Short Communication

Apical surface of the epithelial cells in the gallbladder of the rainbow trout and the tench*

G. Viehberger
Institute of Histology and Embryology, University of Vienna, Vienna, Austria

Summary. The free surface of the epithelial cells in the gallbladder of the rainbow trout (a predatory fish) and the tench (an omnivorous fish) is characterized by well-developed microvilli. They are irregularly arranged in the tench, but form a true brush border consisting of regularly aligned microvilli in the rainbow trout. In both species membrane-bounded cytoplasmic protrusions, up to 5 μm in diameter, extend from the apical surface. These protrusions are free of granules, secretory vesicles or other organelles; only in the tench some of them contain glycogen. Thus, the previously used terms "apocrine and droplet secretion" are not justified; the epithelial protrusions are now to be regarded as droplets of degenerated cytoplasm. Since they resemble the protrusions reported in fetal and postnatal epithelial cells in the gallbladder of higher vertebrates, interspecific differences are discussed. There is no significant correlation between the seasonal activity of the fish and the abundance or structure of the cytoplasmic protrusions.

Key words: Gallbladder epithelium – Brush border – Apocrine secretion – Ultrastructure – Teleosts

The gallbladder epithelium carries out both absorptive and secretory functions. Since the experiments of Virchow (1857), the absorption of lipids by the epithelial cells of the gallbladder is well established. Hayward (1962) and Wahlin et al. (1974) demonstrated pinocytotic uptake of thorotrast particles. Moreover, gallbladder epithelial cells absorb water and dissolved bile salts from the bile (for literature, see Reuss 1980). Thus, structures such as microvilli and lateral folds are characteristic of the gallbladder epithelium.

Send offprint requests to: Mag. Dr. G. Viehberger, Histologisch-Embryologisches Institut der Universität Wien, Schwarzenbichleri str. 17, A-1090 Wien, Austria

* This paper is dedicated to Professor Gertrude Eberl-Rothe on the occasion of her 70th birthday

Acknowledgements: The author is greatly indebted to the Institute of Zoology of the University of Vienna for permission to work on the Cambridge Stereoscan Mark IIA (Technical assistance: Mr. A. Losert). The phototechnical help of Mr. H.D. Schermann is gratefully acknowledged
To date, secretory processes of gallbladder epithelia in teleosts have been described only by light-microscopical methods. Togari and Okada (1960) reported "apocrine and droplet secretion" of mucus and mucoid substances. In contrast, in higher vertebrates (rabbit: Yamada 1974; Mongolian gerbil: Wahlin 1979; mouse: Wahlin 1976, 1977; Wahlin et al. 1974, 1976a, b; Kawahara et al. 1979; guinea pig: Inferrera and Ferlazzo 1974; Wahlin and Schiebler 1975), and in man (Koga 1973; Luciano et al. 1974) merocrine secretion of mucosubstances has been demonstrated electron microscopically. The only electron-microscopical investigation carried out on the gallbladder epithelium of a teleost (carp: Bader 1966a) does not mention secretory processes.

In the present investigation the ultrastructural aspects of the apical surface of the gallbladder are studied in an attempt to clarify the nature and possible functional significance of the apical protrusions. A predatory fish (rainbow trout), which does not display winter rest (Amann and Gnaiger 1979), is compared with an omnivorous teleost (tench), which spends the winter in a hibernation-like state (Rosa 1958; Anwand 1965), during different seasons of the year (in early spring, before the tench begins to feed, and in late autumn, at the end of the feeding period).

Materials and methods

In early spring as well as in late autumn five rainbow trout (Salmo gairdneri Richardson, Salmonidae), with a body weight of about 60 g, and five tenches (Tinca tinca L., Cyprinidae), body weight about 160 g, of both sexes, fed ad libitum (Bundesinstitut für Gewässerforschung und Fischereiwirtschaft Scharfling/Mondsee, Austria), were decapitated, their gallbladders removed and dissected into small tissue blocks.

Transmission electron microscopy

Conventional methods. Tissue blocks were fixed for 2 h in phosphate-buffered 2 % glutaraldehyde (0.1 M; pH 7.4), postfixed in Palade-buffered 2 % OsO₄ for 1 h and embedded in Epon 812. Semithin sections (1 μm thickness) were stained with toluidine blue. Consecutive ultrathin sections were stained with uranyl acetate and lead citrate.

Ruthenium-red staining. (Luft 1971a, b). Tissues were fixed for 2 h in 3 % glutaraldehyde in 0.1 M sodium-cacodylate buffer (pH 7.4) containing 0.15 % ruthenium red. After rinsing in buffer, postfixation was carried out for 1 h in 2 % OsO₄ in the same buffer, again with addition of 0.15 % ruthenium red. Samples were embedded in Epon 812. Semithin and ultrathin sections were examined without further staining. The transmission electron microscopy was performed with a Siemens Elmiskop Ia.

Scanning electron microscopy

After fixation in phosphate-buffered 2 % glutaraldehyde (0.1 M; pH 7.4) for 4 h, the specimens were rinsed in buffer, dehydrated in ethanol and acetone and critical point dried. The dried tissue blocks were mounted with colloidal silver, coated with gold and examined with a Cambridge Stereoscan Mark IIA.

Results and discussion

The free surface of the light and dark epithelial cells in the gallbladder of the rainbow trout and the tench displays microvilli and blunt cytoplasmic protrusions. The microvilli are irregularly arranged in the tench (Fig. 1a), whereas the cells of the rainbow trout are characterized by a regular brush border (Fig. 1b).

The cytoplasmic protrusions, measuring up to 5 μm in diameter, cannot be observed in every epithelial cell (Fig. 1d, e); they are not permanent structures of the