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ISSN 0792 - 156X

PUBLISHER:
Israeli Journal of Aquaculture - BAMIGDEH -
Kibbutz Ein Hamifratz, Mobile Post 25210,
ISRAEL
Phone: + 972 52 3965809
http://siamb.org.il

SHORT COMMUNICATION

ALTERATION OF RENAL TISSUE IN NILE TILAPIA, *OREOCHROMIS NILOTICUS*, AFTER TRANSFER TO SALINE WATER

A.C. Karasu Benli and H. Yavuzcan Yildiz*

Department of Fisheries and Aquaculture, Faculty of Agriculture, Ankara University, 06110 Ankara, Turkey

(Received 19.4.04, Accepted 6.6.04)

Key words: Nile tilapia, renal tissue, saline water

Abstract

Changes in renal tissues and plasma osmolality were investigated in Nile tilapia *(Oreochromis niloticus)* 72 hours after transfer from fresh water to 9 or 18 ppt salinity. Exposure to high salinity was associated with cell infiltration into renal tissue. Plasma osmolality increased with increasing salinity but the hematocrit remained unchanged.

Introduction

Increasing demand for fresh water for agricultural, industrial, and domestic purposes is gradually limiting freshwater aquaculture. The efficient use of marine and brackish water for aquaculture is a vital alternative (Suresh and Lin, 1992). It has often been suggested that euryhaline tilapias could be cultured in high salinity brackish water or marine systems (Watanabe et al., 1985). Many tilapia species are euryhaline. *Oreochromis* (formerly *Sarotherodon*) tolerates a wide variety of environmental conditions (acidity, salinity, temperature, poor quality water, etc.) and has high growth and reproductive rates that make it very suitable for culture (Avella et al., 1993). Although the tolerance limits of species vary considerably (Suresh and Lin, 1992), tilapia have hydromineral regulatory mechanisms to adapt to fluctuating halinity (Hwang et al., 1989). *T. nilotica* survived direct transfer from fresh water to 50% seawater (17.5 ppt), but not to 75% seawater (Stickney, 1986).

* Corresponding author. E-mail: Hijran.Yavuzcan@agri.ankara.edu.tr

In teleosts, extracellular ion levels and osmotic regulation are primarily controlled by the gills, intestine, and kidneys (Altinok et al., 1998). Adaptation of tilapia to saline water involves structural and functional changes in the gills. Such changes have been defined by several authors (Mallatt, 1985; Hwang et al., 1989; Laurent and Perry, 1991; Avella et al., 1993), but it is surprising that renal changes have not.

The primary objectives of this study were to describe the changes in renal tissue and plasma osmolality of Nile tilapia, *Oreochromis niloticus*, exposed to saline waters.

Materials and Methods

Fifteen Nile tilapia, *O. niloticus,* with a mean body weight of 67.36±17.68 g, were obtained from the Fisheries Unit of the Aquaculture and Fisheries Department of Ankara University. Fish (n = 5 for each treatment) were transferred directly from fresh water to either 9 or 18 ppt salinity and kept in fiberglass tanks containing 200 l water at a stocking density of 5 fish per tank. Salinity was prepared by mixing tap water and Instant Ocean artificial sea salts. Control fish were kept in fresh water. Water temperature was maintained at 24°C. Fish were fed a commercial trout diet once a day at a daily rate of 2% of their body weight. Fish were maintained for 72 hours in these salinities and then sampled.

At the end of 72 hours, blood samples were drawn by cardiac puncture into heparinized syringes. Fish were not anesthetized before bleeding. The blood was centrifuged for 7 min at 3300 revolutions per minute and the plasma was removed. Plasma osmolality was determined with a Wesco 5000 Osmometer. Hematocrit measurements were made immediately after drawing samples of blood into heparinized capillary tubes and centrifuging at 12,500 rpm for 4 min (Siwicki and Anderson, 1993). The fish were sacrificed and the kidney was fixed in Bouin's fluid. The tissues were dehydrated through graded alcohol solutions, cleared in xylene, and embedded in paraffin. Sections (5-6 μm thick) were cut and stained with hematoxylen-eosin and examined under a light microscope.

One-way ANOVA was used to determine differences among treatment groups for each blood analyte. When a significant (p<0.05) difference was detected, the means were compared using Duncan's multiple range test.

Results

The tilapia tolerated direct transfer from fresh water to 9 or 18 ppt salinity for 72 hours; no fish in any treatment group died. Cell infiltration into the interstitial renal tissue was observed (Fig. 1) while no histopathological changes in the renal tissue were detected in the control group (Fig. 2). Mean osmolality

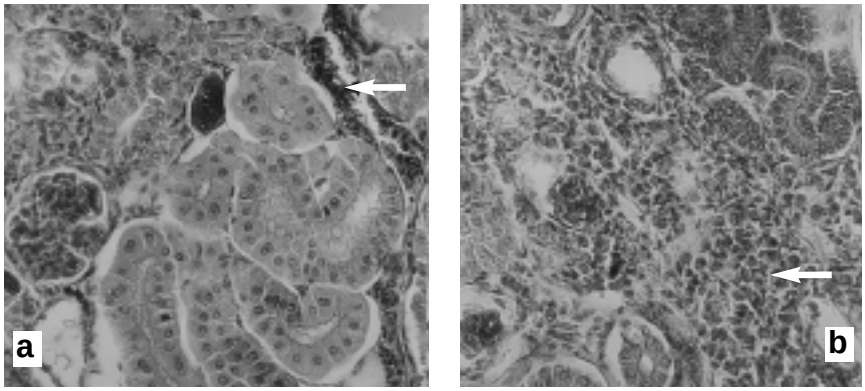

Fig 1. Cell infiltration (arrows) into interstitial tissue of the kidney of Nile tilapia (*O. niloticus*) exposed to (a) 9 ppt or (b) 18 ppt salinity (x 200).

and hematocrit values after 72 hours are shown in Table 1. Plasma osmolality was significantly higher than the control in both salinity treatments ($p<0.05$) while hematocrit was similar in all groups ($p>0.05$).

Discussion

Through effective mechanisms of osmoregulation, teleosts are able to maintain the osmotic constancy of internal milieu and survive in hypertonic sea water or hypotonic fresh water. The gill is the most important extrarenal organ responsible for this osmoregulation (Hwang et al., 1989). Nevertheless, the fish kidney receives the vast majority of postbranchial blood and therefore renal lesions might be expected to be good indicators of environmental changes (Hinton and Lauren, 1990). The response of the kidney to the more concentrated medium in this study appeared as cell infiltration in interstitial tissue. Although glomerular alterations in trout and Prussian carp adapted to sea water have been noted (Elger and Hentschel, 1981; Brown et al., 1983; Gray and Brown, 1987), cell infiltration in interstitial tissue in tilapia due to high salinity had not previously been reported. Thus, pre-acclimation may be of much physiological significance for some euryhaline teleosts during seawater adaptation.

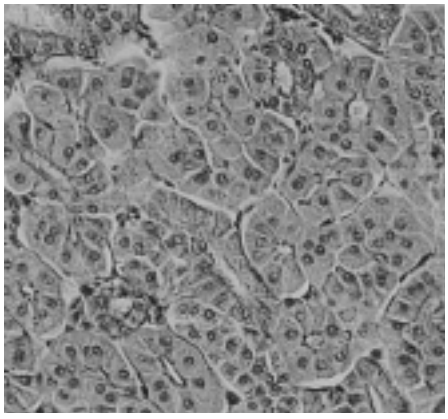

Fig 2. Normal renal tissue of Nile tilapia (*O. niloticus*) in the control (x 200).

Table 1. Mean±SE of plasma osmolality and hematocrit (Hct) of Nile tilapia *(Oreochromis niloticus)* 72 hours after direct transfer from fresh water to 9 or 18 ppt salinity.

Parameter	*Control*	*Salinity level*	
		9 ppt	*18 ppt*
Plasma osmolality (mmol/kg)	326.00±2.53^{c}	352.87±0.22^{b}	418.25±0.45^{a}
Hct (%)	12.19±1.55^{a}	13.09±1.12^{a}	11.19±0.46^{a}

Different letters in a row indicate significant differences between treatment groups ($p<0.05$).

Plasma osmolality significantly rose in the fish transferred to 9 or 18 ppt salinity. Similar increases in plasma osmolality were reported for *O. mossambicus* during seawater acclimation (Hwang et al., 1989). However, the present results reveal that redistribution of ions between the plasma and cell tissue does not occur within 72 h in *O. niloticus*. There was no evidence of hemoconcentration in the tilapia exposed to 9 or 18 ppt salinity as these salinity levels did not influence hematocrit values.

In conclusion, the present study provides additional information on saline water acclimation in Nile tilapia. The changes in renal tissue observed in this study should be considered when evaluating the effects of salinity with respect to adaptation timing.

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