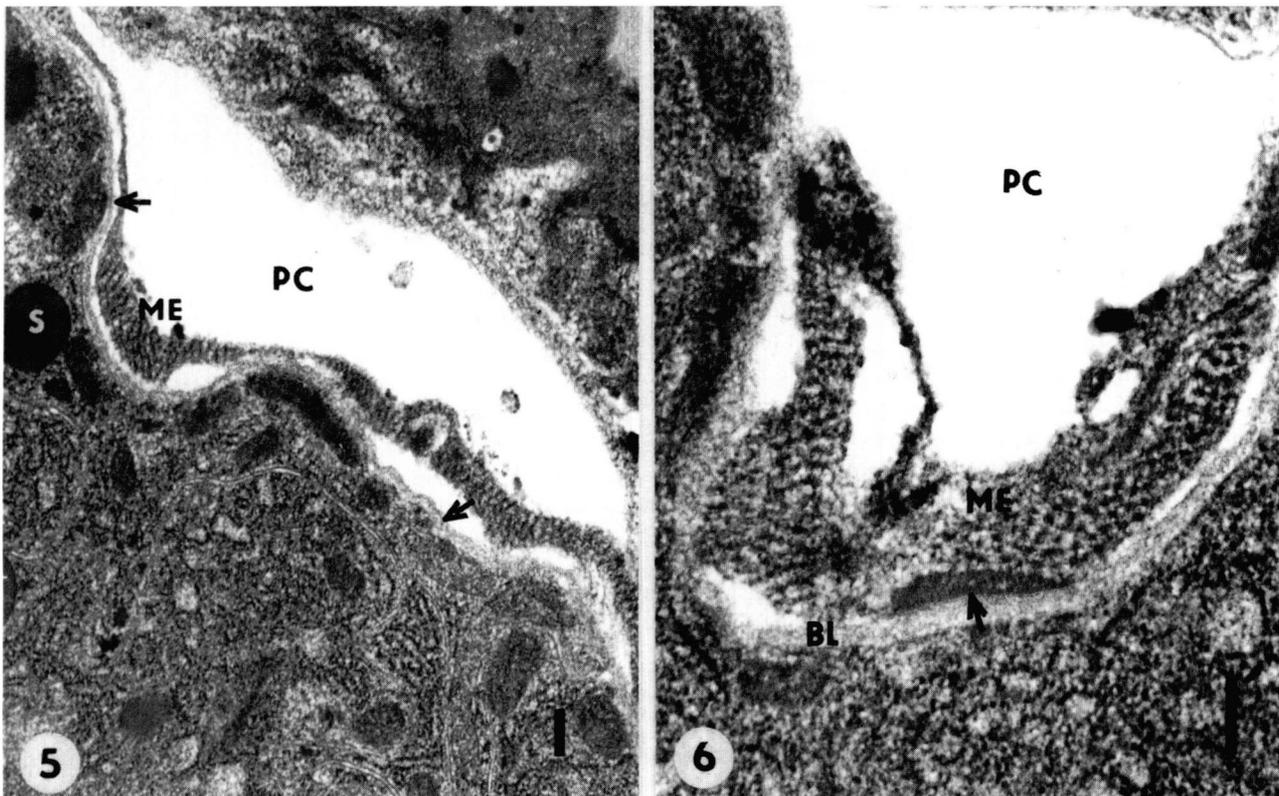
The stichosome of *C. pterophylli* consists of a single row of large gland cells, the stichocytes (Fig. 1) and an esophagus with cuticular lining (Figs 1, 4). The whole surface of the stichocytes adheres to a thin basal lamina. Over this basal lamina the stichosome surface through the whole length covers a meshwork (fenestrated layer) of muscle cells (Figs 5, 6). The dimensions of the lobes on the surface of the stichocyte (Fig. 1) depend on the contraction or dilatation of the peristichocytal muscle bands. The muscle cells, localized external to the stichocyte basal lamina contain myofilaments (Fig. 5) and are connected with the basal lamina by hemidesmosomes (Fig. 6). Concentration of electron dense granules occur around the nucleus and collecting ducts (Figs 1, 2, 3, 4). There is a great size diversity in granules (Figs 2, 3). Smaller-sized granules could represent stages of granulogenesis. Mature granules measure 500 nm. Some of them are round, other of irregular shape. The stichocyte cytoplasm contains a high concentration of rough endoplasmic reticulum with abundant small cisternae (Fig. 2), Golgi systems, and mitochondria mainly concentrated at the periphery of the cell. Around the nucleus, among the dense secretory granules, there are

aggregations of narrow collecting ducts containing small amount of electron dense material (Fig. 3). These collecting ducts, of irregular contour, pass through the cell to the esophagus (Figs 1, 4).

The esophagus (Fig. 4) comprises the cuticle and flattened epithelial cells connected by means of very fine desmosomes. No myofilaments were identified in this part of esophagus. The epithelial cells are separated from the stichocyte plasmalemma by a thin basal lamina. At some parts these epithelial cells are not detectable, mainly at the level of the last stichocyte, where small cytoplasmic evaginations of the stichocyte are connected directly to the cuticle by dense material. At the level of the last stichocyte, the stichosome is connected with the basal lamina of two pseudo-coelomocytes. At this level the esophagus, bordered by a cuticle, terminates, and continues as the intestinal lumen bordered by a microvillous zone of the enterocytes (see Ždárská & Nebesářová 1999 – Figs 1, 2, 3).

DISCUSSION

In cross sections of *C. pterophylli* one unicellular stichocyte surrounds the esophagus as in *Calodium hepaticum* (Wright, 1972), *Pseudocapillaria cato-*



Figs 5-6. – Stichocyte of *C. pterophylli*. Fig. 5. Muscle cells (ME) on the stichocyte surface. Arrows: basal lamina on the stichocyte surface, S: secretory granule, PC: pseudocoelom, scale bar = 200 nm. Fig. 6. Contracted part of the muscle cell (ME) with cross sectioned myofilaments and hemidesmosome (arrow), attaching this part to the stichocyte basal lamina (BL). PC: pseudocoelom, scale bar = 200 nm.

stomi (Mc Darby *et al.*, 1987), *Trichuris* species (Sheffield, 1963; Jenkins, 1970; Wright, 1972) and *Trichinella spiralis* (Khan, 1966; Bruce, 1970; Despommier, 1974; Despommier & Müller, 1976; Takahashi *et al.*, 1990, 1992). The unicellular stichocytes of *C. pterophylli*, and the above mentioned species, differ from the voluminous syncytial stichocytes of the genus *Diocetowittus* (Bain & Ghadirian, 1967; Moravec 2001).

The well developed peristichocytal muscle reticulum of the stichosome in *C. pterophylli*, as in *Calodium hepaticum* and *Trichuris* species (Wright, 1972) and *Trichinella spiralis* (Bruce, 1970; Despommier, 1974; Takahashi *et al.*, 1990) is important for the contractions that can be transmitted through the stichosome to the esophagus and from the esophagus to the intestine. Their function is probably to squeeze the content of the stichosome part of the esophagus to the intestine. The stichosome part of the esophagus in *C. pterophylli* comprises the cuticle and thin layer of epithelial cells connected with the stichocyte basal lamina. As in *C. hepaticum* (Wright, 1972) no myofilaments are present in the stichosome part of the esophagus of *C. pterophylli*.

Intracellular filament bundles localized around the collecting ducts in *C. hepaticum* (Wright, 1972) were not detected in the stichocytes of *C. pterophylli*. Electron-dense secretory granules observed in stichocytes of the anterior, middle and posterior part of the stichosome, which are concentrated around the stichocyte collecting ducts, probably desintegrate when entering into the ducts. In the collecting ducts of *C. pterophylli* some electron dense material is present and presumably is carried from the stichocyte into the esophagus. No granules were observed in the canalicular tree. We do not divide the mature electron-dense granules in *C. pterophylli* into two types. In our opinion coexistence of two types of granules (more or less rounded) in *C. pterophylli* represents two stages of granulogenesis which can result, as documented in *T. spiralis* (Takahashi, 1992), in a difference in antigenicity. The dense secretory granules probably contain some of the enzymes identified in *Trichuris muris* by Nimmo-Smyth and Keeling (1960). In transportation of the stichocyte secretory product from the collecting ducts to the esophagus lumen assist probably contractions of the peristichocytal muscle reticulum.

Our ultrastructural investigation of the stichosome of *C. pterophylli* has not confirmed a pore-like opening of the stichocytes to the esophagus as reported by Bruce (1970) and Takahashi *et al.* (1992) in *Trichinella spiralis*, Wright (1972) in *Calodium hepaticum*, and Bain & Ghadirian (1967) in *Diocetowittus chabaudi* and *D. wittei*. At the ultrastructural level in *Trichuris* species Sheffield (1963), Jenkins (1970) and Wright (1972) were unable to detect these pore-like openings too. Pore-like openings of stichocytes to the esophageal

lumen undoubtedly occur in *C. pterophylli* as in *C. hepaticum*, *T. spiralis* and *Diocetowittus* spp. In *C. pterophylli* as in *Trichuris* spp, they have not yet been seen in electron microscopy because of the great sampling problem involved in locating this single, small structure in the large stichocytes.

ACKNOWLEDGEMENTS

We are grateful for the help given by Dr F. Moravec and Ing. B. Škoríková in collecting the parasitized hosts. We also appreciate the technical assistance of Mr. A. Polák and Mrs. P. Masařová. This study was supported by a grant from the Grant Agency of the Czech Republic no. 524/97/0009 and a grant of the Academy of Sciences of the Czech Republic no. K2-022-601.

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Reçu le 10 février 2001

Accepté le 6 décembre 2001