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Salinity Tolerance of Oreochromis niloticus and O. mossambicus F1 Hybirds and Their Successive Backcross

DENNIS ALMAZAN MATEO

Institute of Aquaculture
College of Fisheries and Ocean Sciences
U. P. in the Visayas

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DENNIS ALMAZAN MATEO

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ABSTRACT

The effect of backcrossing on the salinity tolerance of the offspring of the hybrid *O. mossambicus* (Mo) x *O. niloticus* (Ni) was determined using median lethal salinity (MLS) and optimum salinity tolerance (OST) as indices of tolerance. The reciprocal Hybrids 1 (H1)(Mo x Ni and Ni x Mo), the first hybridization, were backcrossed with parental *O. mossambicus* in reciprocal crosses (i.e. with *O. mossambicus* as mother or father) to produce the reciprocal Hybrids 2 (H2) (H1 x Mo and Mo x H1), the backcross 1 and reciprocal Hybrids 3 (H3) (H2 x Mo and Mo x H2) and the backcross 2. These reciprocal hybrids and pure parental species were exposed to progressive changes in salinity at 6 ppt intervals until total mortality. Standard length (SL) was measured to correlate the size to salinity tolerance. Clinical signs and social behavior were observed during the test.

Parental *O. mossambicus* showed the highest salinity tolerance, followed by reciprocal H3, H2 and H1, while parental *O. niloticus* had the lowest. There was an increase of salinity tolerance in the offspring as they were backcrossed to the saline-tolerant parent *O. mossambicus*.

Both parents (*O. mossambicus*) contributed to the salinity tolerance of the offspring. Maternal inheritance was observed in reciprocal H1 and reciprocal H2, while paternal inheritance was observed in reciprocal H3. H1 had the highest heterosis. Both H2 and H3 stocks had negative and slight positive heterosis, indicating that they are good candidates as base population for selection.

Size and salinity tolerance were significantly related in H'2 and H'3 compared to the other group of fishes. Bigger fish survives longer in elevated salinities compared to smaller one. In the selection phase for growth, salinity tolerance might be indirectly selected, because larger fish survives longer regardless of age.

Social behavior during acclimation to salinity was observed. Generally, there was a decrease in the dominance of dominant individuals with the increase in salinity. *O. niloticus* and H1 stocks were increasingly aggressive at 30-36 ppt. H1 still had a residual dominant individuals until 96 ppt. Dominance disappeared in the other groups (H2 and H3 and pure O. mossambicus) at 48 ppt.

Loss of dominance among dominant individuals, cessation of feeding/minimal food intake, sunken eyes and abdomen, color changes and sluggish movement were observed before fish mortality.

Multicellular chloride cells increased its size and number in tilapias, including the degeneration of the size of their glomerulus as they were transferred to higher salinities. Specifically, O, niloticus has a smaller chloride cells and lesser degeneration as compared to O. mossambicus and hybrids 1, 2 and 3.

Transmission of salinity tolerance gene may be a multigene-factor inheritance. It is not controlled by a single gene, but by several genes summed together in the magnitude of salinity tolerance (i.e. adaptation of chloride cells and glumerulus, and adaptation of other osmoregulating organs, enzymes and hormones). Additive inheritance was observed due to their nearly zero heterosis. Maternal/paternal inheritance was observed due to the difference of salinity tolerance between the reciprocal breeds.

Hybrids 1 will not fit as base population for selection due to their high heterosis and aggressive behavior, that might be transmitted in the next generation. Hybrids 3 will not fit as base population for selection due to the high inbreeding values. Hybrids 2 best fit as base population for selection due to their low heterosis (additive inheritance), low aggressiveness and zero inbreeding. However H1 can contribute in the base population for selection, because heterosis not only governed by dominance-recessive effect but also additive. H3 can contribute to the base population, due to their high salinity tolerance.

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Introduction

Background of Study

Tilapias are naturally distributed in Africa, and the Jordan Valley (Wohlfarth and Hulata, 1981; Pullin and McConnell, 1982; Trewavas, 1982) and were introduced to other places for aquaculture purposes.

Tilapias are popular culture species because of their high environmental tolerant ranges. They can withstand adverse conditions and are very tolerant of low dissolved oxygen concentrations, even below 1 mg/l (Colman and Edwards, 1987). During culture, tilapias are able to survive in cages and tanks with very low dissolved oxygen and toxic gases. They can withstand water conditions with carbon monoxide concentrations of 50 - 72.6 ppm. They tolerate very high concentrations of ammonia at 2.4 ppm of unionized ammonia (Daud *et al*, 1989). They tolerate high turbidities and are resistant to high levels of pollution and toxic substances, whether organic or inorganic, natural or artificial. Tilapias are cultured in wastewater in India (Colman and Edwards, 1987).

Almost tilapias are euryhaline, and are able to live and reproduce in salinity higher than 30 ppt. This salinity occurs in the coast, coastal lagoons and estuaries in Africa, and brackishwater ponds and river mouths in the Philippines. Some tilapias naturally breed in the canal of Suez in the Red Sea. These species which include *Tilapia guineensis, Sarotherodon melanotheron, Tilapia zilli and Oreochromis mossambicus* can tolerate salinities of 0 to 120 ppt (Trewavas, 1982).

Tilapias possess various characteristics which make them desirable species to culture in brackishwater farms. There are species of tilapias with potential for brackishwater farming. These include *Oreochromis niloticus, O. mossambicus, Oreochromis aureus, Oreochromis spilurus, Oreochromis hornorum, S. melanotheron* and the hybrid red tilapia.