GROWTH PERFORMANCE OF NILE TILAPIA, *OREOCHROMIS NILOTICUS* L. REARED IN GLASS AQUARIA TANKS UNDER DIFFERENT TREATMENTS AND DURATIONS

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ABSTRACT

A total of 240 fry of Nile tilapia, *Oreochromis niloticus* L. seven days post hatched with an average weight 0.014g were stocked in twelve glass aquaria tanks. The experiment was designed as 4 treatments x 6 weeks factorial replicated thrice to assess the effect of duration of androgen treatment on growth rates of Nile tilapia. The pelleted feed used in this study (Lucky Star tilapia starter) of 53.20 crude protein was incorporated with the steroid hormone 17α-Methyl Testosterone (17α-MT) at 60mg/kg to feed the experimental fishes for different durations: 7-14, 14-21, 21-28, and 28-35 days. Fish were fed daily to satiation. Statistical analysis on average body weight gain (BWG), final weight (FW), feed intake (FI) and specific growth rate (SGR) indicated significant ($P < 0.05$) differences among the treatment group at fortnightly trials. The feed conversion ratio (FCR) values recorded (1.73, 1.76, 1.77 and 1.71) in all the treatment durations (7-14, 14-21, 21-28 and 28-35) respectively were not significantly different ($P > 0.05$). Survival rate was 100% among the treatments. There was no significant difference ($P > 0.05$) in the water quality parameters recorded among all the treatments. Based on overall growth rates, fishes on 17α-MT administered in feed and under 21-28 and 28-35 treatment durations were the best and showed significantly higher FW, BWG, SGR and FI compared to other treatment durations. The present study asserted that the extension of the androgen treatment for 21-28 days enhanced the growth rate in *O. niloticus* and helped to attain faster growth rate in tilapia fry. This should avoid the stunted growth of tilapias which is the bottleneck in the tilapia industries and enable aquaculturists to economize the production cost of mass rearing of Nile tilapia.

Keywords: *O. niloticus*, Growth, Steroid hormones, Treatment duration, Aquaria tank, Methyl testosterone

INTRODUCTION

Steroid hormones have been used to increase growth, protein synthesis, and efficient utilization of feeds in a number of terrestrial animals (Matty and Cheema, 1978). The research on the effects of anabolic steroids (e.g. methyltestosterone or ethynyltestosterone) in fish has been mainly directed towards sex reversal (Nuanmanee *et al*., 2004; Vorasayan and Petchrich, 2004) or to the inducement of sterility (Manzoor-Ali and Satyanarayana-Rao, 1989; Gupta and Acosta, 2004; Kaliba *et al*., 2007; Straus *et al.*, 2013). The increased growth rate obtained by supplementing diets with anabolic steroids has important implications for the fish culturist. Today, the fish industry is handicapped by the steadily increasing cost of feed stuffs. Fish growth enhancing hormones are a means to increase the demand of feed so that fish can attains desired size in shorter time.

Several researchers have used various androgens to successfully produce all-male tilapias (Macintosh *et al*., 1985; Chakraborty and Banerjee, 2010; El-Greisy and El-Gamal, 2012; Khan *et al*., 2014), and they have recommended optimum dosages and treatment durations. For tilapias, proper timing and duration of androgen treatment have been contradictory (Shelton *et al*., 1978; Shelton, 1989; Pandian and Varadaraj, 1990). However, when applied to large-scale culture, these recommendations have often failed to produce the desired results (Guerrero, 1982) most especially when it comes to output. This shortcoming has adversely affected the potential of using this endocrine technique for sex reversal (Shelton *et al*., 1981) by commercial aquaculturists. More emphasis is based on the sex reversing activity of the steroid hormone while little or no emphasis is based on the growth potentials of the steroid hormone with an optimum duration. However, it must be well noted that investigations on the influence of this hormone on the feed intake and conversion efficiency of fish are scanty (Arul, 1986). The present study therefore was undertaken to assess the effect of duration of androgen treatment on growth rates of Nile tilapia reared in glass aquaria tanks under laboratory conditions in order to ascertain the optimum treatment duration and growth promoting efficiency of the steroid hormone, 17α-Methyl Testosterone (17 α-MT) at 60mg/kg on *Oreochromis niloticus.*

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MATERIALS AND METHODS

Nile tilapia, *Oreochromis niloticus* L. brood stock weighing an average weight of 300g procured from the Nigerian Institute for Oceanography and Marine Research (NIOMR). These were kept in fibre glass tanks at a ratio of 1:1. On October 6, 2014 (experiment day 0), a total of 240 fry of Nile tilapia (*O. niloticus*) seven days post hatched, with 0.014 g initial average weight were stocked in twelve glass aquaria tanks of $0.01m^3$ capacity under laboratory conditions at a density of 20 fish/tank. The experiment was designed as 4 treatments for 6 weeks factorial replicated thrice to assess the effect of duration of androgen treatment on growth rates.

The pelleted feed used in this study (Lucky Star tilapia starter) of 53.20 crude protein was incorporated with the steroid hormone 17 α-Methyl Testosterone (17 α-MT) at 60mg/kg to feed the experimental fishes for 7, 14, 21 or 28 days after stocking. Fry were fed untreated feed after the prescribed duration of androgen treatment. Because post-yolk sac fry were treated with MT-60 upon collection from brood tanks, actual durations of androgen treatment in each group were7-14, 14-21, 21-28, and 28-35 days respectively. All the treatments were replicated thrice. The feeding trial lasted 6 weeks (42 days). Fish were fed daily to satiation.Ten fish each were randomly sampled bi-weekly from each treatment during the experimental period. Fish samples were obtained in the early morning and kept in glass aquaria tank filled with fresh water from the same tank to avoid fish stress during measurement of the body weight. Fish body weights were determined and recorded to the nearest 0.01g using electronic weighing balance (Mettler PC 180). Fish were returned to their tanks after measurement. Measurement exercises were completed on each sampling day before feeding with appropriate ration. Growth performance was determined and feed utilization was calculated as following:

(a) Initial mean weight = (g/fish)

(b) Final Weight of fish= (g/fish)

(c) Mean bi-weekly weight gain (g) = $\frac{\text{Total bi-weekly weight gain (g)}}{\text{Total surviving fish weight (g)}}$

(d) Absolute growth rate (g/day) = $\frac{\text{Final Weight – Initial Weight (g)}}{\text{Culture period (days)}}$

(e) Specific growth rate = $\frac{\text{Log e Final weight – Log e Initial weight}}{\text{Culture period (days)}} \times \frac{100}{t}$

Where *e* is the base of natural logarithm and t, the culture period in days (Brown, 1957). .

(f) Fish survival (%) = $\frac{\text{No of survival after culture}}{\text{No of fish stocked}} \times \frac{100}{t}$

or

% survival = (100 – mortality) %

(g) Feed conversion Ratio = $\frac{\text{weight of feed}}{\text{weight gain of fish}}$

(h) Feed efficiency Ratio = $\frac{\text{weight gain of fish}}{\text{weight of feed}}$

The water quality was monitored to ensure adequate and appropriate water quality for fish growth. The physical qualities of the water i.e. temperature and some chemical properties such as pH, dissolved oxygen, unionized ammonia and total ammonia were measured bi-weekly in situ using the LaMotte Freshwater Aquaculture test kit (Model AQ-2). Data collected were subjected to statistical test using analysis of variance (ANOVA). Mean separation was done using Duncan's Multiple Range Test and Least Significant Difference. All tests were carried out at 5% probability level ($P < 0.05$) (Duncan, 1955). Results were also represented using tables.

RESULTS

The result of the proximate analysis of the experimental diet (Lucky Star tilapia starter) is presented in Table 1.

Table 1. Proximate analysis of the experimental diet (Lucky Star tilapia starter)

Nutrients (%)	Lucky Star
Crude Protein	53.20
Crude Fat	12.80
Crude Fibre	1.80
Ash	12.01
Moisture	7.11

Statistical analysis on average body weight gain (BWG), final weight (FW), feed intake (FI) and specific growth rate (SGR) indicated significant ($P < 0.05$) differences among the treatment group (Table 2) and fortnightly.

Table **2.** Effect of duration of androgen treatment on growth rates of Nile tilapia fry (5-22 days post-hatching) reared in glass aquaria tanks under laboratory conditions.

Duration of Androgen Treatment (Days) Parameters	7-14	14-21	21-28	28-35
Initial Average Weight (g/fish)	0.013	0.013	0.015	0.014
Final Average Weight (g/fish)	0.42^{b}	0.43^{b}	0.84^{a}	0.93^{a}
Average Body Weight Gain (g/fish)	0.41^{b}	0.42^{b}	0.83^{a}	0.92^{a}
Daily Weight Gain (g/fish)	0.01^{a}	0.01^{a}	0.02^{a}	0.02^{a}
Specific Growth Rate (%/day)	8.27^{d}	8.33^{c}	9.58^{b}	10.00^{a}
Feed Intake (g feed/fish)	0.71^{b}	0.74^{b}	1.47^{a}	1.57^{a}
Feed Conversion Ratio	1.73^{a}	1.76^{a}	1.77^{a}	1.71^{a}
Feed Efficiency Ratio	0.58^{a}	0.57^{a}	0.56^{a}	0.59^{a}
Survival Rate (%)	100^{a}	100^{a}	100^{a}	100^{a}

Means in same row with different superscripts are significantly different ($P < 0.05$).

However, fish in all treatments gradually grew with fortnights, and the highest final average weight was obtained in the last fortnights (Table 2). The final body weight (FW) followed the same trend with the average body weight gain (BWG), specific growth rate (SGR) as well as the feed intake (FI). The fish on 17α-MT administered in feed and under 21-28 and 28-35 treatment durations showed significantly higher FW, BWG, SGR and FI compared to other treatment durations (Table 2). The daily weight gain (DWG) values showed similar pattern. The feed conversion ratio (FCR) values recorded (1.73, 1.76, 1.77 and 1.71) in all the treatment durations (7-14, 14-21, 21-28 and 28-35) respectively were not significantly different ($P > 0.05$) as indicated in Table 2. Following the same trend, the feed efficiency ratio (FER) values recorded (0.58, 0.57, 0.56 and 0.59) in all the treatment durations (7-14, 14-21, 21-28 and 28-35) respectively were not significantly different ($P > 0.05$). Survival rate was 100% among the treatments.

The results of physical and chemical water quality parameters are presented in Table 3. In general, there was no significant difference ($P > 0.05$) in the water quality parameters recorded among all the treatments as recorded in Table 3. Results revealed that all tested physical and chemical parameters were within the permissible levels required for tilapia growth.

Table 3. Mean values of water parameters monitored during the 6 weeks culture period.

Duration of Androgen Treatment (Days) **Parameters**	**7-14**	**14-21**	**21-28**	**28-35**
Temperature (^{0}C)	26.63	26.42	26.50	26.50
pH	7.00	6.71	6.95	6.88
Dissolved oxygen (mg/l)	3.44	3.28	3.18	3.05
Total ammonia nitrogen (mg/l)	0.20	0.20	0.20	0.20

DISCUSSION

The significant growth rates exhibited by the hormone treated fishes from 7-14 to 28-35 treatment durations in this study (Table 2) could be as a result of the anabolic effect of Methyl testosterone (MT) in the cultured tilapia treated with the steroid hormone. These results are in line with the findings regarding anabolic effect of MT in fish and all-male culture of tilapia by different authors. It is well known that anabolic steroids may produce fish with increased weight gains and muscle deposition (Ahmad *et al*., 2002). The increase in fish growth may be because of that MT induce the feed digestion and absorption rate causing increase in body weight (El-Greisy and El-Gamal, 2012), or may be MT administration increased the proteolytic activity of the gut as the case in mirror carp leading to increase in growth rate (Lone and Matty, 1981). (Hanson *et al*., 1993) reported that 10-60 ppm MT-treatment showed the best growth than control. Varadaraj *et al* (1994) observed faster growth in *O. mossambicus* when fed 17α-MT. These results are also in line with Dan and Little (2000) that compared the culture performance of different strains of *O. niloticus* and found that considering all strains, MT treatment resulted in a final size of fish larger than mixed sex fish. Similarly, Sparks *et al* (2003) found that *O. mossambicus* fry fed with MT added to their feed grew significantly larger than their respective controls. Significant increase in growth in 17α-MT treated group of tilapia was also recorded by Ridha and Lone (2008). The increased growth rate obtained by supplementing diets with anabolic steroids has important implications for the fish culturist. It is known that the aquaculture industries are handicapped by the steadily increasing cost of feedstuffs. Growth promoting hormones are a means to increase the efficiency of feeds so that fish can be raised to desired size in shorter time. In this context, using hormone supplemented diets may improve the economics of operation and the utilization of facilities (Abdelghany, 1996).

In the present study, the increased feeding rate observed in hormone treated fishes (Table 2) indicate that 17α-MT could induce the appetite of Nile tilapia resulting in more food ingestion and thus improved growth rates as observed in this study. A perusal of literature revealed that while 17α-MT induces appetite and food consumption in gold fish, *Carassius auratus* (Ai *et al*., 2006) and *Oncorhynchus kisutch* (Fagerlund *et al*., 1979), it depresses appetite and feeding rate in *Salmo gairdneri* (Yamazaki, 1976; Bulkley, 1972). According to Montajami (2012), different kind of materials such as anabolic hormones can be added to feed in order to stimulate feed intake and the growth of fishes as observed in this study. The increased feed intake coupled with the improved food conversion among all the treatment durations could have enhanced the growth rate in the experimental fish treated with the steroid hormone. While it is very clear that the hormone treated fish in this study have significant growth rate, the maximum growth, however, is achieved from 21-28 to 28-35 days. However, from 7-14 days to 14-21 days, the growth rate is insignificant. It is also clear from the present study that administration of 17α-MT through feed increases growth rate and thus helps to attain faster growth rate in tilapia fry. This would enable the aquaculturists to economize the production cost of mass rearing of Nile tilapia.

The present study indicated that there wasa positive relationship between hormone treatment durations and the growth parameters. The results of the study demonstrated that treatment of Nile tilapia, *O. niloticus* with 17α-MT for only 7-14 days and 14-21 days was not sufficient to enhance their growth rates. On the other hand, extending androgen treatment to 21-28 days enhances their growth performance in which the growth rates doubles other

treatment durations and follows by 28-35 days. In view of this, treatment duration 28-35 days is non-cost effective in the androgen administration. According to Watanabe *et al* (1996) in a study conducted on sex reversal of Florida Red Tilapia in brackish water tanks under different treatment durations on 17 alpha-ethynyltestosterone administered in feed, reducing the effective duration of androgenic treatment for sex reversal in Florida red tilapia to 7-14 days can increase hatchery productivity by accelerating output and allowing transport of fry to grow out facilities at much smaller sizes. On the contrary, reducing the effective duration of androgenic treatment for sex reversal in Nile tilapia to 7-14 days as observed by Watanabe *et al* (1996) might be cost effective in the androgen administration, which might also economize the production cost of mass rearing of Nile tilapia but not the accelerated growth rates of the cultured fishes. This might hinder the fish from reaching the marketable size within the shortest period of time. Surprisingly, in terms of enhanced growth rates in *O. niloticus*, as observed in this present study, extending androgen treatment to 21-28 days would definitely increase hatchery productivity by accelerating output since the growth rates of fishes on 21-28 days significantly promotes the growth of *O. niloticus* when compared to other treatment durations. Several studies are in agreement that testosterone produces muscle hypertrophy by increasing muscle protein synthesis (Bhasin *et al*., 2001). The higher serum testosterone concentration up to a particular time period, increased growth performance and greater protein content of the treated fish can surely be analyzed considering this knowledge.

The 100% survival rate recorded among the treatments is an indication that the 17α-methyltestosterone (MT) did not affect survival rate of fish, which may be due to rapid hormonal excretion in fish via faeces and gills (Cravedi *et al*., 1993). The survival rate of the species treated with the hormone indicates that hormone treatment has no adverse effect on general fish health (Chakraborty and Banerjee, 2010).

The water quality parameters values (Table 3) were within the acceptable limits for Nile tilapia as stated by El-Sayed *et al* (1996), Milstein and Svirsky (1996), and Salem (2006). The physico-chemical parameters monitored in the glass aquaria tanks under laboratory conditions, as indicated in Table 3 showed that water temperature, dissolved oxygen (DO), pH and total ammonia nitrogen (TAN) values varied among all the treatments and this is in accordance to (Frank, 2000; Marjani *et al*., 2009) findings, who stated that DO should be above 3mg/L, pH of 6.0-9.5, temperature (28 ± 10C). No significant difference in water temperature, pH, DO, and TAN was observed among the treatment durations (Table 3).

The present study asserted that the extension of the androgen treatment to 21-28 days enhances the growth rates of *O. niloticus* and thus helps to attain faster growth rate in tilapia fry. This would avoid the stunted growth of tilapias which is the bottleneck in the tilapia industries and thereby enable the aquaculturists to economize the production cost of mass rearing of Nile tilapia.

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