STUDY OF ACCLIMATION PROTOCOL AND FECUNDITY OF TILAPIA, OREOCROMIS MOSSAMICUS IN SEAWATER.
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Gradual acclimation of tilapia fingerlings, Oreochromis mossambicus from freshwater to seawater was conducted in cement tank under wet laboratory condition. Salinity was increased at a rate of 7 ppt / day, fingerlings were acclimatized to live in almost near seawater condition by the 5th day of experiment. The entire water was exchanged with complete seawater from the 6th day onwards. However, water temperature and dissolved oxygen was maintained at 30.0 ± 1°C and 6.32 ± 0.51 ppm respectively and other parameters maintained within tolerable range. The duration taken to acclimatize the tilapia fingerlings from freshwater to seawater was 5 days. Experiments were also conducted consecutively to determine the fecundity of the tilapia, O. mossambicus in full-strength seawater (36± 1 ppt). Brooder were selected in a ratio of 1:3 (male: female) and stock in cement tank. Eight matured male and twenty four matured female were used in the tank. No significant effect on fecundity was found with respect to the size of male and female brooders. The ratio of 1:3 was found ideal to reduce aggressive behavior during the breeding periods.

Acclimation of euryhaline fishes in seawater bridge the gap between production and consumption and thereby encourage aquaculture¹. Adaptation of Tilapia spp. to seawater culture could lead to significant expansion of tilapia production worldwide, particularly in coastal areas of the tropical and subtropical. Tilapia fishes, despite being freshwater fishes, are believed to have been evolved from marine ancestors². It has been reported that O. mossambicus can tolerate up to 120 ppt water salinity³. Moreover, they can grow normally and reproduce at water salinity of 49 ppt and their fry live and grow reasonably well at 69 ppt⁴. O. aureus, O. mossambicus required 04 days and O. niloticus 08 days for acclimation⁵. Gradual increase of salinity in freshwater on an average of 5 ppt/day, the tilapia fingerlings became acclimatized to live in almost near seawater condition by the 7th day⁶. When the daily increment of salinity was above 8 ppt/day, O. niloticus had a significantly lower Mean Lethal Survival (MLS) which may be attributed to an incomplete development or activation of the chloride cells of gills with the increasing salinity. Tilapia spp. can tolerate a higher salinity after a progressive transfer, also called multistep acclimation, gradual increase or stepwise increase⁶.

Tilapia is an ideal candidate for warm water aquaculture. They spawn easily in captive condition. Generally, the size at first maturation of tilapia under aquaculture conditions ranges from 30-50 g⁷. This size is small compared to a size of 150-250 g at which tilapia reproduce in the wild. The maturation of tilapia at small sizes may due to the unstable or stressful environmental conditions⁸. Male tilapia grow faster than females because females use considerable energy in egg production and do not eat when they are incubating eggs⁹. Prior to spawning, the male construct a nest on the bottom of a water body where the female lays the eggs and male fertilizes them¹⁰. Over 20% of teleost families are known to exhibit parental care behaviours¹¹. Among them, members of the Cichlididae family exhibit diversified patterns, which include egg guarding and mouth brooding activities¹². The type of parental care helps to distinguish the genera of tilapias. Members of the genera Oreochromis and Sarotherodon are mouth breeders whereby usually the female carries the fertilized eggs and newly hatched eggs in the mouth, offering incubation and protection, whereas, Mouthbrooders are normally polygamous¹³-¹⁴. Substrate brooders (genus Tilapia) are usually monogamous and both parents may care for the eggs, including fanning water through the nests to incubate the embryos¹⁵. Parental tilapia fish (Oreochromis spp.) display an elaborated form of parental care by incubating newly hatched embryos in oral buccal cavity until the complete adsorption of yolk sac¹⁶. Parental care is a

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very important adaptation among fish for ensuring the survival of their offspring. Mouth brooding undoubtedly offers the benefit of physical protection from predators or environmental stressors and the capacity to transport fries to a more conducive environment16.

The selection of suitable, pure and high quality brooder is the core of successful production of quality and quantity of offspring. Some characteristic feature for selection of brooder are: Broodfish should be free from injuries, should not be too old, should not be spawned several times because fecundity decreases with maternal age and successive spawnings, and should be genetically pure, and questionable origin must be avoided17.

Stocking density and sex ratio has been adopted for different tilapias brooder, with varying result. Sex ratio of 3:1 and 2:1 in tilapia hybrids were more productive than 1:1 and 1:2 ratio, due to the effect of Male pressure or the increase in spawning frequency of individual females whereas a ratio of 1:≤3 (male : female) appear optimum, and is suggested especially when synchronized spawning is required18. Nile tilapia, a male: female ratio of 1:2 produced more seed than a 1:3 ratio 19. Fecundity is proportional to the body weight of the female. A 100 g female will produce about 100 eggs per spawn, while a female weighing 600-1000 g can produce 1000 to 1500 eggs. Total number of spawning of Nile tilapia females was greater in brackish water (15 ppt) than in either full strength seawater (32 ppt) or fresh water20. Eggs can absorb some nutrients directly from water, egg yolk is the main source of nutrition for embryonic development in fish21.

MATERIAL AND METHODS

The present study was carried out at Coastal aquaculture farm

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**Table-1. Acclimation protocol of O. mossambicus fingerlings to Seawater**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Initial Quantity of freshwater (lit.) V&lt;sub&gt;1&lt;/sub&gt;</th>
<th>Initial Salinity (ppt) S&lt;sub&gt;1&lt;/sub&gt;</th>
<th>Final Salinity (ppt) S&lt;sub&gt;2&lt;/sub&gt;</th>
<th>Quantity of freshwater to be taken out (lit.) V&lt;sub&gt;2&lt;/sub&gt;</th>
<th>Quantity of seawater to be added (lit.) V&lt;sub&gt;3&lt;/sub&gt;</th>
<th>Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1800</td>
<td>07</td>
<td>07</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1800</td>
<td>07</td>
<td>14</td>
<td>900</td>
<td>900</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1800</td>
<td>14</td>
<td>21</td>
<td>1200</td>
<td>600</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1800</td>
<td>21</td>
<td>28</td>
<td>1350</td>
<td>450</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>1800</td>
<td>28</td>
<td>35</td>
<td>1440</td>
<td>360</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>1800</td>
<td>35</td>
<td>35 Seawater</td>
<td>1800</td>
<td>0</td>
<td>6</td>
</tr>
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</table>

**Table-2. Fecundity analysis of Oreochromis mossambicus brooder**

<table>
<thead>
<tr>
<th>TL (cm)</th>
<th>BW (g)</th>
<th>Mature male</th>
<th>Mature female</th>
<th>Number of eggs</th>
<th>Fertilization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.25</td>
<td>500</td>
<td>16.80</td>
<td>490</td>
<td>1320</td>
<td>92.50</td>
</tr>
<tr>
<td>22.50</td>
<td>425</td>
<td>18.00</td>
<td>460</td>
<td>1564</td>
<td>95.00</td>
</tr>
<tr>
<td>20.60</td>
<td>480</td>
<td>15.50</td>
<td>380</td>
<td>1178</td>
<td>89.81</td>
</tr>
<tr>
<td>23.50</td>
<td>575</td>
<td>15.80</td>
<td>395</td>
<td>1204</td>
<td>91.80</td>
</tr>
<tr>
<td>21.20</td>
<td>510</td>
<td>20.00</td>
<td>425</td>
<td>1402</td>
<td>96.00</td>
</tr>
</tbody>
</table>

**Table-3. Analysis of water quality parameter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range of variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>29.19 ± 0.06 to 31.91 ± 0.02</td>
</tr>
<tr>
<td>Dissolved Oxygen (ppm)</td>
<td>06.20 ± 0.01 to 06.98 ± 0.01</td>
</tr>
<tr>
<td>Salinity (ppt)</td>
<td>35 to 36</td>
</tr>
<tr>
<td>pH</td>
<td>7.55 ± 0.03 to 7.75 ± 0.01</td>
</tr>
<tr>
<td>Alkalinity (ppm)</td>
<td>107.52 ± 0.23 to 113.42 ± 0.09</td>
</tr>
<tr>
<td>Hardness(ppm)</td>
<td>5681.1 ± 0.22 to 6089.6 ± 0.28</td>
</tr>
<tr>
<td>NH&lt;sub&gt;4&lt;/sub&gt;N (μg/L)</td>
<td>0.12 ± 0.04 to 0.23 ± 0.02</td>
</tr>
<tr>
<td>NO&lt;sub&gt;2&lt;/sub&gt;-N (μg/L)</td>
<td>0.01± 0.01 to 0.04 ± 0.03</td>
</tr>
<tr>
<td>NO&lt;sub&gt;3&lt;/sub&gt;-N (μg/L)</td>
<td>0.07± 0.04 to 0.13± 0.03</td>
</tr>
</tbody>
</table>
unit, Tharuvaikulam (located between latitude 8°53’53.31” N and longitude 78°10’34.97” E) of Fisheries College and Research Institute (TNFU), Thoothukudi, Tamil Nadu, India. Tilapia fingerlings (*O. mossambicus*) were procured Institute fish farm. Commercial crumble feed (protein content 35 %) was given daily at the rate of 5% of body weight. Later, the salinity was increased by 7 ppt on every day by removing freshwater and by adding of appropriate amount of moderate seawater (35 ppt). Salinity values were assessed adopting the standard procedures\(^2\). The required quantity of freshwater or seawater was calculated by using the following simple formula:\(^5\):

\[
S_1 \times V_1 = S_2 \times V_2 \\
V_2 = S_1 \times V_1 / S_2 \text{ (or) } V_1 = S_2 \times V_2 / S_1
\]

Where,

- \(S_1\) = Initial salinity (ppt)
- \(V_1\) = Initial vol. of water (Litre)
- \(S_2\) = Final salinity (ppt)
- \(V_2\) = Final vol. of water(Litre)

Before starting the experiment, the physico-chemical parameters of this and freshwater and seawater used for the experiment were also assessed\(^2\). Broodstock were manually selected, sexed and transferred to conditioning cement tank (Length: 1.5 m; Breadth: 1.5 m; Height: 0.80 m; Area: 2.25 m\(^2\); Volume: 1.80 m\(^3\)). The broodstock were stocked at a sex ratio of 1:3 (male: females). The average initial weights were 498 g for male and 412 g for female fish. Broodstock were fed the commercial diet (35% CP) at a feeding rate of 4 % of total biomass. Feed was introduced at 10.00 am and 4 pm with amounts adjusted at about 60 days. Water quality was monitored once weekly and the parameters ascertained included pH, temperature (°C); dissolved oxygen (DO) in mg/l; ammonia (NH\(_3\)-N) in mg/l; nitrate (NO\(_3\)) in mg/l and nitrite (NO\(_2\)) in mg/l. Water alkalinity and total ammonia nitrogen (TAN mg/L) were weekly determined\(^2\).

RESULTS AND DISCUSSION

By gradual adding of seawater in freshwater on an average of 7 ppt / day, the tilapia fingerlings, *O. mossambicus* were acclimatized to live in almost near seawater condition by the 5\(^{th}\) day of experiment (Table-1). The entire water was exchanged with complete seawater from the 6\(^{th}\) day onwards. During the entire course of the acclimation, tilapia fingerlings did not show any sign of distress, their feeding and swimming. Tilapia fingerlings required 04 days to acclimatize from freshwater (0 ppt) to seawater (35 ppt)\(^1\). In the present study similar result was affirmed. The duration taken to acclimatize the tilapia fingerlings from freshwater (0 ppt) to seawater was found to be 05 days. Hybrid tilapia acclimated salinity (5 ppt) change to seawater. Each day approximately 20% of the culture water was replaced with fresh full-strength seawater (37-40 ppt) and thereby increasing the ambient salinity by 2 to 3 ppt\(^2\). Acclimation of tilapia fingerlings in almost near seawater condition by the 5\(^{th}\) day upon the gradual increase of salt concentration in freshwater on an average of 5 ppt per day\(^5\). Therefore, tilapia culture is not limited to freshwater. Tilapia is territorial and feed space for nest building and spawning. Male fish were matured earlier than female fish. There was no significant difference in the total length (TL) of mature male (21.61 ± 1.5 cm) and female (17.22 ± 1.87 cm). The average body weight (BW) of the brooder (Table-2) in this study was 325g with the mean brooding capacity of 985 egg on each cycle. The hatching rate from eggs of the brooder were high (93% ± 1.20) and hatched larva almost normal. However, water temperature and dissolved oxygen was maintained at 30.0 ± 1°C and 6.32 ± 0.51 ppm respectively and other parameters maintained within tolerable range(Table-3).

ACKNOWLEDGEMENTS

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REFERENCES

ACCLIMATION PROTOCOL AND FECUNDITY OF TILAPIA