

Ultrastructure of the male efferent system of the silkworm, *Bombyx mori*

1. Herold's gland and ejaculatory duct

Keiichiro MIYA

3-11-30 Yamagishi, Morioka, Iwate 020, Japan

The male efferent system in *Bombyx* consists of the vasa deferentia, seminal vesicles, accessory glands and ejaculatory duct like the other lepidopterans. Except the vasa deferentia, they differentiate from the genital cavity (Herold's gland) during the pupal stage. Development and structure of *Bombyx* male efferent system were described by Verson and Bisson (1896; cited by Matsuda, 1976) and Ikeda (1913). In addition Ômura (1938) observed the male reproductive organ in detail and discussed the relation between the secretions from the different regions of the organ and the activation of spermatozoa. However, there have been few informations on the ultrastructure of the male reproductive system. I report the ultrastructure and development of the Herold's gland and ejaculatory duct.

The Herold's glands were obtained from mature larvae and pupae just after pupation, and the ejaculatory ducts were removed from pupae 6 days after pupation, pharate adults and newly emerged adults. The methods used for electron microscopy were as described in the previous paper (Miya, 1987).

The genital cavity (Herold's gland) of *Bombyx* is a pear-shaped organ lying midventrally at the posterior margin of the eighth abdominal segment. The anterior part connects with the vasa deferentia at the both sides and the posterior part attaches to the sternum. It is enclosed by a common epithelial sheath, and the space between this sheath and the body of the gland is filled with numerous intersitial cells. The anterior part of this gland consists of a single layer of cylindrical cells and the posterior part is constructed by cells adjoining to each other with complex digitated cell membranes. The seminal vesicles, accessory glands, and ejaculatory duct differentiate from the anterior part, where, however, any difference in ultrastructure can not be observed at this stage. The cells extend short cytoplasmic processes into the lumen and their cytoplasm is filled with microtubules running along the longitudinal axis and abundant polysomes. From the posterior part a portion of the penis is derived and it is characterized by the thick tunica interna consisting of fine filaments secreted toward the lumen.

As to the origin of the efferent system in lepidopterans, there were several different opinions (Matsuda, 1976), but the present observation suggests that the whole efferent system in *Bombyx* is all mesodermal except for the tube within the penis.

After pupation the common epithelial sheath of the Herold's gland is broken and the efferent system develops rapidly. The ejaculatory duct consists of the upper duplicated region and lower single region. According to the previous light microscopic observation by Ômura (1938), the ejaculatory duct is enclosed by circular and longitudinal muscles and is divided to three regions from the viewpoint of the structural and functional characteristics, but the uppermost region is electron microscopically subdivided into two regions.

1. The upper region (*Glandula spermatophorae*)

This region is constructed by a pair of ducts and two subregions are distinguished electron microscopically. The first subregion has two cell types. A cell type with tubular endoplasmic reticula (ER) changes the ER to vesicular type during development to indicate active secretion. Numerous round electron-dense granules are discharged from these cells into the lumen. In the other cell type the ER develop poorly and free ribosomes are scattered in the cytoplasm. Later in the organ formation, the free ribosomes gather to form polysomes, and lacunae with few organelles are observed sporadically in the cytoplasm. Sometimes a part of cytoplasm is constricted off into the lumen.

In the second subregion the cells adjoin to each other with complex digitated cell membranes and the ER indicate flat lamellar structure. Some cells send large protrusions into the lumen and their apical side is clothed with long microvilli-like structure. Such structure seems to relate to the secretion in this subregion.

2. *The middle region (Glandula alba)*

This region is constructed with a single layer of long cylindrical cells with poorly developed ER. Later the ER develop and change to vesicular type. They produce small round electron-dense granules and discharge them into the lumen. Microvilli are short and rough at the lumen side, and the infoldings of cell membrane are conspicuous at the outside.

3. *The lower region (Glandula prostatica)*

This region is constructed with elongated cells containing numerous vesicles, and later the cells become enlarged and many vacuoles containing substance medium in electron density appear in the cytoplasm. Contents of these vacuoles are secreted into the lumen to become homogeneous secretion.

According to Ômura (1938), the secretion of the upper region of the ejaculatory duct formed spermatophore in the female copulatory pouch, that of the middle region formed the pearly body attached to the spermatophore, and that of the lower region activated the spermatozoa.

As mentioned above, the ejaculatory duct of *Bombyx* is constructed by different types of cells with characteristic ultrastructure, which seem to correspond to the different secretions.

References

- Matsuda, R. (1976) *Morphology and Evolution of the Insect Abdomen*. viii+534pp. Pergamon Press, Oxford, N. Y.
Miya, K. (1987) *Bull. Sugadaira Montane Res. Ctr.*, (8), 89-99.
Ômura, S. (1938) *J. Fac. Agr., Hokkaido Imp. Univ.*, 40, 129-170.