

**SUB-TYPES OF MITOCHONDRIA RICH CELLS
IN THE GILLS OF FRESHWATER RAINBOW TROUT**

G.G. Goss¹
F. Galvez¹, G.S. Hawkings¹ and S.D. Reid²
¹Biological Sciences, University of Alberta
Edmonton, Alberta T5G 2E9 CANADA
²Biology, Okanagan University College
Kelowna, British Columbia.

Introduction:

Rainbow trout are anadromous, existing in both freshwater and seawater environments. These environments cause opposing extremes relating to ionic loss and uptake for the trout. In a freshwater environment, the trout has a gradient of ion loss from its body to the hypo-osmotic external water. A fish living in a seawater environment has the reverse challenges as the medium has a higher concentration of ions than the fish (*i.e.* a fish in seawater will be constantly gaining ions by passive diffusion). The gill epithelium is a dynamic transporting membrane that manipulates ion exchange (*e.g.*, sodium and chloride) to achieve both ion and acid-base homeostasis. Classically, the gill epithelium is thought to consist of two cell types, the pavement cell, which makes up over 90% of the total gill area and the mitochondria-rich (MR) cells (Goss *et al.*, 1998). It is believed that the MR cell is the major regulation site for ion balance (Goss *et al.*, 1992; Perry, 1998).

Results and Discussion

Recently, our lab has developed a method of separating the MR cells into at least two functionally distinct populations of cells (Goss *et al.*, 2001; Galvez *et al.*, 2002, Reid *et al.*, submitted). We have demonstrated that peanut lectin agglutinin (PNA) binds only to one sub-type of the MR cells of the fish gill (Goss *et al.*, 2001), which we term PNA-positive MR cells (PNA⁺). A magnetic bead separation system was developed to isolate the PNA⁺ MR cells from the PNA negative (PNA⁻) MR cells (Galvez *et al.*, 2002). Separation allowed for morphological and physiological characterization of each of the cell types. While both cell types are rich in mitochondria, PNA⁺ cells have an ovoid

nucleus with a dense vesiculo-tubular network while PNA⁻ cells have distinct morphological features including irregular nuclei, dense peripheral chromatin, and a less developed vesiculo-tubular network. Furthermore, we have demonstrated that acid-activated and phenamil-sensitive Na⁺ uptake, an indicator of eNaC mediated Na⁺ uptake, as well as environmentally induced alterations in H⁺ ATPase expression and activity, are found only on PNA⁻ MR cells. We propose updating the current model for gill ion transport in the cells of freshwater fish (see Figure 1) linking Na⁺ uptake to an electrogenically coupled H⁺ ATPase on PNA⁻ (termed α -type) MR cells type and suggest that chloride uptake/base exchange is mediated by PNA⁺ (termed β -type) MR cells.

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References

- Galvez F, SD Reid, G Hawkings and GG Goss 2002 Isolation and characterization of mitochondria rich chloride cells and pavement cells from the gill of freshwater rainbow trout. *Am J Physiol. R.* 282: R658-R668.
- Goss GG, S Adamia and F Galvez 2001 Peanut lectin binds to a sub-population of mitochondria rich cells in the rainbow trout gill epithelium. *Am J. Physiol R*, 281: R1718-R1725.
- Reid, SD, GS Hawkings, F Galvez and GG Goss 2001 Localization and characterization of sodium influx in isolated rainbow trout gill epithelial cells. Re-submitted to *J Exp Biol*, May 2002.
- Perry, SF (1997). The chloride cell: Structure and function in the gills of freshwater fishes. *Annu. Rev. Physiol.* 59, 325-347.

Figure 1. Proposed Freshwater Fish Gill Ion Transport Model:



