

**CHANGES IN THE SURFACE ULTRASTRUCTURES OF
MITOCHONDRIA-RICH CELLS AND EXPRESSION OF SODIUM
PUMPS IN GILLS OF TILAPIA, *OREOCHROMIS MOSSAMBICUS*,
TRANSFERRED FROM SEAWATER TO FRESH WATER**

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Introduction

Mozambique tilapia (*Oreochromis mossambicus*) is able to maintain the osmotic constancy of internal milieu and survive in hypertonic salt water or hypotonic fresh water (Hwang et al. 1989). Biochemical studies on long-term adaptation showed that activities as well as contents of gill Na,K-ATPase in tilapia changed with environmental salinity (Lee et al., 2000). Moreover, ultrastructures of gill epithelial mitochondria-rich (MR) cells where most gill sodium pump was located were found to change with external salinity (Lee et al., 1996; Lee et al. 2000). Being a freshwater euryhaline species, Mozambique tilapia cannot survive after direct transfer from freshwater (FW) to seawater (35‰, SW), unless pre-adapted to 20‰ salt water (BW) for at least 24hrs. However, tilapia adapt rapidly after direct transfer from SW to FW (Hwang et al. 1989). To realize the mechanism of FW-adaptation in SW tilapia, a series of time course experiments were performed. Gills were sampled, phenotypic changes of MR cells were examined, and expression of Na,K-ATPase from abundance of α -subunit mRNA and protein to activity were compared.

Experimental designs and results

Mozambique tilapia reared in SW were transferred directly to FW and

sampled at 0, 3, 6, 12, 24, 48hrs, and 30 days. Serum was collected for analysis of osmolality and gills were dissected out for ultrastructural and biochemical and molecular examination.

Within 3hrs after transfer, a significant decrease in serum osmolality was found. After 3hrs, the osmolality declined slowly with time until the osmolality of the 48hrs group reached the same level as the 1-month (FW) group. For expression of branchial sodium pump in three different levels, i.e., mRNA, protein, and activity, significant decrease occurred in 6hrs, 24hrs, and 3hrs post-transfer, respectively (Fig. 1). No significant changes in branchial MR cell density were found in tilapia transferred directly from SW to FW (Fig. 2).

There is only one type (deep hole) of MR cells in SW tilapia. However, the vicissitudes of MR cell phenotypes (wavy convex, shallow basin, and deep hole) occurred within 48hrs after transfer to FW (Fig. 2).

Our results showed that the surface ultrastructures of MR cells change from SW type to FW type during 48hrs after transfer. Moreover, the activity, protein and mRNA abundance of gill sodium pumps as well as serum osmolality come to stable and exhibit similar levels of freshwater fish in 48hrs post-transfer. It is concluded that it takes two days for tilapia to adapt from SW to FW.

References

Hwang, P.P., C.M. Sun and S.M. Wu 1989. Changes of plasma osmolality, chloride concentration and gill Na-K-ATPase activity in tilapia

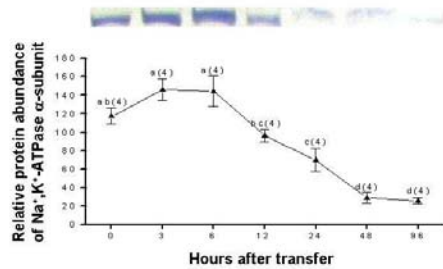


Figure 1. Changes of Western blot and relative protein abundance of Na⁺, K⁺-ATPase α-subunit of tilapia gill following transfer from 35‰ SW to FW. Significant decrease occurred within 24hr after transferring to FW

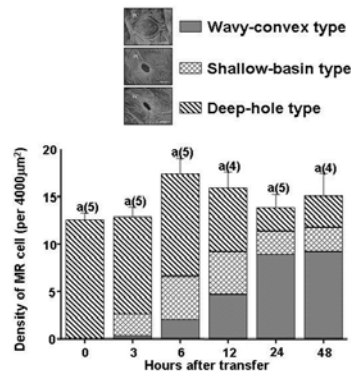


Figure 2. Changes in density and type of MR cell of tilapia gill filament following transfer from 35‰ SW to FW. No difference of MR cell density was found. Wavy-convex type of MR cell showed significant increase after transferring to FW.

Oreochromis mossambicus during seawater acclimation. Mar. Biol. 100:295-299.

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