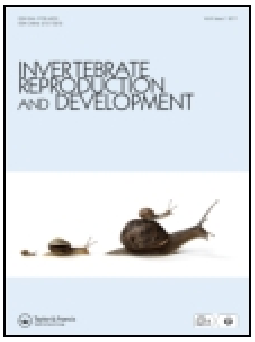



Invertebrate Reproduction & Development

ISSN: 0792-4259 (Print) 2157-0272 (Online) Journal homepage: http://www.tandfonline.com/loi/tinv20

# Ultrastructure of spermathecal epithelium of Ctenolepisma longicaudata (Insecta: Thysanura)

SMITA PALIT & SANTI G. PAL

**To cite this article:** SMITA PALIT & SANTI G. PAL (1999) Ultrastructure of spermathecal epithelium of Ctenolepisma longicaudata (Insecta: Thysanura), Invertebrate Reproduction & Development, 36:1-3, 159-162, DOI: 10.1080/07924259.1999.9652693

**To link to this article:** http://dx.doi.org/10.1080/07924259.1999.9652693

Published online: 01 Dec 2010.

Submit your article to this journal

Article views: 9

View related articles

Citing articles: 2 View citing articles

Full Terms & Conditions of access and use can be found at
http://www.tandfonline.com/action/journalInformation?journalCode=tinv20

**Download by:** [NMBU] **Date:** 08 September 2017, At: 00:19

*Invertebrate Reproduction and Development*, 36:1–3 (1999) 159–162
Balaban, Philadelphia/Rehovot

0168-8170/99/$05.00 © 1999 Balaban

# Ultrastructure of spermathecal epithelium of *Ctenolepisma longicaudata* (Insecta: Thysanura)

SMITA PALIT* and SANTI G. PAL
*Department of Zoology, Calcutta University, 35 Ballygunge Circular Road, Calcutta 700 019, India*
*Fax +91 (33) 33476-4419*

Downloaded by [NMBU] at 00:19 08 September 2017

## Summary

The epithelial cells and their ultrastructural features of the Spermatheca of *Ctenolepisma longicaudata* have been described. In addition to the epithelial cells, both muscle and cuticular cells are also present in this organ. A variety of secretory vesicles and granules having lysosomal enzymes or mucoproteins is elaborated by the epithelial cells which are subsequently conducted to the apical cytoplasm for discharge in the lumen. Microtubules are involved in the direction of flow of secretory products. Besides, the cuticular and muscle cells of his organ of *C. longicaudata* make the latter exceedingly complicated for sperm storage, conduction and viability.

*Key words*: Apterygote, spermatheca, cuticular cells, epithelial cells, secretions, glycogen

## Introduction

The reproductive significance of the spermatheca of *Ctenolepisma longicaudata* in storage and nutrition of sperm has been studied from the ultrastructural details of this organ. The functional morphology of insect spermatheca has been reviewed by several workers (Davey, 1985; Cedric Gillot, 1988). Further Bistch (1991) gave fine structural details of the epidermal glands in Apterygota. Recently, insect epidermal glands have been restudied by Quennedy (1998) but no comprehensive account was available on spermatheca of the Apterygotes.

## Materials and Methods

*Ctenolepisma* was collected from the drawers of our laboratory. The animals were kept alive in long cylindrical glass jars and were provided with small papers. Adult females were sacrificed; their spermatheca were dissected out in 0.1 M phosphate buffer (pH 7.2) and fixed in 2% ice cold glutaraldehyde in 0.1 M phosphate buffer for 1 h at 4°C. Tissues were postfixed in 1% $OsO_4$ in distilled water at room temperature. Dehydration was carried out in alcohol series and embedded in Araldite mixtures. Sections were cut with glass knives, stained with uranyl acetate and lead citrate and examined under the electron microscope.

*Corresponding author.

*Proceedings of the 8th International Congress on Invertebrate Reproduction and Development, Amsterdam, The Netherlands, 10–14 August 1998.*

Downloaded by [NMBU] at 00:19 08 September 2017

## Results

The spermatheca of *Ctenolepisma longicaudata* is histologically complex with glands and fine ductules (Pal and Palit, 1986a, 1986b). The glandular epithelium of the spermatheca extends throughout, along with a thick cuticle, lining the lumen. The extended postero-dorsal region consists of several stratified muscle layers. Ultrastructurally, three different cell layers are observed.

### *Glandular epithelium cells*

The glandular epithelium cells are tall, supported by a thick basement membrane with a basal plasma membrane that is deeply infolded and forms narrow channels; the lateral cell membranes are closely apposed and possess membrane-associated densities (Fig. 1). The nucleus is large and rounded. The outer margin of the nucleolemma is studded with ribonucleoprotein particles, and many nuclear pores are visible. The nucleoplasm shows moderate electron density. The cytoplasm consists of RER and several types of ovoid vesicles. Some irregular vesicles are filled with an electron-dense fine substance, others are membrane-bound vesicles with ribosomes; some granular osmiophilic masses without a membrane are observed. A non-extensive Golgi apparatus lies close to the nucleus. Further, many electron-dense fibrillar myelin bodies and beta-glycogen particles are scattered in the cytoplasm (Fig. 2).

### *Cuticular cells*

The cuticular cells are responsible for the production of a thick cuticular layer or intima within the spermatheca. The cells are small; their apical cytoplasm integrates with the cuticular region. The nucleus is irregular and its outer membrane is studded with small ribonucleoprotein particles. Each nucleus contains a conspicuous nucleolus. Dense heterochromatin material is arranged in a wavy pattern along the inner nuclear membrane. The cytoplasm is characterized by many mitochondria. RER and numerous small membrane-bound osmiophilic bodies are also observed (Fig. 3). The apical cytoplasm of the cuticular cell is vacuolated. The marginal cytoplasm adjoining the cuticle possesses many small electron-dense granules displaying a osmiophilic substructure within a clear-looking vesicle (Fig. 4).

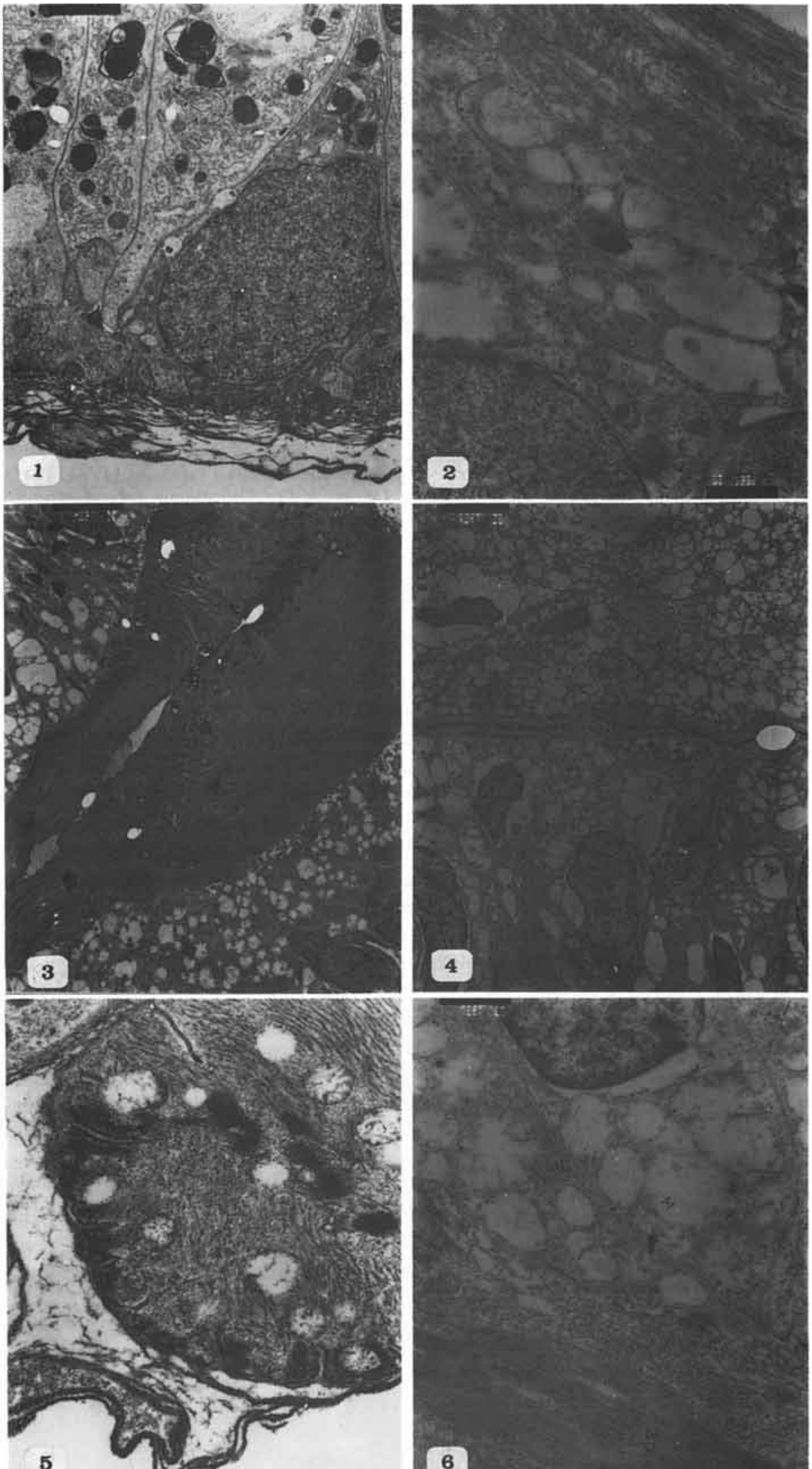
The apical marginal cytoplasm of the cuticle cell shows the presence of several tapering, dense, filamentous bundles originating from the cuticle. Ultrastructurally, three distinct layers can be distinguished in the cuticle, namely epicuticle, subcuticle and endocuticle. The epicuticle is the outermost electron dense layer of 0.05 $\mu$m in thickness. This is composed of lipoprotein materials (Pal and Palit, 1986b). The subcuticle is composed of four to five parallel-arranged wavy layers of alternate electron-lucent and electron-opaque components. It measures about 0.5 $\mu$m in thickness. The endocuticle is moderately electron-lucent and many pore canals pass through this zone which ultimately open into the lumen of the spermatheca. The diameter of the pore canals is 0.9 $\mu$m (Figs. 3, 4).

### *Ultrastructure of muscle cells*

The muscle cells contain actin and myosin types of myofilaments. The agranular sarcoplasmic reticulum lies parallel to the long axis of the sarcoplasm. Mitochondria are close to the nucleus but do not show features of high metabolic activity. The sarcoplasm is filled with myofilaments, fine granules and lipid droplets. Myofibrils show distinct I and A bands which are further partitioned by one or two "Z" bands (Fig. 5). The nucleus is angular, with a scattered mass of heterochromatin and euchromatin at the periphery and a small nucleolus. The plasma membrane invaginates into the sarcoplasm at regular intervals forming minute channels. Some clear areas are present in basal muscles (Fig. 6). These are apparently without membranes and may possess some floccular materials. Beside these, there are deposits of beta-glycogen particles.

---

**Figs. 1–6.** Fig. 1. Electron micrograph of glandular epithelial cells of spermatheca, basement membrane (BM), nucleus (N), RER, part of Golgi complex (GC), vesicle (V), mitochondria (M), myelin body (M). ×11,500. Fig. 2. Electron micrograph detailing part of a glandular epithelial cell. Connective tissue (CT) and part of muscle cell (MC), vacuolated epithelial cell (EP). × 11,500. Fig. 3. Electron micrograph showing cuticular cell with dense heterochromatin and nucleolus in the nucleoplasm, irregular nuclear envelope (NE), secretory vesicles (SV), secretory masses (SM), mitochondria (M) and thin cuticle deposition (CU). ×2500. Fig. 4. Electron micrograph showing details of stratified cuticle showing epicuticle (Cu), subcuticle (S Cu) and endocuticle (En Cu) with dark deposits and some sections of sperm (Sp). ×5800. Fig. 5. Magnified view of a section from muscle region showing invagination of sarcolemma (S), myofilaments (MF) and mitochondria (M). ×3600. Fig. 6. Highly magnified view of a section from muscle cell region showing nucleus (N), sarcoplasmic reticulum (SR) I A bands, mitochondria (M). ×13,860.




Downloaded by [NMBU] at 00:19 08 September 2017

Downloaded by [NMBU] at 00:19 08 September 2017

## Discussion

Morphologically, the spermathecal complex of *Ctenolepisma* is different from the accounts of Barnhart (1961) and Torgerson and Akre (1969). Ultrastructurally, three distinct cell types are the common elements in this organ (Adyodi and Adyodi, 1975; Davey, 1985).

The various vesicles with electron-dense and flocculant materials, osmiophilic bodies and myelin structures are probably involved in biosynthesis and these substructures may belong to the lysosomal family or they may consist of mucoproteins or secretory products, as claimed previously in some Pterygote insects (Hallberg, 1984; Kokwaro et al., 1981). These secretory products are synthesized early within the cell and probably undergo chemical modification as they move subsequently towards the apical region of the cells for discharge. The heterogeneity and structural diversity of the secretory vesicles or granules within the epithelial cells indicate that a complex regulatory synthetic pathway is in operation in these cells.

The extensive distribution of RER and the localization of numerous microtubules at the level of the nuclei are highly suggestive of their participation in the flow direction of various secretory materials in these cells of the spermatheca. Similar features have been recorded earlier (Bistch, 1981, 1991; Cedric Gillot, 1988). The cuticle cells are involved in cuticulogenesis (Bistch, 1981). It is clear that the cell types and their subcellular components of the spermatheca of *C. Longicaudata* are exceedingly complicated, and this interdependence of various vesicles, granules, vacuoles and microtubules is highlighted in the present study. Cuticular cells and muscle cells in the spermatheca of *C. longicaudata* form other essential components of this organ. In fact, the histological structures and the fine cellular features of muscle cells require new explanations for sperm storage, conduction, etc., in this organ.

## References

Adiyodi, K.G. and Adiyodi, R.G., Morphology and cytology of the accessory sex gland in invertebrates. Int. Rev. Cytol., 43 (1975) 353–398.

Barnhart, C.C. Sr., The internal anatomy of the silverfish (*Ctenolepisma campbelli* and *Lepisma saccharina*) Thysanura: Lepismatidae. Ann. Entomol. Soc. Amer., 54 (1961) 177–196.

Bistch, J., Ultrastructural modification of the glandular epithelium of the receptaculum seminis in *Thermobia domestica* Insecta Thysanura during the molting period. Cell Tissue Res., 220 (1981) 99–113.

Bistch, J., The glandular units of the spermatheca of Machilids (Microcoryphia) ultrastructural modification during molt. Int. J. Ins. Morph. Embryol., 18 (1989) 97–110.

Bistch, J. and Bistch, C., Glands epidermiques des apterygote ultrastructural modification lors de lomue. Ann. Soc. Ent. Fr. NS, 27 (1991) 129–142.

Davey, K.G., The female reproductive tract. In: Comprehensive Insect Physiology, Biochemistry and Pharmacology, Kerkut, G.A. and Gilbert, L.I. (eds.), Vol. 1, Pergamon Press, 1984, Oxford, pp. 15–36.

Gillot, C., Invertebrates, Vol. III. Accessory Sex Glands, Adiyodi K.G. and Adiyodi, R.G. (eds.), BH Bup., 1988, India, pp. 319–471.

Hallberg, E., The spermathecal complex in *Ips* typographus differentiation of the spermathecal gland related to age and reproductive state. J. Ins. Phys., 30 (1984) 197–202.

Kokwaro, E.D., Odhiambo, T.R. and Murithi, J.K., Ultrastructural and histochemical study of the spermatheca of the tsetse *Glossina morsitans* M. Westwood. Inst. Sci. Appl., 2 (1981) 135–143.

Pal, S.G. and Palit, S., Microscopy of the spermatheca of *Ctenolepisma longicaudata*. In: Advanced Insect Physiology, Pathak, S.C. and Sabai, Y.N. (eds.), Today & Tomorrow's Privn. & Pub., 1986a, New Delhi, pp. 231–237.

Pal, S.G. and Palit, S., Further observations on spermatheca of *Ctenolepisma longicaudata*. In: Advances in Cytology and Genetics, Bhatnagar, V.S. (eds.), Allahabad University, 1986b, India, pp. 15–18.

Quennedy, A., Insect epidermal gland cells ultrastructure and morphogenesis. In: Microscopic Anatomy of Invertebrates, Vol. 11A, Wiley-Liss, New York, 1998, pp. 177–202.

Torgerson, R.L. and Akre, R.D., Reproduction morphology and behaviour of a thysanuran, *Trichatelura manni*, associated with Army Ants. Anal. Entomol. Soc. Amer., 62 (1969) 1367–1374.