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The Effect of Acclimatization of Fresh Water Red Hybrid Tilapia in Marine Water

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Abstract: This study shows gradual acclimation of 40 fresh water red hybrid tilapia *O. mosssambicus* X *O. hornorum* (salinity = 0.1‰) to marine water (42‰) during a period of 2 weeks. The adapted fishes (80%) tolerated living in marine water for 7 days. The histological sections of gills, liver and kidneys clears the appearance of chloride cells only in the gills of the marine water adapted fishes. Sections of the liver contain bile granules within the hepatic cells of the liver of the adapted fishes and the histological sections of their kidneys shows dilatation in the tubular lumen.

Key words: Red hybrid tilapia, acclimatization, histological study

INTRODUCTION

The fish tilapia are widely distributed species in the tropical and subtropical regions of the world. They have several attributes which make them attractive as culture species: high tolerance of poor water quality, crowding and environmental condition[1]. Red hybrid tilapia *O. mossambicus* X *O. hornorum* are growing faster than other tilapia breeds and desirable for the consumer[2]. The effects of dietary protein level and water salinity, feed conversion ratio, efficiency ratio and body composition of juvenile red tilapia hybrid *O. mossambicus* X *O. niloticus* were investigated showing that salinity was of minor importance to change in body composition[3], The salinity of 10 and 20 part per thousand (‰) combined with feeding and starvation on the enzyme activities in the plasma of rainbow trout, *Salmo gairdneri* was studied by Sauer and Haider[4].

Fish osmoregulatory problems associated with changes in salinity have been studied in eurhaline fish species live in different levels of salinity in their environment during their life[5,6]. Also these studies concerned fishes that move from one habitat to the other during their ontogeny, such as salmonid fishes[7-9]. Salinity is one of the important environmental factors of fish, like other physiochemical factors, it has an important effect on the main life processes of the fish such as survival, food conversion, embryonic growth and hatching[10].

Dorshev[11] showed that grass carp fry of age of 4 weeks could live in 9 and 12‰ salinities for more than 2 months. Mozambique tilapia tolerates salinities up to 120‰[12] and it is a good model organism for studies on ionic and osmotic adaptation of teleost fishes. Tilapia of genus Oreochromis is another suitable biological model for studying the mechanism of osmoregulation in teleost fish as they can survive direct transfer from fresh water to salt water[13].

The chloride cells are specialized for ionic regulation in gill epithelial[14-16] and they are the site of ion extrusion in sea water adapted fish[17-18].

It is now well established that chloride cells play a role in Nacl up take, Ca2+ uptake and acid-base balance in fresh water adapted teleosts[19]. Some studies have reported morphological changes and the excistance of more than one type of chloride cells[20,21].

Lee *et al.*[22] elucidated the relationship between the deep hole chloride cells and the salinity adaptation in tilapia *Oreochromis mossambicus.*

The aim of this study is to report on the adaptation of the fresh water red tilapia to marine water and the histological changes occurred in the gills, liver and kidney.

MATERIALS AND METHODS

The red tilapia studied in this experiment are hybrid of two species *Oreochromis mossambicus* and *Oreochromis hornorum.* Forty live fish (about 20 g, 13 cm T.L.) were brought from Ismailia Fisheries Research Center in Suez Canal University to the laboratory and were kept in fresh water aquaria for two weeks for acclimatization to the lab conditions (temperature ranged between 27±1°C). Fish were fed artificial pellets.

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Sea water obtained from (the Suez Canal Bitter Lakes) once a week and was kept in closed plastic tanks. The experiment was to observe the effects of transferring red tilapia from fresh water (0.1‰) to sea water (42‰) through gradual increase in salinity from 0% (0.1‰) to 100% (42‰).

The salinity was increased every 24 h adding sea water so that the fish remained 24 h in each concentration. The experiment was carried out in 4 plastic containers, each contained 20 L of water and 10 fish. Fish remained 7 days in 100% sea water and after that the mortality were estimated and the live fish were used for the following analysis.

Fish after that dissected to get the kidney, liver and gills which were preserved in Bouin's fixative. Tissues were processed, sectioned at 5 µm then stained using haematoxylin and eosin, then examined microscopically. Photomicrographs were made as required.

RESULTS AND DISCUSSION

Concerning the mortality (Table 1) the data revealed that mortality of red tilapia increased with raising the concentration of marine water, the mortality (2.5%) started with 16.8‰ (40%) marine water, raised to 10.5% with the salinity of 25.2‰ (60%). Mortality raised gradually till it reached 20.8% with the salinity of 42‰ (100%) after the end of the experiment (about 12 days).

Alive fishes remained in marine water for 7 days. This data indicates that the acclimation of fresh water red tilapia needed about 2 weeks to be able to live in marine water. As for *Gambusia affinis* was found that all fishes died after 24 h exposure to 20.5‰ (50%) of sea water and mortality was 100% after exposure to 30.7‰ (75%) sea water after 8 h[23].

The effect of salinity on the induced spawning of *Mugil cephalus* revealed that 100% sea water (32-34‰) was recommended for use during spawning phase (24). An average of 40% of grass carp survived for 180 days or more under 4 different salinities 3, 5, 7 and 9%[25].

Chervinski[26] conducted experiments to determine the tolerance limits of fishes to different salinities. He reported a series of trials on the adaptability of the guppy Poecilia reticulata to different salinities up to 150‰ sea water. In addition he noted the effects of transferring guppies from 50 to 100% sea water through gradual increases in salinity. The adapted fishes to salt water remained alive for one week after the end of the experimental and this similar to what we noted in this study.

Histological studies: Chloride cells are noted in the gills of marine water adapted red tilapia in Fig. 1 and 2 but was not found in Fig. 3 for the fresh water red tilapia. Hibiya[27] mentioned that when fresh eel adapted to sea water, the activation of chloride cells is noted within 2 to 4 days and gills take one month to be completely of the sea water

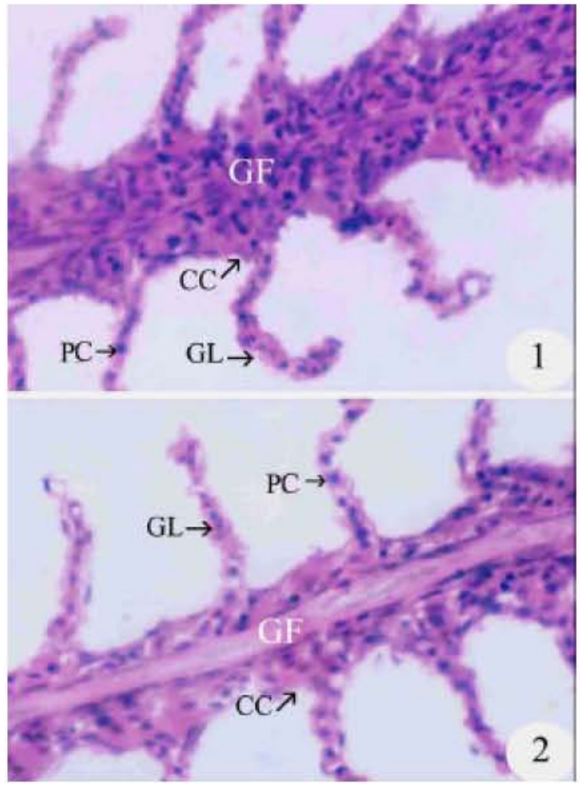


Fig. 1 and 2: Photomicrograph of a section of gill of marine adapted fish showing the gill filament (GF), gill lamellae (GL), Pillar cells (PC) and chloride cells (CC). (HE, X 400)

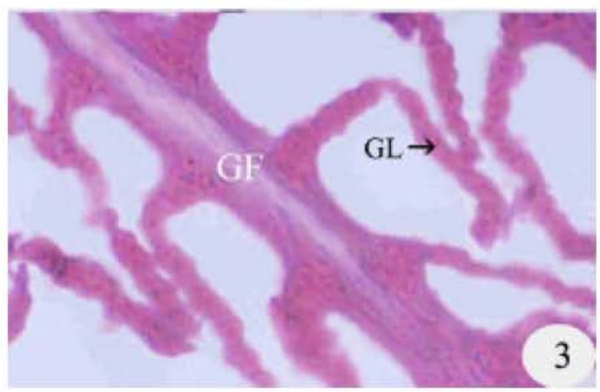
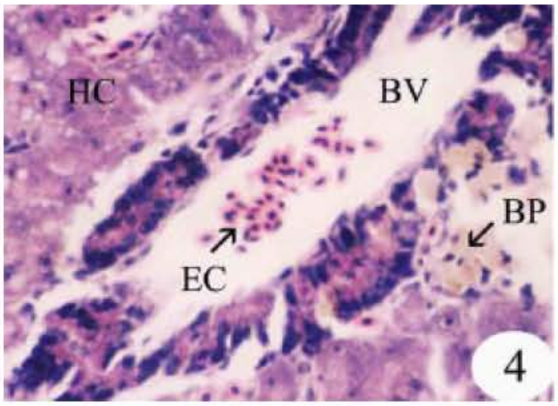


Fig. 3: Photomicrograph of a section of gill of fresh water fish showing the gill filament (GF) and gill lamella (GL). (HE, X 400)



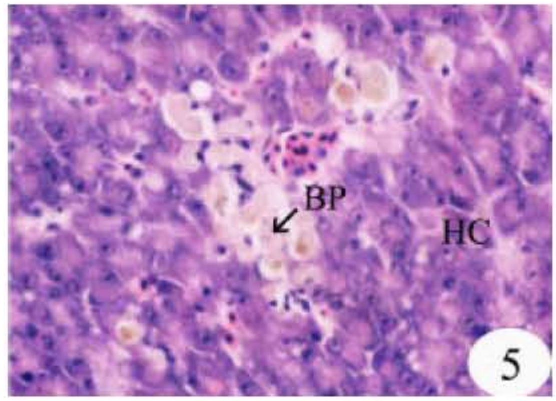
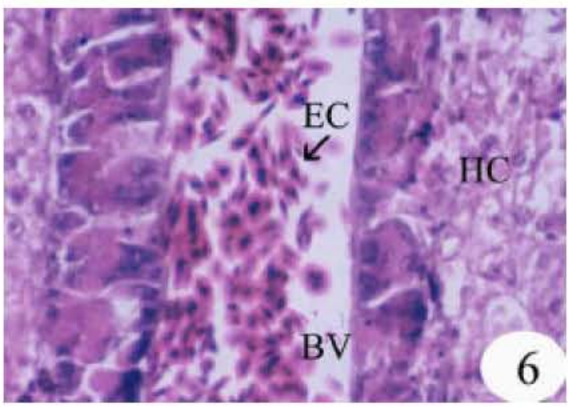


Fig. 4 and 5: Photomicrograph of a section of liver of marine water adapted fish showing the hepatic cells (HC), blood vessels (BV), the erythrocytes (EC) and bile pigments (BP). (HE, X 400)



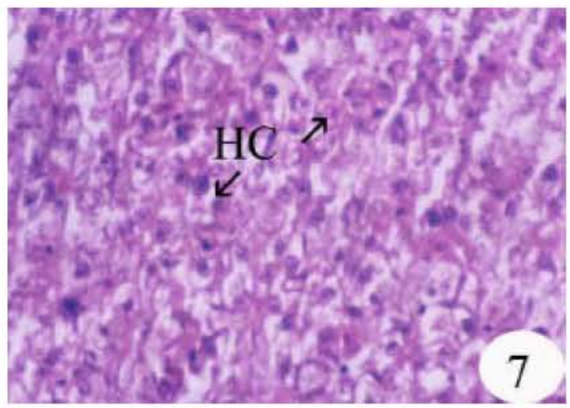


Fig. 6 and 7: Photomicrograph of section of liver of fresh water fish showing the hepatic cells (HC), the blood vessels (BV) and erythrocytes (EC), (HE, X 400)

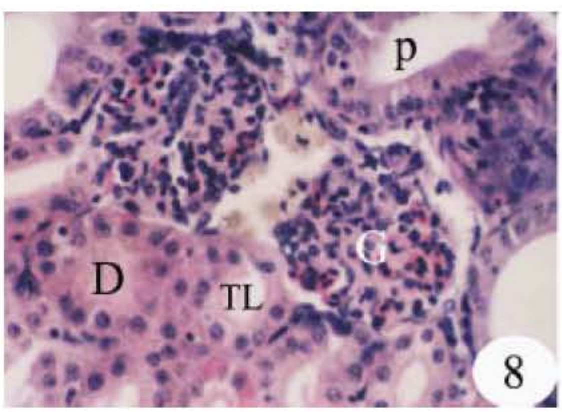


Fig. 8: Photomicrograph of a section of kidney of marine adapted fish showing the glomerulus (G), Proximal (P) and distal (D) convoluted segments and the tubular lumen (TL). (HE. X 400)

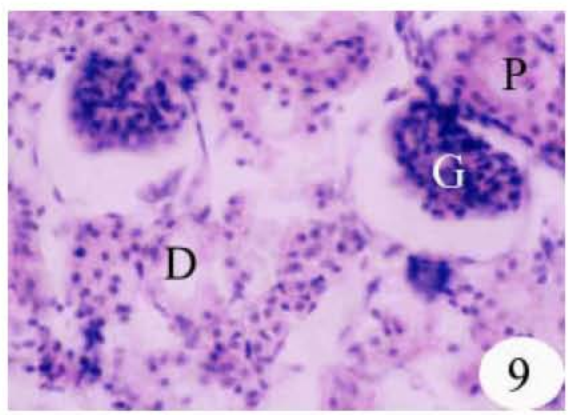


Fig. 9: Photomicrograph of a section of the kidney of fresh water fish showing the glomerulus (G) and the proximal (P) distal(D) convoluted segments. (HE, X 400)

Table 1: Mortality of fresh water red hybrid tilapia *O. mossambicu* X *O. hornorum* with various concentrations of sea water after gradual transfer from 10% (5‰) to 100% sea water (42‰)

Sea water conc.	10% 4.2‰	20% 8.4‰	30% 12.6‰	40% 16.8‰	50% 21‰	60% 25.2‰	70% 29.4‰	80% 33.6‰	90% 37.8‰	100% 42‰
Mortality	-----	------	------	2.5%	2.5%	10.5%	11.7%	13.3%	19.2%	20.8%

type. In this study the chloride cells were present in the gills of the fishes after 2 weeks of living in marine water.

Sections were taken in the liver of the marine adapted red tilapia (Fig. 4 and 5). They revealed the presence of yellowish green granules within the hepatic cells and this may due to the disturbance in drainage of bile juice. These granules were absent (Fig. 6 and 7). The bile granules may explain the stress on the liver during adaptation to marine water.

Hibiya[27] described the bile pigments in the liver and mentioned that they refers to the stagnation of the bile outflow from the hepatic cells.

Kidneys sections of marine adapted fish in Fig. 8 showed diluted of the tubular lumen while it is absent in the kidney of the fresh water fishes (Fig. 9). The dilation of the tubular lumen was noticed by Hibiya[27]. He mentioned that dilation usually observed in the distal portion of the tubule and there is a marked decrease in the length of the epithelial cells which is followed by the increase of the lumen volume.

In conclusion the possibility of adapting freshwater fishes to live in different salinities in spite of the histological changes occurred, which may help in fish farming.

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