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Structure of the Chloride Cell in the Gill Epithelium of *Mugil aurata* (Mugillidae, teleostei)

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Abstract

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The main ultrastructural properties of gill chloride cells in ***Mugil aurata*** *from south of Caspian sea was investigated. These cells are packed with other cells in filament epithelia and are divisible into dark and light cells. Quantitatively the two cells are notably different in membranous network and the number of mitochondria. The tubulo-vesicular in both cells comes in close contact with mitochondria and nucleus. The close relation was observed between the chloride cells and accessory. This indicates that chloride cells are communicated with external milieu via the channel system of accessory cells.*

Key words: Gill, chloride cell, *Mugil aurata.*

Introduction

A functional chloride cell is structurally characterized by the presence of many mitochondria and abundant tubular system. These cells are involved in ion transport in the fish gill. They also play key roles in acid-base regulation by altering chloride and carbonate exchange (David *et al*., 1999).

It is clear that ionic composition of an aquatic environment is affected by so many factors and gill epithelia should have the ability to excrete and or absorb salts. So, morphological researches are the main route for providing the basic data which can be indicative for physiological investigations. From these viewpoints, the purpose of this study was to identify the fine structure of the chloride cells in *Mugil aurata* which belongs to mugilidae.

Materials and Methods

Mugilidae (*Mugil aurata*) were caught from south of Caspian Sea (salt osmolity 12.64-12.48 g/lit pH=7.5-9). The gills were dissected out and processed for TEM. The gills were fixed by immersion in 2% phosphate-buffered glutaraldehyde (pH=7.4), post fixed in 2% osmium tetroxide for 2 h, dehydrated in graded concentrations of alchol, from 50% to absolute, followed by propylene oxide, epoxy resin and

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propylene oxide and embedded in epoxy resin. After trimming the blocks, ultrathin sections were cut, harvested on grids and stained with uranyl acetate and lead citrate before viewing on a LEO electron microscope.

Results and Discussion

The chloride cells in *Mugil aurata* were distributed along the length of filaments and in interlamellar space. This finding is consistent with many species, including Tilapia, Lampry gills (Li *et al*., 1995), teleostes *Oreochromis alcalicus* and *Oreochromis niluticus* (Cioni *et al*., 2006).

There are heteromorphic cells in epithelium of filaments in *M. aurata* (Fig.1). This multicellular structure in this species is defined in some seawater fishes including *M. capito*, *Anguilla anguilla* (Isisag and Karakisi, 1998), *Oreochromis alcalicus, Oreochromis niloticus* (Cioni *et al*., 2006).

In this species, the mucosal surface of chloride cells is sunk below the pavement cells and they form invaginations as apical crypt (Fig.1).

The main ultrastructure of the chloride cell is presence of the numerous, well developed mitochondria and an expansive tubular system. Although, it has recently been found that with various species, the cells are remarkably heterogeneous (Carmona *et al*., 2004). In this species, the chloride cells were ultrastructurally divisible into two groups: the light (less electron dense) and the dark (more electrons dense) (Fig.1). Two cell groups, were also reported in freshwater (*Brachydanio rerio, Oreochromis niloticus*) or seawater teleosts (*Oreochromis alcalicus*) (Cioni *et al*., 2006). In some species (*Brachydanio rerio, Oreochromis niloticus and Oreochromis alcalicus*) the two cells are of different sizes and are located superficial or deep (Cioni *et al*., 2006).

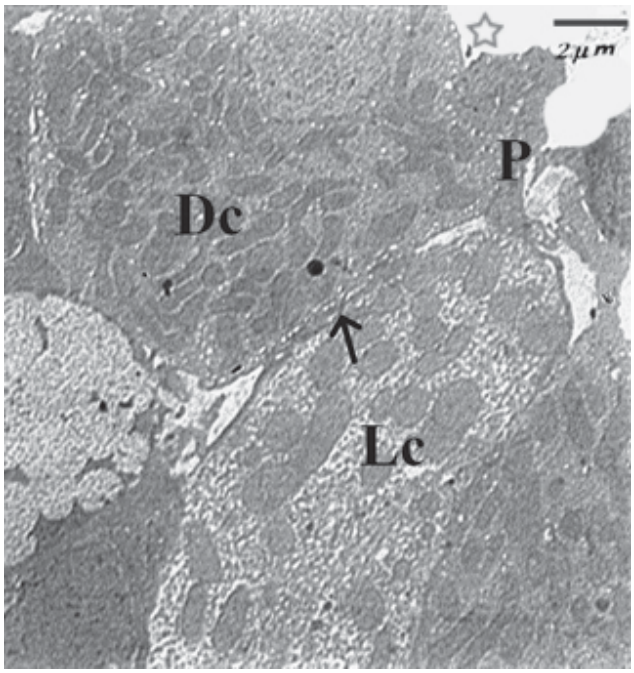

Fig. 1. The filament of the gills of *Mugil aurata* showing the dark chloride cell (Dc) and light chloride cell (Lc). The pavement cells (p) are on the epithelial surface. Note the direct contact between Dc and Lc (arrow) and invagination on the surface (*).

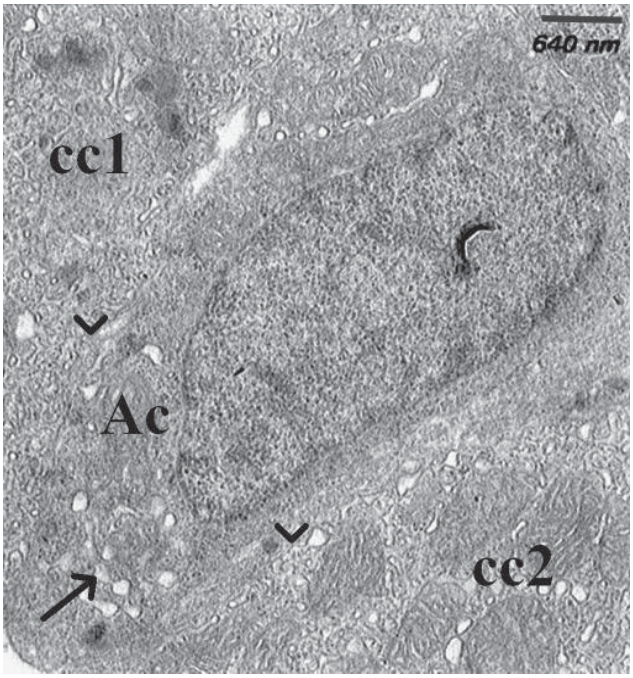

Fig. 2. Accessory cell are usually found between two chloride cells. The close relation between membranous system of Cc (arrowhead) and infolding protrution (arrow) of accessory cell show the mediator role of this cell in ionic transport.

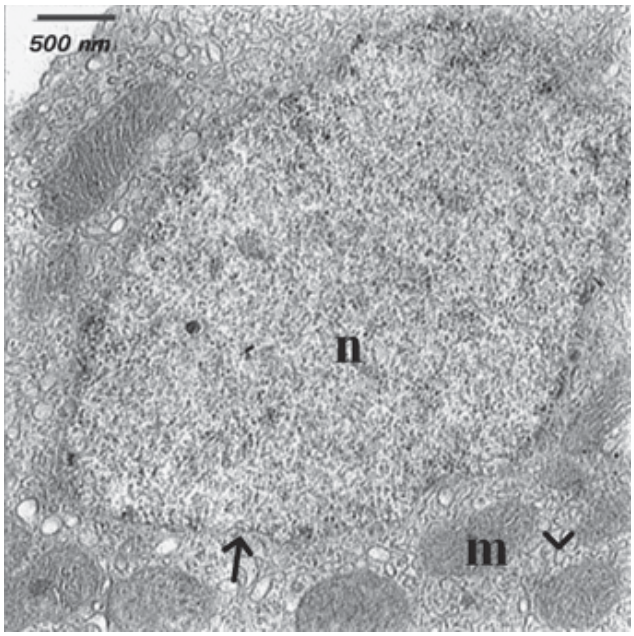

Fig. 3. Tubulo-vesicular network comes into close contact with mitochondria (arrow head) and nucleus (arrow). Note this network is small and tight in dark cells.

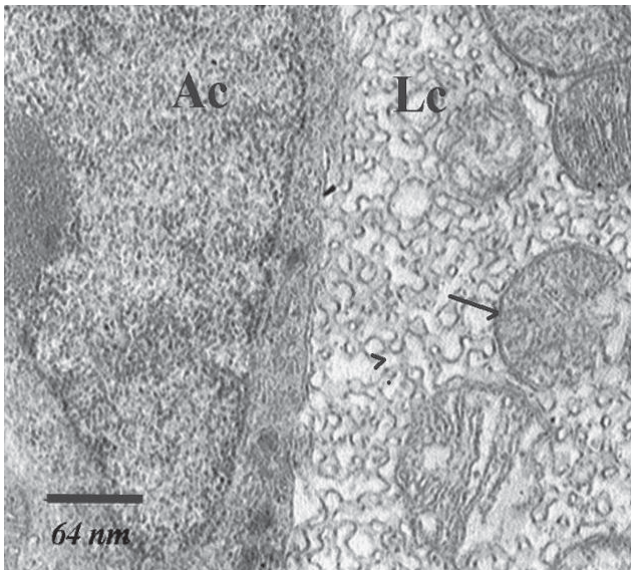

Fig. 4. Membranous system in light cells seems to smooth sheets of endoplasmic reticulum (arrow head), note the close relation between mitochondria and membranous system (arrow).

Both cells in *Mugill aurata* are at the same level and they lie in direct contact with each other, or there may be an accessory cell between them (Fig.1, 2).

The tubular network of light cell is more developed and mitochondria are less than dark cells. The membranous system in light cells seems to be made up of endoplasmic reticulum which develops in a network of anastomosed smooth sheets (Fig. 4). The broad network of tubular system in light cells is a distinctive feature of the chloride cells as a structural change that occurs in this cell type, when a euryhaline species passes from fresh to saltwater (Vigliano *et al.*, 2006). The vesiculotubular membranous system in dark and light cells of seawater is more developed than in freshwater fishes (Carmona *et al.*, 2004).

The tubules of *M. aurata* chloride cells are often in close association with the channels and infolding protrusions of accessory cells (Fig.2). This shows a mediatory role in regulation of internal ionic composition that two accessory and chloride cells form a leaky paracellular pathway.

In dark and light cells, the tubulo-vesicular complex is in intimate contact with the mitochondria (Fig. 3). This finding is consistent with the previous studies (Cioni *et al.*, 2006) and it can provide energy requirements for ionic exchange.

It is concluded that in *M. aurata* acclimated in "Caspian Sea" mitochondria rich chloride cells present ultrastructural features as located in filament, two dark and light chloride cells, the presence of multicellular complexity, slightly invaginated cell surface, development of vesiculotubular and the presence of an intercellular channel system with more developed tubular system. These features resemble to euryhaline-seawater adapted fishes.

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