MORPHOLOGICAL AND ANATOMICAL STUDIES ON THE DIGESTIVE SYSTEM OF MATURE LARVA OF AMRADIPLOSIS ALLAHABADENSIS (DIPTERA : CECIDOMYIIDAE)

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The digestive system of Amradiplosis allahabadiensis occupies a considerable part of the body cavity and consists of alimentary tract and its associated glands. Oesophagus is uniformly wide, attached to the cylindrical ventriculus, its wall is lined with peritrophic membrane and mesentric epithelial cells, posteriorly the ventriculus is connected to a short slender ileum which narrows down into a long narrow colon, connected with a slightly broader rectum. The larva possesses three associated glands, the salivary glands, the malpighian tubules and anal glands. The salivary gland consists of three portions viz., secretory region, reservoir and duct. The malpighian tubules are two in number connected at the junction of the ventriculus and ileum. Each duct is made up of two large excretory cells, with prominent nuclei and highly granular cytoplasm. The unicellular anal glands are four to six in number located on either side of the posterior end of the rectum near the anus.

Ara and Wermerster gave a comparative anatomy of the digestive tract of cecidomyiid larvae. The anatomy and histology of the full grown larva of Dasyneura leguminicola and Rhabdophaga saliciperda were worked out by Metcalf and Sen who noticed the presence of oesophageal valve. The alimentary canal of cecidomyiid larvae has also been described by a few workers. Available literature reveals that very little is known about the histology of the larval alimentary canal of the cecidomyiids. Thus, the present work has been undertaken on the morphological and anatomical studies of the alimentary canal of A. allahabadiensis.

MATERIAL AND METHODS

Full grown larvae of A. allahabadiensis were collected by cutting the full grown gall of Mangifera indica leaf. Living larvae were directly mounted in Polyvinyl alcohol. Some
of them were fixed in Carnoy's fixative. Histological details of digestive tract were studied from the microtomy sections stained in Mallory's triple stain, Haematoxylin and eosin stains. Figures were drawn with the help of Camera lucida.

OBSERVATIONS

The digestive system of larva includes an alimentary canal and its associated organs (Plate No. I, Fig. 1).

(a) The Alimentary canal: The whole length of the alimentary canal is nearly as long as the larval body, measuring about 1.56 mm in length (Plate No. I, Fig. 2), and can be divided into the usual three regions viz., the fore gut, the mid gut and the hind gut.

The fore gut consists of the buccal cavity, pharynx and oesophagus. The mouth is a minute aperture on the ventral surface of the head and is bordered by the rudimentary mouth parts consisting of a pair of maxillae, a pair of mandibles laterally, labrum dorsally and labium ventrally. It leads to the buccal cavity which is connected by a pair of pharyngeal bars and is internally lined by a thin layer of chitinous intima (Plate No. I, Fig. 3). The pharynx is continued into the oesophagus (Plate No. II, Fig. 2) where the common salivary duct opens. Oesophagus slightly narrows and passes through the brain mass and takes a straight course upto the third thoracic segment. The wall of the oesophagus is formed by a layer of small and regular epithelial cells with small nuclei. Internally it is lined by a thin intima, which is observed in the L.S. (Plate No. II, Figs. 5, 9). Muscles are not visible. At the junction of the fore gut and the mid gut, two celled oesophageal valve is present.

The mid gut is started from the third thoracic segment, the oesophagus bulges out into a ventriculus which forms a wide tube (Plate No. I; Figs. 1 & 2) (Plate No. II; Fig. 5). It is lodged in the first five segments of the abdomen, occupying major portion of the haemocoel (Plate No. I; Fig. 2). The walls of the ventriculus are composed of five to ten highly enlarged vacuolated mesentric epithelial cells. The cytoplasm is granular and the nucleus is very large. The cell wall is thinner than the cell wall of the oesophageal cells, so much so that sometimes the cell wall in between two adjacent cells is not distinctly visible. Externally, these cells rest on a delicate basement membrane. Muscles were not visible (Plate No. II; Fig. 6).

A very delicate, poritrophic membrane secreted by mesentric epithelial cells can be seen lining the lumen of the ventriculus. The wall of the ventriculus is very thin and highly distensible and the prominent nuclei are situated close to the inner wall of the
cells. Often cells of the ventriculus are seen bulging in the lumen in T.S. and L.S. (Plate No. II, Figs. 5 & 6).

The hind gut is a slender, straight, narrow tube without any loops (Plate No. I, Fig. 1) but three separate regions viz., a broad and short ileum, a long and narrow colon and a small rectum are clearly distinguished. Hind gut starts from the fifth segment and extends upto ninth the abdominal segment. At the junction of the mid and hind gut a number of peculiar cells project into the mid gut cavity (Plate No. II; Fig. 7). The cells of the ileum are large in size and contain spongy cytoplasm with some scattered granules. The cell boundaries are not distinct.

Fig. No. 1. Alimentary canal of 4th instar larva, 2. 5th instar larva, 3. Head capsule and mouth parts (ventral view).

Segment, then continues into the colon having a narrow lumen. The colon is narrow, lined by small flat irregular cells with prominent nuclei and extends upto the seventh segment. The wall of the colon is very thin. The colon passes into a short and slightly broader rectum which opens into the anus (Plate No. I; Fig. 2). The rectum is composed of large columnar cells with large nuclei (Plate No. II, Fig. 11).

(b) Associated glands: The fourth instar larva possesses three glands in association
with the alimentary canal. These glands are the salivary glands, the malpighian tubules, and the anal glands.

The pair of salivary glands is conspicuous, present one on each side of alimentary tract extending up to the second abdominal segment (Plate No. I; Figs. 1 & 2). Each gland consists of three portions viz., secretory region, reservoir and duct (Plate No. I, Fig. 1). The distal end of each gland is a long narrow medially curved tube.

The secretory portion of the salivary glands have 10-12 paired cells with large nuclei. It is followed by an enlarged region called reservoir, situated in the first and second thoracic segments. The secretory portion joins this region in between two gigantic granular cells which are followed by another pair of progressively smaller cells but distal cells are larger than the cells of any other region (Plate No. II; Fig. 3). These tubes proceed forward to form the cylindrical lateral ducts which comprise the third region of the salivary glands. During the course of the duct, a large number of small scattered cells are visible on its walls. The two ducts from either side meet together to form a common median duct, are formed of very thin intima and without any taenidia (Plate No. II, Fig. 8).

The malpighian tubules are two thick tubes arising from the anterior extremity of the hind gut (Plate No. I; Figs. 1 & 2) and are located in the fifth to seventh abdominal segments. They can be seen through the skin of the larva due to their yellowish colour. They float freely in the body cavity and do not form loops but run almost straight posteriorly on either side of hind gut. It has been observed from that these tubes are made up of two large excretory cells with conspicuous prominent nuclei and highly granular cytoplasm (Plate No. II, Fig. 10). A central collecting canal is seen to traverse through these cells.

The anal glands are four to six unicellular glands which are located on either side of the anal walls. Each gland is somewhat flask shaped with a short duct opening into the anal invagination. The cytoplasm contains minute secretory granules and is vacuolated. The nuclei are large (Plate No. II; Fig. 12).

DISCUSSION

The whole length of the alimentary canal is nearly as long as the body of the larva, but has also been reported to be longer than body length. The length of the gut is highly variable in cecidomyiids. The buccal cavity is present as noticed by Metcalf. Similarly pharyngeal structure agrees with the description given by Ara, Sen and Anderson. They further reported that the pharynx is well developed and acts as pump. In the larva of D. lequminicola, Metcalf called this region buccal cavity because the
sallivary duct opens here. In the present study the buccal cavity and pharynx have separate existence and pharynx is not used as a pump organ. The smooth chitinous lining of the pharynx devoid of longitudinal ridges is in agreement with the findings of Sen. The oesophagus is simple, straight and not dilated to form a crop. It directly opens into the proventriculus as noticed by other workers in the larvae of different species. The mid gut is continuous with the hind gut and two special cells placed at entrance appear to project into the mid gut and may be called guard cells due to their position as reported in the larvae of Oligotrophus olearuae and R. saliciperda. Wermeister and Metcalf do not report three divisions in the hind gut, but in the present case the hind gut has three divisions viz., ileum, colon and rectum, in agreement with other authors. In the present study the mouth parts of the mature larva are weakly developed and are of piercing and sucking type, which has also been described by other workers. It proves that the general structure of alimentary canal in the present case is not very low in organisation due to less feeding of the mature larva. In the gall producing and cocoon forming larvae the large salivary glands are much more developed than those of non gall producing ones. The wall of the secretory region is composed of two rows of cells with large nuclei in the present work, also observed in O. olearuae and R. saliciperda. In the present observation the salivary glands of the larvae are not simple, they possess a prominent reservoir, which is made up of gigantic granular cells, therefore, it is of a highly specialized type also reported in Itonidinaria trifila and Macrodiplosis dryobia.

Two malpighian tubules present in the larva, open in between the ventriculus and ileum in agreement with earlier reports and they are symmetrical as reported in R. saliciperda. Anal glands are flask shaped with large nuclei and vacuolated cytoplasm, these structures agree with the reports from R. saliciperda.

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REFERENCES


