MICROSCOPICAL ANATOMY OF LARVA OF CHELADONTA COSTULATA (ACARINA: TROMBICULIDAE) II. BODY TEGUMENT AND DIGESTIVE SYSTEM

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Abstract. The cuticle of gnathosoma of Cheladonta costulata larva consists of a smooth and firm epicuticle and sclerotized procuticle. The cuticle of the idiosoma is elastic. The wall of the digestive system is formed by cells lying on the basal membrane. During the process of sucking, however, the intestinal cells, which were originally spherical, get an appearance of a club reaching up to the lumen of intestine. In a fully engorged larva the intestine appears to be united and fill the major part of body. The lumen of the intestine is filled with eosinophilic granules of various size, among which are minute granules with basophilic tinge. The excretory bladder is located between posterior lobes of the intestine. In an unengorged larva, the excretory bladder is conical and possesses a conspicuous wall of a cellular structure. Its lumen is empty. In a fully engorged larva, the excretory bladder is oval, covered with a thin membrane, and its lumen is filled with guanine crystals.

The internal anatomy and histology of larvae of the genus Cheladonta has not yet been dealt with in any paper. Only Kepka (1963) has noticed the structure and content of the intestine of these larvae. Sixl (1973) described the morphology of larvae, nymphs and adults of Ascioschoengastia latyshevi. He studied in detail the sensory and genital organs and described also the digestive system of larva. According to this author, the digestive system begins with six glands, the opening of which is situated near chelicerae. A strongly muscular oesophagus leads into the intestine which is interrupted by an excretory bladder. In this bladder are crystals of unknown origin.

MATERIAL AND METHODS

The material was collected by Daniel and Šlais (1957) during the investigations of a natural focus of haemorrhagic nephrosonephritis in eastern Slovakia. It was processed by the same methods as those described in detail in the previous paper (Schramlová 1978).

RESULTS

A. BODY TEGUMENT

The body tegument of trombiculids, like that of other arthropods, is formed by a layer of hypodermal cells secernating the cuticle. The cuticle of gnathosoma of Ch. costulata consists of a smooth and firm epicuticle, beneath which is a fully sclerotized, very firm procuticle. On the other hand, the cuticle of the idiosoma is elastic, flexible and permits a maximum extension which is enabled by the structure of its procuticle. The larva enlarges three- to four times during its metamorphosis into the nymph.

The larva which has not yet fed or has just started to feed has the cuticle of idiosoma...
markedly frilled. The alternating ridges and grooves of the folds appear like narrow
and wide bands (Plate I, Fig. 2). Several layers are discernible in transverse section
through the cuticle: the surface layer is formed by the epicuticle, which is strongly
frilled in unengorged larva and whose frills are filled with mesocuticle. The inner sur-
face is formed by the endocuticle, which is also markedly frilled and the ridges of
its frill reach up to the frilled epicuticle. During the process of feeding the cuticle is
gradually smoothening and in a fully engorged larva the idiosoma is already smooth
(Plate I, Fig. 3). Only the epicuticle may be still slightly undulated.

Beneath the cuticle, there is a layer of hypodermal cells which also change during
the process of feeding. In unengorged larvae it consists of flat cells with a small,
clear nucleus adjoining to the cuticle (Plate II, Fig. 1). The borders of cells are not
sharp. In engorged larvae, the layer of hypodermal cells increases, the borders be-
 tween individual cells are more distinct, the nucleus is conspicuous and granules are
discernible in their cytoplasm. In unengorged larvae, the granules were not visible
as individual structures, they were pressed together and caused the homogeneously
basophilic character of this layer. Owing to the increase of body size, in fully engorged
larvae the hypodermal cells are more extending, become flat, and their nuclei are
prominent. Thus the whole layer differs from the low, basophilic hypoderma of
unengorged larvae.

B. DIGESTIVE SYSTEM

The digestive system begins with the mouth opening, pharynx and oesophagus.
The thin wall of oesophagus consists of basophilic cells and its inner surface is lined
with a smooth, slightly eosinophilic cuticle. The oesophagus passes between cerebral
ganglia and then widens in form of a funnel and opens into anterior common cavity
of main lateral parts of the intestine. The intestine fills the major part of body. Each
of its halves forms three secondary lobes. The intestinal wall consists of cells lying
on the basal membrane. The appearance of intestinal cells remain unchanged during
the process of feeding. The intestinal cells of unengorged larvae are rounded and
their nucleus with the nucleolus is clearly visible (Plate I, Fig. 2). The nuclear chroma-
tin is arranged on the periphery of the nucleus forming a 0.7 μm wide layer, which
gives rise to a 0.5 μm wide light field around the nucleolus. The cytoplasm of these
intestinal cells is filled with small granules staining intensively with haematoxyline.
Already at the beginning of the feeding process, there occur changes in the intestinal
cells: vacuoles start to arise in the cytoplasm in the proximity of the nucleus and
chromatin is dispersed in the whole nucleus. During the further course, the vacuoles
shift in apical direction and another granules of various character appear in the cell
cytoplasm. The changes occurring inside the cells manifest themselves also in the
shape of cells: they are no more spherical but club-shaped, extending towards the
lumen of intestine. Their cytoplasm is gradually filled with further granules showing
eosinophilic staining ability. No intestinal cells of original form have been found
in a fully engorged larva. The intestine appeared as a unit filling the majority of the
body and filled with eosinophilic granules of various size (Plate I, Fig. 3) among
which small granules with basophilic tinge were dispersed.

C. EXCRETORY BLADDER

The excretory bladder is situated between posterior lobes of the intestine. Like
almost all other organs of the larva, also the excretory bladder undergoes changes
during the feeding process. In an unengorged larva it is conical and is situated in the
posterior part of idiosoma. At this stage, its wall is conspicuous, with cellular structure
and the lumen is empty (Plate I, Fig. 1). During the feeding process, guanine crystals
begin to accumulate inside the bladder and it is gradually extending. (Plate II, Fig. 2) its wall becomes thinner and loses the cellular character. In a fully engorged larva, the excretory bladder is oval, covered with a thin membrane on the surface, and its lumen is filled with guanine crystals (Plate I, Fig. 3).

DISCUSSION

The cuticle of Ch. costulata larvae was compared with that of ticks described in detail by Balashev (1967). In accord with Balashev’s conclusions we have found that also the cuticle of gnathosoma of Ch. costulata is formed by a firm and smooth epicuticle and beneath it is a fully sclerotized procuticle. Like in ticks of the family Argasidae, the cuticle of idiosoma consists of two layers: outer epicuticle and inner procuticle, which is formed by a mesocuticle and inner, very thin layer of endocuticle. In an unengorged larva of Ch. costulata, the endocuticle is hardly discernible from the mesocuticle.

The digestive system of trombiculid larvae has been only little studied. Kepka (1963), Voigt (1971) and Sixl (1973), who studied the anatomy of larvae, usually omitted the structure and function of the intestine. We were unable to find any paper dealing with this subject in detail. Only Kepka (1963), who studied the larvae of several mite species, always found only a granular mass and no cells in the content of intestine in Ch. costulata and Ch. ikaoensis larvae. In our studies, this granular mass was found only in the intestine of fully engorged larvae of Ch. costulata. In earlier phases of feeding, however, the content of intestine is different and the cellular structure of the intestinal wall, whose appearance is changing in various phases of feeding, was well discernible in these phases.

Also the changes in intestinal cells which occur during the feeding process of Ch. costulata larvae were compared by Balashov’s (1967) detailed description of the intestinal wall during the feeding of ticks on their host. Similarly as the intestinal wall of unengorged larva of Ch. costulata, in unfed larvae of ticks the intestinal wall consists of one layer of cells with a conspicuous nucleus. During the feeding of ticks, there occur changes in the intestinal cells and vacuoles arise in the proximity of the nucleus. The same was observed also in the intestinal cells of Ch. costulata larvae. Also the club-shaped form and extension of intestinal cells into the lumen of the intestine was identical in larvae of both Ch. costulata and ticks. Balashov (1967) observed that individual intestinal cells were released into the lumen of the intestine, but this phenomenon has not been seen in the larvae of Ch. costulata. The intestinal cells in their original form (low) adjacent to the basal membrane are visible in every phase of feeding in tick larvae. But this is not the case with Ch. costulata, and in a fully engorged larva the intestine is filled with a granular mass and the cellular structure of the intestine is not visible.

МИКРОСКОПИЧЕСКАЯ АНАТОМИЯ ЛИЧИНКИ КРАСНОТЕЛКИ CHELADONTA COSTULATA (ACARINA: TROMBICULIDAE)
II. ПОКРОВ ТЕЛА И ПИЩЕВАРИТЕЛЬНАЯ СИСТЕМА

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Резюме. Кутикула гнатосомы лицинки Cheladonta costulata образована гладкой и крепкой эпикутикулой и склеротизированной прокутикулой. Кутикула идосомы эластична. Стена пищеварительной системы состоит из клеток, лежащих на базальной мембране. Во время питания круглая форма клеток кишечника превращается в дубинковидную и они протягиваются в просвет кишечника. Кишечник съятой лицинки кажется не разделенным,
и выполняет большую часть тела. Просвет кишечника заполнен эозинофильными зернами разного размера, среди которых мелкие зернышка с легкой базофильной окраской. Между задними лопастями кишечника расположен экскреторный мешок. У не пытающейся личинки экскреторный мешок конусовидный, его стена отчетлива и имеет клеточную структуру. Просвет не заполнен. У сытой личинки экскреторный мешок овальный, на поверхности покрыт тонкой оболочкой и просвет его выполнен кристаллами гуанина.

REFERENCES


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Fig. 1. Excretory organ (E) with visible cellular structure of wall (Se) lies between posterior lobes of intestine. Intestinal cells (Sb) are club-shaped and extend into the lumen of intestine. (Haematoxylin-eosin, 800×.)

Fig. 2. Tangential section through posterior part of idiosoma of larva which has started to feed. Note the frills of cuticle (K) and layer of hypodermal cells (H) beneath it. Intestinal cells (Sb) have a nucleus (N) with still preserved arrangement of chromatin, but vacuoles (V) already begin to form in the proximity of nuclei. Sv — muscles. (Haematoxylin-eosin, 800×.)

Fig. 3. Tangential section through engorged but still attached larva in the area of ulcer. Note the smooth cuticle (K) and intestinal granules (Sg) of various size. Excretory bladder (E) is filled with guanine crystals: its wall is very thin, without cellular character. (Haematoxylin-eosin, 800×.)
Fig. 1. Tangential section through larva which has started to feed. (Haematoxylin-eosin, 400×).
Fig. 2. Tangential section through engorged, unattached larva. Intestinal granules of various size (Sg), excretory bladder (E) filled with guanine crystals. (Haematoxylin-eosin, 400×.)