Growth and feed utilization of the Nile tilapia fry pre-exposed to different water temperatures and hormone 17α methyltestosterone

Hosam M. Agouz
Central lab of aquaculture research, Abassa, Abou-Hammad, Sharkia, Egypt

ABSTRACT

The effect of water temperatures in combination with or without hormone 17α methyltestosterone application for different periods (1, 2, 3 and 4 weeks) on sex ratio and survival rate of O. niloticus fry were investigated. Three rearing temperatures (25, 30 or 30°C) were tested; within each rearing treatment two levels of 17α methyltestosterone (0 or 60 mg/kg basal diet) were used. Sex ratio and survival rate of O. niloticus fry were determined after 1, 2, 3 and 4 weeks. Therefore, 24 groups (3 × 2 × 4) were tested. At the end of this experiment, sex reversed fry were chosen at random from each group and stocked in 72 L aquaria (3 replicates for each group, 3×24) and used to investigate the effect of rearing water temperature in combination with or without hormone application for different periods (1, 2, 3 and 4 weeks) on growth performance and feed utilization of O. niloticus fry during one month after treatment period.

The highest final body weight (BW), body length (BL), weight gain (WG), specific growth rate (SGR) and the worst feed conversion ratio (FCR) were obtained for fry reared (pre-exposed) at 35°C and fed on the diet supplemented by 60 mg 17α-MT for one week and the lowest final BW, BL, WG, SGR and the best FCR were recorded for the control fry group (reared at 25°C and fed on the diet free from 17α-MT for two weeks) and the same trend was also observed for tilapia fry pre-exposed to each of water temperature and 17α-MT for three or four weeks. For the control, fry group rearing periods (1, 2, 3 or 4 weeks) did not affect the final BW, BL, WG, SGR or FCR of growing the Nile tilapia fry while, increasing the rearing period for C35H1 gradually increased these parameters.

Keywords: pre-exposed, water temperature, hormone (17α methyltestosterone) Nile tilapia, growth performance, feed utilization

INTRODUCTION

Tilapias (Oreochromis niloticus) are a paradox in reproduction. The relative fecundity of O. niloticus species is low; 6,000-13,000 eggs/kg/spawn. However, this is compensated by high survival rate and its iteroparity nature. Ideally, a fish species used in aquaculture is not allowed to reproduce in the culture environment before reaching market size. This phenomenon presents a significant challenge to the fish culturist. Most tilapia species often reach maturity within 6-8 months of hatching at a size often less than 100 g. Under favourable conditions tilapia will start to reproduce leading to intraspecific competition hence stunted growth and become unmarketable (Beaven and Muposhi 2012).

All male culture of tilapia is preferred because of their fast growth. Several techniques have been used to produce monosex tilapia to control unwanted reproduction and among these include; manual sexing (Guerrero, 1982); hybridization (Hickling, 1960), genetic manipulation (Pandian and Varadaraj 1988, Soltan et al., 1999 and Abdel-Hakim et al., 2000); and sex reversal through sex oestrogenic hormone administration (Guerrero, 1982 and Soltan et al., 2013).
Hormone treatment does not alter the genotype of the fish but directs the expression of the phenotype. Production of all male population through administration of androgen (17α-MT) is considered to be the most effective and economically feasible method for obtaining all male tilapia populations (Guerrero and Guerrero 1988). Recently hatched tilapia fry do not have developed gonads such that it is possible to intervene at this early point in the life history and direct gonadal development to produce monosex populations. Exogenous steroids given during the gonadal development period can control the phenotype overriding the expression of the genotypically determined sex.

Some studies provided evidence that water temperature also governed the phenotypic sex of Oreochromis spp. A vast majority of experiments demonstrated that high temperatures favoured the production of (almost) monosex male progenies (O. niloticus: Baroller et al., 1995: 1996 a & b; O. aureus: Baras et al., 2000 & Soltan et al., 2013). Except for some strains (Trewavas, 1983), 36-37°C is close to the upper incipient lethal temperature of O. niloticus (Balarin and Hatton, 1979), and above the thermal optimum for its growth (Melard, 1986).

Therefore, this study aimed to evaluate growth performance and feed utilization of O. niloticus sex reversed fry by rearing in different water temperature or hormone treatments for different periods.

**MATERIALS AND METHODS**

The present experiment was carried out at the hatchery unit at the experimental station of the World Fish Center, Abbassa, Abou-Hammad, Sharkia, Egypt to investigate the effect of rearing water temperature in combination with or without hormone 17α methyltestosterone application for different periods (1, 2, 3 and 4 weeks) on growth performance and feed utilization of sex reversed O. niloticus fry.

**Experimental fish:**

In previous experiment (Soltan et al., 2013), we investigated the effect of rearing in different water temperature in combination with or without hormone application for different periods (1, 2, 3 and 4 weeks) on sex ratio and survival rate of O. niloticus fry as the following:

- **T1:** C25H0 fry reared at 25°C and fed 17α-MT free diet.
- **T2:** C25H1 fry reared at 25°C and fed 60 mg/kg diet 17α-MT supplemented diet.
- **T3:** C30H0 fry reared at 30°C and fed 17α-MT free diet.
- **T4:** C30H1 fry reared at 30°C and fed 60 mg/kg diet 17α-MT supplemented diet.
- **T5:** C35H0 fry reared at 35°C and fed 17α-MT free diet.
- **T6:** C35H1 fry reared at 35°C and fed 60 mg/kg diet 17α-MT supplemented diet.

At the end of this experiment sex ratio and survival rate were determined and sex reversed fry were chosen at random from each group (24 group, 6 treatments × 4 periods) and stocked in 72 L aquaria (3 replicates for each group, 3 × 24). Each aquarim was stocked with 15 fish therefore a total number of 1080 fish were used in the present study.

**Basal diet and fish feeding:**

Fish feed was formulated in the fish preparation Lab of the Worldfish center. Thomas-Willey Laboratory Mill Model 4 grinder was used for grinding the corn to small granules of 0.5 mm mesh. Ingredients of the feed were mixed and formulated using Hobarts mixer (model D300T) for 15 minutes. Oils, starch, mineral mixture and vitamins were added gradually to ingredient in the mixer. The mixed ingredients were then pelletted using Thomas-Willey laboratory Mill model 4 to form feed pellets.
The basal diet was prepared by thoroughly mixing of the ingredients (Table 1). Water was added to the ingredients of each diet for mixing these ingredients and then dried. After drying, the diets were broken up and sieved into the convenient pellet size. Fish were given the experimental diets 6 day/week at a daily rate of 3% of total biomass (twice daily at 9.00am and 3.00pm) till the end of experimental period. Every two weeks, fish were taken from each aquarium then weighted and the amount of feed was adjusted according to the changes in body weight throughout the experimental period.

Table 1: Formulation and composition of the artificial diet used for *O. niloticus*.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal (65%)</td>
<td>38</td>
</tr>
<tr>
<td>Soy bean meal (44%)</td>
<td>30</td>
</tr>
<tr>
<td>Yellow corn</td>
<td>23</td>
</tr>
<tr>
<td>Bran</td>
<td>3.5</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>3</td>
</tr>
<tr>
<td>Vitamins &amp; minerals mixture¹</td>
<td>2.2</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>0.3</td>
</tr>
<tr>
<td>Sum</td>
<td>100</td>
</tr>
<tr>
<td>Crude protein</td>
<td>40.2</td>
</tr>
<tr>
<td>Metabolizable energy (Kcal/kg feed)</td>
<td>2895</td>
</tr>
<tr>
<td>P/E ratio (mg protein/kcal)</td>
<td>138.86</td>
</tr>
</tbody>
</table>

¹ Vitamin & mineral mixture/kg premix: Vitamin D3, 0.8 million IU; A, 4.8 million IU; E, 4 g; K, 0.8 g; B1, 0.4 g; Riboflavin, 1.6 g; B6, 0.6 g; B12, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin, 20 mg; Mn, 22 g; Zn, 22 g; Fe, 12 g; Cu, 4 g; I, 0.4 g, Selenium, 0.4 g and Co, 4.8 mg.

**Growth performance and feed utilization parameters:**
Growth performance and feed utilization parameters were calculated as follows:

Weight gain = W2 (g) – W1 (g)

Specific growth rate (SGR): \( \frac{\ln W_2 - \ln W_1}{t \times 100} \) Where: \( \ln \) = The natural log, \( W_1 \) = The initial weight, \( W_2 \) = The final weight and \( t \) = period in days

Feed conversion ratio (FCR) = Feed intake (g)/weight gain (g)

**Statistical analysis:**
Statistical analysis of the obtained data was analyzed according to SAS (1996). Differences between means were tested for significance according to Duncan's multiple rang test as described by Duncan (1955).

**RESULTS AND DISCUSSION**

**Body weight (BW)**

Results of Table 2 showed that, the average BW of Nile tilapia fry ranged between 4.19 and 4.23 g with insignificant differences between the different experimental groups. After one month growing period the average BW of pre-exposed fry ranged between 33.53 and 60.29 gm and the differences between these means were significant (P<0.001). The highest BW for Nile tilapia fry treated for one week (60.29 g) was obtained for fry pre-exposed to 35°C and fed the diet supplemented by 60 mg 17α-MT for one week and the lowest final BW (33.53 gm) was obtained for the control fry group (reared at 25°C and fed the diet free from 17α-MT). The highest BW of Nile tilapia fry treated for two weeks (68.72 g) was obtained for fry pre-exposed to 35°C and fed 60 mg 17α-MT supplemented diet and the lowest final BW (34.89 g) was obtained for the control fry group (reared at 25°C and...
fed the diet free from 17α-MT). The same trend was also observed for tilapia fry pre-exposed by each of water temperature and 17α-MT for three or four weeks.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fry treated for one week</th>
<th>Fry treated for two weeks</th>
<th>Fry treated for three weeks</th>
<th>Fry treated for four weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial BW(g)</td>
<td>Final BW(g)</td>
<td>Initial BW(g)</td>
<td>Final BW(g)</td>
</tr>
<tr>
<td>C25H0</td>
<td>4.19</td>
<td>33.53 f</td>
<td>4.25</td>
<td>34.89 f</td>
</tr>
<tr>
<td>C25H1</td>
<td>4.19</td>
<td>37.69 e</td>
<td>4.20</td>
<td>42.92 e</td>
</tr>
<tr>
<td>C30H0</td>
<td>4.23</td>
<td>55.70 b</td>
<td>4.21</td>
<td>60.31 b</td>
</tr>
<tr>
<td>C30H1</td>
<td>4.24</td>
<td>48.54 c</td>
<td>4.20</td>
<td>52.59 c</td>
</tr>
<tr>
<td>C35H0</td>
<td>4.21</td>
<td>60.29 a</td>
<td>4.25</td>
<td>68.72 a</td>
</tr>
<tr>
<td>SE</td>
<td>±0.12</td>
<td>±0.35</td>
<td>±0.14</td>
<td>±0.39</td>
</tr>
</tbody>
</table>

Means followed by different letters in each column for each treat for each trait significantly different (P<0.05).

With regard to the effect of pre-exposured rearing period, results indicated that, final BW of control tilapia fry group (C25H0) are relatively the same and found to be 33.53, 34.89, 33.66 and 33.90 gm for fry groups treated by normal water temperature 25°C and fed the diets free from 17α-MT for 1, 2, 3 or 4 weeks of treatment periods.

On the other hand, fry group C35H1 (fry treated by high water temperature 35°C and fed the diets supplemented by 17α-MT) final BW found to be 60.29, 68.72, 76.55 and 84.09 g for fry groups pre-exposured for 1, 2, 3 or 4 weeks, respectively.

The obtained results indicated that, for control fry group (C25H0) rearing periods (1, 2, 3 or 4 weeks) did not affect the final BW of growing Nile tilapia fry while, increasing rearing period (1, 2, 3 or 4 weeks) for C35H1 gradually increased final BW (60.29, 68.72, 76.55 and 84.09 g) and this result may be attributed to increasing male percentage with increasing treatment period (by water temperature and 17α-MT).

Previous studies have been conducted in this area most of their results come in agreement with the current results. Guerrero (1975) found that the mean weights of hormone treated fry at harvest were generally higher than that of the control O. aureus. Also, Guerrero (1979) reported a higher yield in MT-treated groups of O. mossambicus over control, and Macintosh et al., (1985) found that, there were significant differences between fry treated and untreated. They obtained an average weight increase of 64% over controls when feeding O. mossambicus fry with MT-30 mg for 60 days.

Also, McAndrew and Majundar (1989) obtained 25.7% increase in weight over controls when O. niloticus fry were treated with MT-40 for 40 days. Varadaraj (1990) observed that the increase in mean body weight of fry treated with 19-norethisterone acetate than control for 15 days by be attributed to the anabolic effect of 19-NE on metabolism. Khater (1998) indicated that, O. niloticus fry treated with different doses of 17α-MT (0, 15, 30, 60 and 90 mg/kg diet) for different periods (14, 21 and 28 days) had significantly higher BW as compared to the control group which received no hormone in their diet (P<0.05). In this respect, Ferdous and Ali (2011) indicated that, the dose of 60 mg MT/kg of feed resulted in maximum male population (94.28%) of O. niloticus fry with a feeding period of 28 days after hatching.

Body length (BL)

Results of Table 3 showed that the average BL of O. niloticus fry ranged between 5.77 and 6.25 cm with insignificant differences between the different experimental groups. After one month growing period the average BL of pre-
Growth of Nile tilapia pre-exposed to water temperatures and hormone

The highest BL of Nile tilapia fry treated for one week (15.38 cm) was obtained for fry pre-exposed to 35°C and fed the diet supplemented by 60 mg 17α-MT for one week and the lowest final BL (11.07 cm) was obtained for the control fry group (reared at 25°C and fed the diet free from 17α-MT for one week). Also, the highest BL of Nile tilapia fry treated for two weeks (17.11 cm) was obtained for fry pre-exposed to 35°C and fed the diet supplemented by 60 mg 17α-MT for two weeks and the lowest final BL (13 cm) was obtained for the control fry group (reared at 25°C and fed the diet free from 17α-MT) and the same trend was also observed for tilapia fry pre-exposed to each of water temperature and 17α-MT for three or four weeks.

With regard to the effect of previously rearing period, results also indicated that, final BL of control tilapia fry group (C25H0) are relatively the same and found to be 11.07, 11.00, 11.07 and 11.04 cm for fry groups treated by normal water temperature 25°C and fed the diets free from 17α-MT for 1, 2, 3 or 4 weeks of treatment periods, respectively. On the other hand, fry group C35H1 (fry treated by high water temperature 35°C and fed the diets supplemented by 17α-MT) final BL found to be 15.38, 17.11, 18.16 and 18.32 cm for fry groups pre-exposed for 1, 2, 3 or 4 weeks, respectively.

The obtained results indicated that, for control fry group rearing periods (1, 2, 3 or 4 weeks) did not affect the final BL of growing Nile tilapia fry while, increasing rearing period for C35H1 gradually increased final BL (15.38, 17.11, 18.16 and 18.32 cm) and this result may be attributed to increasing male percentage with increasing treatment period (by water temperature and 17α-MT).

The current results are in agreement with those reported by Khater (1998) who indicated that, *O. niloticus* fry treated with different doses of 17α-MT (0, 15, 30, 60 and 90 mg/kg diet) for different periods (14, 21 and 28 days) had significantly higher BL as compared to the control group which received no hormone in their diet (P<0.05). In this respect Jensen and Shelton (1979) found that, the mean body length ranged from 1.7 to 1.8 cm when *O. aureus* fry received estradiol for 21 days and they attributed this result to water temperature and hormone 17α-methyltestosterone.

**Weight gain (WG)**

With respect of the interaction between water temperature and 17α-MT, results of Table 4 showed that, the average WG of Nile tilapia fry ranged between 28.77 and 54.87 g with significant differences between the different experimental fry groups after one month growing period for pre-exposed tilapia fry. The highest WG (54.87 g) was obtained for fry pre-exposed to 35°C and fed the diet supplemented by 60 mg

---

Table 3: Effect of water temperature and hormone on body length (BL) of growing Nile tilapia (cm/fish) fry at different treatment periods.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fry treated for one week (cm)</th>
<th>Fry treated for two weeks (cm)</th>
<th>Fry treated for three weeks (cm)</th>
<th>Fry treated for four weeks (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial BL</td>
<td>Final BL</td>
<td>Initial BL</td>
<td>Final BL</td>
</tr>
<tr>
<td>C25H0</td>
<td>5.80</td>
<td>11.07</td>
<td>e</td>
<td>5.89</td>
</tr>
<tr>
<td>C25H1</td>
<td>5.78</td>
<td>11.84</td>
<td>d</td>
<td>6.18</td>
</tr>
<tr>
<td>C30H0</td>
<td>5.88</td>
<td>12.33</td>
<td>c</td>
<td>5.76</td>
</tr>
<tr>
<td>C30H1</td>
<td>5.77</td>
<td>13.40</td>
<td>b</td>
<td>6.03</td>
</tr>
<tr>
<td>C35H0</td>
<td>5.78</td>
<td>11.90</td>
<td>d</td>
<td>6.18</td>
</tr>
<tr>
<td>C35H1</td>
<td>6.25</td>
<td>15.38</td>
<td>a</td>
<td>5.85</td>
</tr>
</tbody>
</table>

Means followed by different letters in each column for each treat for each trait significantly different (P<0.05).
17α-MT for one week and the lowest WG (28.77 g) was obtained for the control fry group (reared at 25°C and fed the diet free from 17α-MT). The same trend was also observed for tilapia fry previously treated by each of water temperature and 17α-MT for two, three or four weeks.

With regard to the effect of previously rearing period, results also indicated that, WG of control tilapia fry group (C25H0) are relatively the same and found to be 28.77, 33.5, 26.40 and 30.92 gm for fry groups treated by normal water temperature 25°C and fed 17α-MT free diet for 1, 2, 3 or 4 weeks of treatment periods, respectively. On the other hand, fry treated by high water temperature 35°C and fed 17α-MT supplemented diet (C35H1), WG found to be 53.87, 63.95, 71.97 and 79.46 g for fry groups pre-exposured for 1, 2, 3 or 4 weeks, respectively.

Table 4: Effect of temperature and hormone on fry weight gain (WG) of Nile tilapia (g/fish)) at different treatment periods.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fry treated for one week (g)</th>
<th>Fry treated for two weeks (g)</th>
<th>Fry treated for three weeks (g)</th>
<th>Fry treated for four weeks (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C25H0</td>
<td>28.77 d</td>
<td>33.50 e</td>
<td>26.40 e</td>
<td>30.92 d</td>
</tr>
<tr>
<td>C25H1</td>
<td>33.30 c</td>
<td>38.55 de</td>
<td>44.86 d</td>
<td>58.85 c</td>
</tr>
<tr>
<td>C30H0</td>
<td>39.21 b</td>
<td>43.99 cd</td>
<td>56.77 c</td>
<td>60.45 c</td>
</tr>
<tr>
<td>C30H1</td>
<td>51.10 a</td>
<td>54.82 b</td>
<td>68.03 a</td>
<td>62.16 bc</td>
</tr>
<tr>
<td>C35H0</td>
<td>43.28 b</td>
<td>47.17 c</td>
<td>62.15 b</td>
<td>66.81 b</td>
</tr>
<tr>
<td>C35H1</td>
<td>54.87 a</td>
<td>63.95 a</td>
<td>71.97 a</td>
<td>79.46 a</td>
</tr>
<tr>
<td>SE</td>
<td>±1.30</td>
<td>±1.83</td>
<td>±1.59</td>
<td>±1.89</td>
</tr>
</tbody>
</table>

Means followed by different letters in each column for each trait significantly different (P<0.05).

The obtained results indicated that, for control fry group rearing periods (1, 2, 3 or 4 weeks) did not affect the average WG of growing Nile tilapia fry while, increasing rearing period for C35H1 gradually increased the average WG (53.87, 63.95, 71.97 and 79.46 g) and this result may be attributed to increasing male percentage with increasing treatment period (by water temperature and 17α-MT). Baras et al., (2001) noticed depression in tilapia growth reared at 37°C and they attributed the depressed growth at 37°C to the increase of routine metabolism and reduction of the scope for activity at temperatures above the optimum. They also added that, growth depression was proportionally lower during the first 14 days of exogenous feeding than in older fish, probably because the optimum temperature for growth decreased in the course of ontogenetic development.

**Specific growth rate (SGR):**

After one month growing period SGR of previously treated tilapia fry for one week ranged between 2.17 to 2.85% and the differences between these means were significant (P<0.001). The highest SGR value (2.85%) was obtained for fry pre-exposed to 35°C and fed 17α-MT supplemented diet for one week and the lowest SGR (2.17%) was obtained for the control fry group (reared at 25°C and fed the 17α-MT free diet for one week).

Results of Table 5 also showed that, after one month growing period, the highest SGR (2.97%) was obtained for fry pre-exposed to 35°C and fed 17α-MT supplemented diet for two weeks and the lowest SGR value (2.34%) was obtained for the control fry group (reared at 25°C and fed the 17α-MT free diet for two weeks) and the same trend was also observed for tilapia fry pre-exposed to each of water temperature and 17α-MT for three or four weeks.
Table 5: Effect of graded levels of water temperature and hormone on fry specific growth rate (SGR) of Nile tilapia (%/day) at different treatment periods.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fry treated for one week (%/day)</th>
<th>Fry treated for two weeks (%/day)</th>
<th>Fry treated for three weeks (%/day)</th>
<th>Fry treated for four weeks (%/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C25H0</td>
<td>2.17 d</td>
<td>2.34 e</td>
<td>2.14 e</td>
<td>2.23 c</td>
</tr>
<tr>
<td>C25H1</td>
<td>2.38 c</td>
<td>2.52 d</td>
<td>2.65 d</td>
<td>2.92 b</td>
</tr>
<tr>
<td>C30H0</td>
<td>2.56 b</td>
<td>2.60 d</td>
<td>2.88 e</td>
<td>2.97 b</td>
</tr>
<tr>
<td>C30H1</td>
<td>2.78 a</td>
<td>2.83 b</td>
<td>3.07 ab</td>
<td>2.97 b</td>
</tr>
<tr>
<td>C35H0</td>
<td>2.61 b</td>
<td>2.71 c</td>
<td>2.97 bc</td>
<td>3.02 b</td>
</tr>
<tr>
<td>C35H1</td>
<td>2.85 a</td>
<td>2.97 a</td>
<td>3.09 a</td>
<td>3.22 a</td>
</tr>
<tr>
<td>SE</td>
<td>±0.03</td>
<td>±0.03</td>
<td>±0.03</td>
<td>±0.04</td>
</tr>
</tbody>
</table>

Means followed by different letters in each column for each treat for each trait significantly different (P<0.05).

With regard to the effect of pre-exposed rearing period, results also indicated that, SGR for control tilapia fry group (C25H0) are relatively the same and found to be 2.17, 2.34, 2.14 and 2.23% for fry groups treated by normal water temperature 25°C and fed the 7α-MT free diet for 1, 2, 3 or 4 weeks of treatment periods, respectively. On the other hand, fry group C35H1 (fry treated by high water temperature 35°C and fed the 17α-MT supplemented diet), SGR found to be 2.85, 2.97, 3.09 and 3.22% for fry groups pre-exposed for 1, 2, 3 or 4 weeks, respectively.

The obtained results indicated that, for control fry group rearing periods (1, 2, 3 or 4 weeks) did not affect the SGR of growing Nile tilapia fry while, increasing rearing period for C35H1 gradually increased final SGR (2.85, 2.97, 3.09 and 3.22%) and this result may be attributed to increasing male percentage with increasing treatment period (by water temperature and 17α-MT).

Treated fish groups (by hormone or temperature) the current study showed an improvement in SGR compared with mixed sex of Nile tilapia obtained in previous studies (Abdel-Hakim et al., 2001 a & b; Hassaan et al., 2013 and 2014 a & b). The obtained results follow the trend as those obtained by McAndrew and Majumdar (1989) who reported that, feeding O. aureus fry with MT-40 mg/kg feed for a period of 40 days resulted in a significant increase in SGR. Also, Khater (1998) indicated that, O. niloticus fry treated with different doses of 17α-MT (0, 15, 30, 60 and 90 mg/kg diet) for different periods (14, 21 and 28 days) had significantly higher SGR as compared to the control group which received no hormone in their diet (P<0.05). Also, Beaven and Muposhi (2012) indicated that O. nioticus fry fed a diet treated with MT had significantly higher growth rate as compared to those fed to a non hormone treated diet.

For other fish species, Woo et al., (1993) found that, there were significant differences in SGR between testosterone treated and untreated red sea bream, Chrysophrys major, and they attributed this result to the fact that the testosterone has anabolic effects on the red sea bream because it increase appetite, the activities enzymes and feed conversion efficiency.

**Feed conversion ratio (FCR):**

The average FCR of Nile tilapia fry ranged between 1.91 to 2.07 with insignificant differences (P>0.05) between the different fry groups pre-exposed for one week after one month of growing period. Results of Table 6 also showed that the worst FCR (2.07) was obtained for fry pre-exposed to 35°C and fed the 17α-MT free diet for one week and the best FCR (1.91) was obtained for fry group reared at 25°C and fed the diet 17α-MT supplemented diet for one week and the same trend was also observed for FCR at all rearing periods 1, 2, 3 and 4 weeks.
Table 6: Effect of graded levels of water temperature and hormone on fry feed conversion ratio (FCR) of Nile tilapia at different treatment periods.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fry treated for one week</th>
<th>Fry treated for two weeks</th>
<th>Fry treated for three weeks</th>
<th>Fry treated for four weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>C25H0</td>
<td>1.92</td>
<td>2.01</td>
<td>1.86 ab</td>
<td>2.00</td>
</tr>
<tr>
<td>C25H1</td>
<td>1.91</td>
<td>1.86</td>
<td>1.75 b</td>
<td>1.77</td>
</tr>
<tr>
<td>C30H0</td>
<td>1.77</td>
<td>1.94</td>
<td>1.94 a</td>
<td>1.89</td>
</tr>
<tr>
<td>C30H1</td>
<td>2.02</td>
<td>1.85</td>
<td>1.83 ab</td>
<td>1.79</td>
</tr>
<tr>
<td>C35H0</td>
<td>2.07</td>
<td>1.97</td>
<td>1.84 ab</td>
<td>1.77</td>
</tr>
<tr>
<td>C35H1</td>
<td>2.03</td>
<td>1.88</td>
<td>1.79 ab</td>
<td>1.76</td>
</tr>
<tr>
<td>SE</td>
<td>±0.09</td>
<td>±0.09</td>
<td>±0.04</td>
<td>±0.08</td>
</tr>
</tbody>
</table>

Means followed by different letters in each column for each treatment period significantly different (P<0.05).

The present results do not agree with those obtained by Khater (1998). He found that, FCR of *O. niloticus* fry treated with different doses of 17α-MT (0, 15, 30, 60 and 90 mg/kg diet) for 14 days were 1.42 1.11, 1.23, 1.08 and 1.05, respectively. There were no significant differences among all hormone-treated groups. However, they were significant different from the control group (P<0.05) which received hormone-free diets. Similar results were also observed for protein efficiency ratio. Matty and Lone (1979) and Lone and Matty (1980 & 1981) demonstrated that natural androgens and MT treatment enhanced the feed efficiency values in common carp, *Cyprinus carpio* L. Also, Phelps *et al.* (1992) obtained similar results when *O. niloticus* fry was fed the diet treated with MT at 60 mg/kg of feed for 28 days.

Variations in the growth rates in this study may also be attributed to the differences in the feed conversion ratios of fry groups. High FCR values for individuals whose diet was androgenised may have contributed to better conversion of feed and the consequent weight gain as compared to the other group. 17 α-MT is an accelerator of mineral uptake into the body as well as their retention and hence males are likely to have a better conversion of food (Falany and Falany, 1996 & Beaven and Muposhi 2012).

Although we observed a relatively high feed conversion ratio in individuals, with diet was androgenised diets than the ones without, the FCR established in this study are rather low as compared to the findings of Watanabe (2000), Soltan *et al.* (2002 & 2006) Abou Zead *et al.* (2008). This could have been due to the fact that the hormone can degrade during storage and on its passage through the digestive tract. Furthermore, the lack of uniformity of the hormone in the feed and hierarchies among fish can cause significant variability in dose among treated individuals making estimates of amounts ingested very difficult. Excessive doses of some hormones can lead to sterility or paradoxical feminization following aromatization of androgens to estrogen.

**REFERENCES**


Soltan, M. A.; Radwan, A. A. and Samra, I. M. (2002). Effect of varying protein, energy and protein to energy ratio on growth, feed efficiency and body
Growth of Nile tilapia pre-exposed to water temperatures and hormone


ARABIC SUMMARY

النمو والإستفادة من الغذاء لزريعة البلطى النيلى التي سبق تعريضها للدرجات حرارة مختفه وهرمون (17 ألفا ميثيل تستوستيرون)

حسام محمود عجوز

المعمل المركزى لبحوث الأسماك – العباسة – ابومحمود الشرقية – مصر

في دراسة سابقة تم إجراء تجربة لدراسة تأثير درجة حرارة الماء مع أو بدون هرمون الذكورة (17 ألفا ميثيل تستوستيرون) على انقلاب الجنس وحيوية زريعة أسماك البلطى النيلى. ولذلك تم تقسيم زريعة أسماك البلطى النيلى إلى ثلاثة مجموعات وتم تحضين ورعاية المجموعات الثلاثة في ثلاث درجات حرارة مختلفة 25، 30 و 35°م وقسمت كل مجموعة إلى سفن المجموع الأول تحتزت الزيروية على غذاء خالي من الهرومون أما الأخرى فقد تحتزت على الزيروية المحتوية على 60 مجم هرمون/كجم. تم تقدير النسبة الجنسية وحيوية بعد مرور 1، 2، 3 أسابيع. والذالك كانت لدى تلك التجربة، عند درجة حرارة المياه كل من 80 متر (3 مكررات لكل مجموعة) وذلك لدراسة تأثير المعاملات السابقة والتي أستخدمت في إثارة البلطى في الأسماك (درجة حرارة الماء والمعاملات). على صفات النمو وال célibة لذروة هذه الأسماك وذلك في تجربة متصلة استغرقت 30 يوم. وكان من أهم النتائج المتحصل عليها ما يلي:

ُحققت مجموعة الزيروية التي تم سبق تعريضها على درجة حرارة مقدارها 35°م وتغذت على الغذاء المعامل هرمونياً لمدة أسبوع أعلى من المتوسطات لوزن وطول الجسم والزيادة في وزن الجسم ومعدل النمو النسبي وأسوأ معدل لتحويل الغذاء بينما حققت مجموعة الزيروية التي تم سبق تعريضها على الغذاء في درجة حرارة 25°م وتغذت على الغذاء الغير هرمونياً لمدة أسبوع أقل من المتوسطات لوزن وطول الجسم والزيادة في وزن الجسم ومعدل النمو النسبي وأفضل معدل لتحويل الغذاء. وقد أدلت النتائج نص الإتجاه بالنسبة لدرجة حرارة مقدارها 25°م وتغذت على الغذاء الغير هرمونياً من أجل deteriorating hermaphroditism. Just as had shown that a mixture of a temperature and the gas at 25°C and fed on the diet without hormone gave the best performance. He also noted that a mixture of a temperature and the gas at 25°C and fed on the diet without hormone gave the best performance in the fish. 

استنتجت النتائج نفس الإتجاه بالنسبة للعديد من الأسماك في المجموعة. واستنتجت النتائج نص الإتجاه بالنسبة لدرجة حرارة مقدارها 35°م وتغذت على الغذاء العالم. 

A previous study was done by a study to study the effect of water temperatures and hormone (17α testosterone) on the sex change and health of Nile tilapia eggs. Therefore, Nile tilapia eggs were divided into three groups and were kept and fed under different water temperatures 25, 30, and 35°C and each group was divided into two parts, one was fed on a diet free of hormone and the other was fed on a diet containing 60 mg hormone/kg. The ratio of sex and health was estimated after 1, 2, and 3 weeks. The same was done in each experiment. The results were obtained after 30 days. And some of the most important results obtained were as follows:

**GROUP 1**: Fed on a diet free of hormone and kept at a temperature of 35°C. The results were: highest weight gain, highest length gain, and highest weight gain and highest length gain. The performance of this group was the best.

**GROUP 2**: Fed on a diet containing hormone and kept at a temperature of 25°C. The results were: lowest weight gain, lowest length gain, and lowest weight gain and lowest length gain. The performance of this group was the worst.

**GROUP 3**: Fed on a diet containing hormone and kept at a temperature of 30°C. The results were: intermediate weight gain, intermediate length gain, and intermediate weight gain and intermediate length gain. The performance of this group was intermediate.

**GROUP 4**: Fed on a diet containing hormone and kept at a temperature of 35°C. The results were: lowest weight gain, lowest length gain, and lowest weight gain and lowest length gain. The performance of this group was the worst.

**GROUP 5**: Fed on a diet containing hormone and kept at a temperature of 35°C. The results were: lowest weight gain, lowest length gain, and lowest weight gain and lowest length gain. The performance of this group was the worst.

**GROUP 6**: Fed on a diet containing hormone and kept at a temperature of 30°C. The results were: intermediate weight gain, intermediate length gain, and intermediate weight gain and intermediate length gain. The performance of this group was intermediate.