Surface Morphology of Dogfish (Scyliorhinus canicula) Gill Epithelium, and Surface Morphological Changes Following Treatment with Zinc Sulphate: A Scanning Electron Microscope Study

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Abstract

The surface morphology of the gill epithelium of the dogfish Scyliorhinus canicula L. (collected near Barcelona, Spain, in February–March, 1981) was studied by scanning electron microscopy. Pavement cells exhibited either surface microvilli or microridges, which were randomly distributed on both the primary (afferent and efferent sides and interlamellar spaces) and secondary epithelium. Chloride cell apical regions on the afferent side displayed characteristics closer to freshwater than to marine teleosts: no apical pits were detected; chloride cells displayed longer microvilli than those of adjacent cells. Two morphologically different cell types were identified: a large chloride cell and a smaller cell (probably a chloride cell too), measuring 4 to 7 μm and 1 μm, respectively, the latter being dominant in the interlamellar spaces. Apart from pavement cells, the mucous cell was the prevalent cell type on the efferent region. The respiratory epithelium consisted of a mosaic of typical epithelial cells; some chloride and mucous cells were present, mainly located at the base of the secondary lamellae. Surface morphological changes were monitored after exposing the dogfish to subacute zinc treatment: 10 ppm Zn (ZnSO₄) for 3 wk. The chloride cell was the only cell type that underwent any modifications: microvilli became longer and tips were swollen following Zn treatment. The results are discussed in relation to a previous study on the effects of zinc sulphate on chloride cell response and heavy metal distribution in excretory organs of the dogfish.

Introduction

Previous light-microscope studies on structural modifications of the gill epithelium of the dogfish Scyliorhinus canicula following treatment with zinc sulphate revealed that chloride cells increased significantly in number after exposure to Zn (Crespo et al., 1981). In order to pursue this study at the ultrastructural level, scanning electron microscope observations of gills of dogfish treated with ZnSO₄ were undertaken.

Few reports can be found in the literature on elasmobranch gill structure (Doyle and Gorecki, 1961; Hughes and Wright, 1970; Wright, 1973; Dunel and Laurent, 1980b; Laurent and Dunel, 1980; Olson and Kent, 1980). To the author’s knowledge, all studies carried out so far on elasmobranch gills comprise light-microscope and transmission-electron microscope reports. Since recent scanning electron microscope (SEM) studies on teleost gill ultrastructure have furnished new complementary information to the understanding of gill functions (Olson and Fromm, 1973; Hossler et al., 1979a, b; Hughes, 1979; Dunel and Laurent, 1980a; Hossler, 1980), the present investigation first describes the surface morphology of the elasmobranch Scyliorhinus canicula, and then the surface morphological changes revealed by SEM following treatment with 10 ppm Zn (ZnSO₄) for 3 wk (subacute treatment). The results are discussed in relation to reports on freshwater and seawater-adapted teleost gill surface ultrastructure and to light-microscope observations of the dogfish gill (Crespo et al., 1981) following Zn treatment.

Materials and Methods

Dogfish (Scyliorhinus canicula L.) of 150 to 300 g body weight were collected in a 80 to 120 m deep zone close to Barcelona (Spain) during the months of February–March 1981. They were kept for at least 1 wk in an open circulation tank (natural seawater: 36‰ S, 13° to 15°) before experiments. Individuals were exposed to 10 ppm Zn (ZnSO₄) for 3 wk as detailed in a previous paper (Crespo et al., 1981).

Preparation of Gill Filaments for SEM

Untreated and treated individuals were anaesthetized with tricaine metanesulphonate (MS-222 Sandoz), gills were re-
Fig. 1. *Scyliorhinus canicula*. Scanning electron micrographs of dogfish gill filament. (a) Afferent side; note surface irregularities (infoldings of epithelium and pores), pavement cell junctions, and chloride and mucous cells emerging where different pavement cells meet (800×). (b) Detail of afferent side; note large (broad arrow) and small (star symbol on left) chloride cells and a mucous cell (thin arrow); also shown are pavement cells exhibiting either surface microvilli or microridges (2,800×). (c) Detail of 2 chloride cells on afferent side (5,800×). (d) Efferent side; granules of mucus can be seen emerging from a pore at intersections of pavement cells; note microvilli and microridges on efferent side (3,200×). (e) Detail of efferent side; vesiculous material emerges from a pore which may correspond to a mucous cell apical region; note microvilli (arrowed) typical of a chloride cell (7,000×). (f) Detail of elongated microridges on efferent side (7,000×). (g) Efferent side and secondary lamellae; note dominance of mucous cells on efferent side of gill filament (200×).