Histochemistry and Ultrastructure of the Epidermis and the Subepidermal Gland Cells of the Freshwater Snails Lymnaea stagnalis and Biomphalaria pfeifferi

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Summary. The epidermis and the associated subepidermal gland cells of the freshwater snails Lymnaea stagnalis and Biomphalaria pfeifferi were studied by means of histochemical and electron microscope techniques.

The single cell layered epidermis is composed of general epidermal cells, cilia cells and a few scattered goblet cells. The foot sole and the epidermal regions of the pneumostome and the ventral surface of the lips near the mouth consist nearly entirely of cilia cells; elsewhere the cilia cells are found scattered among the general epidermal cells.

The apical layer of the general epidermal cells bear microvilli. Numerous mitochondria, vesicles and lysosomes are located in the apical region of the cells. Several Golgi bodies and a poorly developed granular endoplasmic reticulum occur in the supranuclear region; the nucleus lies in the basal part of the cell. The general epidermal cells in the mouth region contain numerous microfilaments compared to the general epidermal cells in the rest of the epidermis. The cilia of the cilia cells in the densely ciliated regions possess well developed roots and basal bodies interconnected by means of the basal feet. With regard to the other cell organelles, cilia cells are quite similar to the general epidermal cells. For comparison a brief study of the ultrastructure of the epidermis of the terrestrial snail Helix aspersa was carried out.

The skin of the snail is covered by a mucous layer produced by various gland cells. In L. stagnalis, in addition to the epidermal goblet cells, thirteen subepidermal gland cell types could be distinguished. The histochemistry of the gland cell types is reflected in the ultrastructure. Three of the gland cell types have an ubiquitous distribution, four types are peculiar to the foot, two types to the lips and five types to the mantle. In B. pfeifferi one epidermal gland cell type and only seven subepidermal gland cell types could be distinguished. Most of these gland cells are limited in their distribution to the foot, lips and mantle edge.

The observations may provide a basis for further study in the functions of the snail epidermis.

Key words: Epidermis — Snails (Lymnaea stagnalis, Biomphalaria pfeifferi) — Histochemistry — Ultrastructure.

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Introduction

The general histology of the epidermis of gastropods has attracted a fairly great deal of attention on account of the various gland cells that are present in or below the epidermal surface (e.g., Herfs, 1921, 1922). Most investigators have limited their studies primarily to the terrestrial pulmonates (Helix pomatia, Burkhardt, 1916; Roth, 1929; Baecker, 1932; Helix aspersa, Campion, 1961; Arion ater, Barr, 1928; Lehmania poirieri, Arcadi, 1963, 1965). The freshwater pulmonates investigated were Biomphalaria glabrata (Australorbis glabratus, Pan, 1958) Lymnaea stagnalis and Planorbis corneus (Bolognani Fantin and Virgo, 1967a, b). Very little histochemistry has been applied in these studies with the exception of those by Campion, Arcadi and Bolognani Fantin and Vigo.

In addition to these general histological investigations much interest has been generated in the mantle epidermis with regard to its role in the formation of the shell and the epiphragm (e.g., Leydig, 1876; Timmermans, 1969) and in the foot epithelium with regard to its role in locomotion (e.g., Elves, 1961).

In contrast to the light microscopical investigations very little research has been done on the ultrastructure of the molluscan epidermis. General investigations are those on two species of the slug Arion (Wondrak, 1967, 1968, 1969) and on the opisthobranch Trinchesia granosa (Schmekel and Wechsler, 1967). Other studies deal primarily with the epidermis of specific regions of the body such as the adhesive epithelium (Acroloxus lacustris, Hubendick, 1958) and optic tentacles (Cardium edule, Barber and Wright, 1969; Vaginulus borellianus, Renzoni, 1968; Helix aspersa, Rogers, 1971) as well as the palps (Welsch and Storch, 1969) and gills (Satir and Gilula, 1970) of several bivalves.

There has been no extensive study, however, of the ultrastructure of the epidermis of the freshwater gastropods. Although various lines of research have implicated the epidermis of the freshwater gastropod to be involved in several functions such as respiration (Zaaijer and Wolvekamp, 1958; Jones, 1961), osmoregulation (van Aardt, 1968; Greenaway, 1970, 1971), and perception (de Vlieger, 1968; Jager, 1971), very little attention has been paid to the structural basis of these functions.

The purpose of this study is to make an investigation of the ultrastructure of the various epidermal regions of the freshwater pulmonate Lymnaea stagnalis. This will be done in conjunction with a histological and histochemical study to provide a more direct basis for the ultrastructural study than the previous studies by other researchers provided. For comparison the epidermis of the freshwater pulmonate Biomphalaria pfeifferi (host of Schistosoma mansoni) and of the terrestrial pulmonate Helix pomatia are studied to some extent.

These investigations can perhaps also provide a basis for research on the penetration of parasites into the snail host.

Material and Methods

For these investigations the following animals were used. Sexually mature specimens of Lymnaea stagnalis (about 25 mm shell length) were obtained from stock reared in the laboratory for many generations under conditions as described by van der Steen et al. (1969). Occasionally a few outdoor snails obtained from Hornmepolder were used for comparison. Adult specimens of Biomphalaria pfeifferi (about 10 mm shell length) were obtained from the