

# GROWTH, SURVIVAL AND REPRODUCTIVE SUCCESS OF *Clarias gariepinus* BROODSTOCKS FED FEED MIXED WITH 17- $\alpha$ -METHYL TESTOSTERONE (MT) IN STAGNANT CONCRETE SYSTEMS

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**Abstract:** The growth performance, survival and reproductive success of *Clarias gariepinus* broodstocks were examined as they responded to 17-  $\alpha$ -methyl testosterone (MT) and absolute ethanol mixed in their feed in varying levels of 50 mgKg<sup>-1</sup> /MT, 100 mgKg<sup>-1</sup> /MT and 0 mgKg<sup>-1</sup> /MT. These inclusion levels also served as the three treatments TC 50, TC 100, TC 0. A total of 24 *Clarias gariepinus* broodstocks were stocked in six (6) concrete stagnant systems of 4 (2 males, 2 females) fishes per tank of 2metre by 2metre square, with duplicated treatments of TC 50 and TC 100. Treatment TC 0 was also duplicated, and served as the control, with 4 fishes per tanks (2 males and 2 females). Duration was for ninety (90) days. The mean initial weights were taken as 2.05  $\pm$ 353.56g for treatment TC 50, 1.60  $\pm$ 282.84g for treatment TC 100 and 1.65 $\pm$ 494.98g for treatment TC 0. Highest mean weight gain of 3.45 $\pm$ 2.22g observed in the study was seen in the *Clarias gariepinus* broodstock tank TC 50. Performance index showed treatment TC 50 performed highest with value 601.85 $\pm$ 239.09. Survival rate was high in treatment TC 50 with 50.0 $\pm$ 0.00%, higher in treatment TC 0 with 62.50 $\pm$ 17.68% and highest in treatment TC 100 with 87.50 $\pm$ 17.68%. Condition factor K was greater than 1 throughout the study showing well-being of the fishes; highest in treatment TC 50 at value 7.20. Water quality parameters were at normal ranges throughout the study.

**Keywords:** growth, survival, reproduction, duplicates, *Clarias gariepinus*, broodstocks, stagnant.

## INTRODUCTION

Fish is very important to a human's diet; often termed an irreplaceable source of animal based protein all over the world (Mubarik *et al.*, 2011). The most cultured catfish species in Africa, especially in Nigeria are *Clarias gariepinus* (Burchell, 1822; Engle and Valderrama, 2001). This specie exhibits different feed utilization efficiencies, growth performance, and disease resistance, under different culture systems (Gamal *et al.*, 2008).

Rearing culturable fish species under controlled environments or enclosures, has become helpful in enhancing fish supply (Afinowi and Marioghae, 1986). 17-  $\alpha$ -methyl testosterone (MT) is reported to hormonally stimulate and enhance growth especially in male fish as it is a male androgen steroid ; with consideration for hormone dosage, treatment start time, duration and stocking density (Mubarik *et al.*, 2011). Stimulation of male fish produces viable seed production (Oguntuase and Adebayo, 2014); yet, viability is further

dependent on the type of synthetic hormone used (Nwokoye *et al.*, 2007), and the efficacy of synthetic hormones records much more hatchability and survivability in catfishes than the natural hormones (Krol *et al.*, 2006).

The use of hormones in female catfish is popular worldwide; yet, there is little information on inducing testicular maturation in male fish (Oguntuase and Adebayo, 2014). Scarcity of male broodstocks are on the high; many of the male broodstocks are without matured testes, so the use of 17-  $\alpha$ -Methyl Testosterone(MT) in feed will come in handy to ascertain increase in the viability of males or not, to be used for induced breeding and their reproductive success. Much work has been done on *Tilapia spp.* and *Cyprinus carpio* using 17  $\alpha$  – Methyltestosterone, yet not enough on *Clarias gariepinus*.

## MATERIALS AND METHODS

This research involved evaluating the growth, survival and reproductive success of *Clarias gariepinus* broodstocks using the male steroid 17  $\alpha$  –MethylTestosterone with a view to determining the effectiveness of the hormone or male steroid 17  $\alpha$  – MethylTestosterone or MT on *Clarias gariepinus* male broodstocks.

### Experimental fish

Broodstocks were procured from the broodstock bank of the National Institute for Freshwater Fisheries Research (NIFFR) hatchery in New Bussa, Niger State of Nigeria and its environs. Broodstock sizes ranged from 1.3kg -2.3kg (1300g – 2300g).

### Experimental site

The source of water was NIFFR'S Kigera Dam which is the Institute's source of water all year round, yet augmented with the borehole systems for the dry season. For this research, the Kigera dam's water was used.

### Experimental Design

Growth, survival and reproductive success of *Clarias gariepinus* broodstocks were achieved by administering the hormone 17  $\alpha$  - MethylTestosterone mixed with absolute ethanol orally, into fish feed. This administration was in varying doses: 50mg/kg and 100mg/kg with the addition of 4ml of absolute ethanol; while the control were fed normal feed diet without the addition of 17  $\alpha$  – MethylTestosterone and absolute ethanol. There were three treatments replicated two times for the main treatments and the control treatment.

These treatments were: TC<sub>50</sub>, TC<sub>100</sub>, TC<sub>0</sub>. TC<sub>50</sub> and TC<sub>100</sub> in six tanks while tanks TC<sub>0</sub> served as the control. Fish feeding with 6mm NIFFR broodstock feed were orally mixed with 17  $\alpha$  -MethylTestosterone and absolute ethanol poured evenly on feed, mixed and dried under room temperature for twenty four (24) hours; then carried out at 2%, 3%, 5% and 5% of the body weight of broodstocks till end of the experiment. *Clarias gariepinus* broodstocks were kept in 2m x 2m x 1m tanks for the duration of this experiment, and stocking was 4 broodstocks per treatment and duplicate, totaling 24 *Clarias gariepinus* broodstocks used to ascertain growth, survival and reproductive success in six tanks. Experimental design was a randomized block design.

### Incubation and Hatching procedures

Fertilized eggs were incubated in six (6) concrete tanks (2m x 2m x 1m). Two of the first tanks contained a batch of fertilized eggs from treatment TC 50; the next two contained a batch of fertilized eggs from treatment TC 100 while the last two concrete tanks contained a batch of fertilized eggs from TC 0 which served as the control. Eggs were incubated at (25°C) with the tanks continuously aerated using aerators throughout the incubation period. Hatching was concluded at 30 hours post-fertilization.

### Fertilization and Hatchability

The greenish eggs mass seen in the tanks were the incubated eggs. Eggs were estimated according to Omitoyin *et al.*, (2011). Percentage hatchability and fertilization were calculated thus:

- % Fertilization =

$\frac{\text{number of fertilized eggs}}{\text{total number of eggs}} \times 100$

number of incubated eggs

(Omitoyin *et al.*, 2011)

- % Hatchability =

$\frac{\text{number of hatchlings}}{\text{number of fertilized eggs}} \times 100$

number of fertilized eggs

(Oyebola and Awodiran, 2015).

### Growth parameters

Growth parameters such as MIW, MFG, MWG, %WG, SGR, CP, FCR, FCE, PI, % Survival.

### Statistical Analysis

Analysis of data for each treatment and feed were assessed and compared using ANOVA, Duncan Multiple Range Test.

- Survival Rate (SR) = number of fish stocked – number of mortalities (Paschal *et al.*, 2006).
- % Survival =

$\frac{\text{number of broodstock survivors at the end of study}}{\text{number of juveniles stocked at the beginning of the study}} \times 100$

number of juveniles stocked at the beginning of the study

(Coulibaly *et al.*, 2007).

- Specific Growth Rate % day (SGR)

$$= \frac{\log_n \text{ final weight} - \log_n \text{ initial weight}}{\text{time (days)}} \times 100$$

(Benedict *et al.*, 2005).

- FCR= Total weight of dry feed offered / Total weight gain (Sveier *et al.*, 2000 ).
- FCE

$$= \frac{\text{Final weight by fish}}{\text{Weight of feed given}} \times 100$$

(Tboujard *et al.*, 2002).

- Performance Index

$$PI = \frac{\text{Survival rate} \times \text{Final mean weight (g)} - \text{Initial mean body weight (g)}}{\text{Rearing duration in days}}$$

Rearing duration in days

(Engle and Valderrama, 2001).

### Water Quality parameters

Water quality parameters carried out for this research were: Water Temperature, Air Temperature, DO, pH, Conductivity, Total Dissolved Solids.

### Experimental duration

Duration for this experiment was 90 days and partial sampling carried out till end of the research.

### RESULTS

**Table 1a**

#### THE RESULT OF PROXIMATE ANALYSIS ON 6MM NIFFR FEED SAMPLE USED

S/N	ID	%MOISTURE CONTENT	% ASH CONTENT	% CRUDE FIBRE	%CRUDE PROTEIN	% CRUDE FAT	%NFE
	NIFFR FEED 6MM	3.118	8.307	4.338	42.891	5.588	35.758
	NIFFR FEED 6MM	3.076	7.645	5.021	43.843	6.021	33.894
	NIFFR FEED 6MM	3.645	7.134	4.124	43.924	5.711	35.462

**Table 1b**

#### THE RESULT OF PROXIMATE ANALYSIS ON 6MM NIFFR FEED MIXED WITH 17-ALPHA-METHYL TESTOSTERONE (MT)

S/N	ID	% MOISTURE CONTENT	% ASH CONTENT	% CRUDE FIBRE	% CRUDE PROTEIN	% CRUDE FAT	% NFE
<b>TC 50</b>	NIFFR FEED 6MM	2.713	8.721	4.225	44.264	5.962	34.115
		3.100	8.337	4.192	44.517	6.148	33.706
<b>TC 100</b>	NIFFR FEED 6MM	2.185	9.15	4.331	43.280	6.236	34.818
		2.316	8.885	4.414	43.530	6.310	34.545
<b>TC 0</b>	NIFFR FEED 6MM	2.194	8.818	4.174	42.588	6.224	36.002
		2.348	8.264	3.962	42.693	5.981	36.752
<b>SEM±ST D</b>		<b>3.27±0.31</b>	<b>7.69±0.58</b>	<b>4.49±0.46</b>	<b>43.55±0.57</b>	<b>5.77±0.22</b>	<b>35.03±1.00</b>

**Table 2**

**THE RESULT OF STATISTICAL ANALYSIS ON 6MM NIFFR FEED MIXED WITH 17-ALPHA-METHYL  
 TESTOSTERONE (MT)**

S/N	ID	% MOISTURE CONTENT	% ASH CONTENT	% CRUDE FIBRE	% CRUDE PROTEIN	% CRUDE FAT	% NFE
TC 50	NIFFR FEED 6MM	2.906±0.27 <sup>b</sup>	8.529±0.27 <sup>a</sup>	4.208±0.02 <sup>a</sup>	44.390±0.1 <sup>c</sup>	6.055±0.13 <sup>a</sup>	33.910±0.28 <sup>a</sup>
TC 100	NIFFR FEED 6MM	2.250±0.07 <sup>a</sup>	9.017±0.15 <sup>b</sup>	4.372±0.04 <sup>b</sup>	43.405±0.14 <sup>b</sup>	6.273±0.04 <sup>b</sup>	34.681±0.15 <sup>b</sup>
TC 0	NIFFR FEED 6MM	2.271±0.08 <sup>a</sup>	8.541±0.30 <sup>a</sup>	4.068±0.11 <sup>a</sup>	42.640±0.05 <sup>a</sup>	6.102±0.13 <sup>a,b</sup>	36.377±0.41 <sup>c</sup>
SEM±ST D		0.07	0.09	0.04	0.19	0.03	0.31

Means in the same column (for each section) with different superscript are statistically different (p<0.05).

**Table 3**

**PERCENTAGE OF *Clarias gariepinus* BROODSTOCKS' REPRODUCTIVE SUCCESS WHEN FED FEED MIXED WITH 17  $\alpha$  –METHYLTESTOSTERONE (MT)**

Treatments	Sterility%	Fry %
TC 50	0.00 <sup>a</sup>	82.05 <sup>a</sup>
TC 100	0.00 <sup>b</sup>	74.01 <sup>b</sup>
TC 0	40.00 <sup>c</sup>	54.0 <sup>c</sup>
SEM	13.333	8.339

Means in the same column (for each section) with different superscript are statistically different (p<0.05).

**Table 4**

**GROWTH PERFORMANCE OF *Clarias gariepinus* BROODSTOCKS FED FEED MIXED WITH 17  $\alpha$  –METHYLTESTOSTERONE (MT) IN STAGNANT CONCRETE SYSTEMS**

Tanks	MIW (g)	MFW (g)	MWG (g)	%WG	SGR (%)	SR (%)	FCR	FCE	PI
TC 50	2.05±353.56 <sup>a</sup>	3.47±35.36 <sup>b</sup>	3.45±31.43 <sup>a</sup>	55.15±21.49 <sup>b</sup>	0.258±0.07 <sup>a</sup>	50.0±0.00 <sup>a</sup>	0.143 ±0.00 <sup>a</sup>	4.97±0.07 <sup>a</sup>	601.85±239.09 <sup>a</sup>
TC 100	1.60 ±282.84 <sup>a</sup>	2.30±282.84 <sup>a</sup>	2.28±279.70 <sup>b</sup>	28.10±15.16 <sup>a</sup>	0.177±0.02 <sup>a</sup>	87.50±17.68 <sup>a</sup>	0.058 ± 0.06 <sup>b</sup>	3.09±0.887 <sup>a</sup>	458.33 ± 215.61 <sup>a</sup>
TC 0	1.65±494.98 <sup>a</sup>	2.39±1428.36 <sup>a</sup>	2.37±1422.86 <sup>b</sup>	48.81±14.48 <sup>a,b</sup>	0.142±0.16 <sup>a</sup>	62.50±17.68 <sup>a</sup>	0.153 ± 0.24 <sup>c</sup>	5.01±1.78 <sup>a</sup>	759.72 ±216.27 <sup>a</sup>
SEM	152.02	357.40	355.91	6.45	0.03	8.33	0.04	0.63	77.92

Means in the same column (for each section) with different superscript are statistically different (p<0.05).

Treatments: <sup>1</sup>TC 50 Treatment *Clarias gariepinus* fed 50 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (50 mgKg<sup>-1</sup> /MT) in feed

<sup>2</sup>TC 100 Treatment *Clarias gariepinus* fed 100 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (100 mgKg<sup>-1</sup> /MT ) in feed

<sup>3</sup>TC 0 Treatment *Clarias gariepinus* fed 0 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (0 mgKg<sup>-1</sup> /MT) in feed

**Table 5**

**MORPHOMETRIC MEASUREMENTS AND CONDITION FACTOR OF *Clarias gariepinus* BROODSTOCKS FED FEED MIXED WITH 17  $\alpha$  –METHYLTESTOSTERONE (MT) IN STAGNANT CONCRETE SYSTEMS**

SPECIES/ TREATMENTS/MAX/MIN VALUES	TOTAL LENGTH (cm)	STANDARD LENGTH (cm)	WEIGHT (g)	CONDITION FACTOR (K)
<i>Clarias gariepinus</i>				
<b>TC 50</b>				
<b>Min</b>	109.5	96.75	2050	5.15
<b>Max</b>	121.25	107.5	3475	7.20
<b>Mean±SEM</b>	115.25 ±2.42 <sup>b</sup>	101.8±2.21 <sup>b</sup>	286.5±322.82 <sup>a</sup>	6.18±0.01 <sup>a</sup>
<b>TC 100</b>				
<b>Min</b>	88.7	79.75	1600	3.13
<b>Max</b>	110.75	99.5	2300	5.28
<b>Mean±SEM</b>	102.17±4.74 <sup>a</sup>	91.56±4.24 <sup>a</sup>	193.25±147.68 <sup>a</sup>	4.18±0.03 <sup>a</sup>
<b>TC 0</b>				
<b>Min</b>	101.5	91.5	1650	3.14
<b>Max</b>	122	106.5	2700	5.39
<b>Mean±SEM</b>	108.28±4.65 <sup>a</sup>	95.88±3.55 <sup>a</sup>	227.5±221.74 <sup>a</sup>	4.28±0.02 <sup>a</sup>

Means in the same column (for each section) with different superscript are statistically different (p<0.05).

Treatments: <sup>1</sup> TC 50 Treatment *Clarias gariepinus* fed 50 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (50 mgKg<sup>-1</sup> /MT) in feed <sup>2</sup> TC 100 Treatment *Clarias gariepinus* fed 100 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (100 mgKg<sup>-1</sup> /MT ) in feed <sup>3</sup> TC 0 Treatment *Clarias gariepinus* fed 0 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (0 mgKg<sup>-1</sup> /MT) in feed

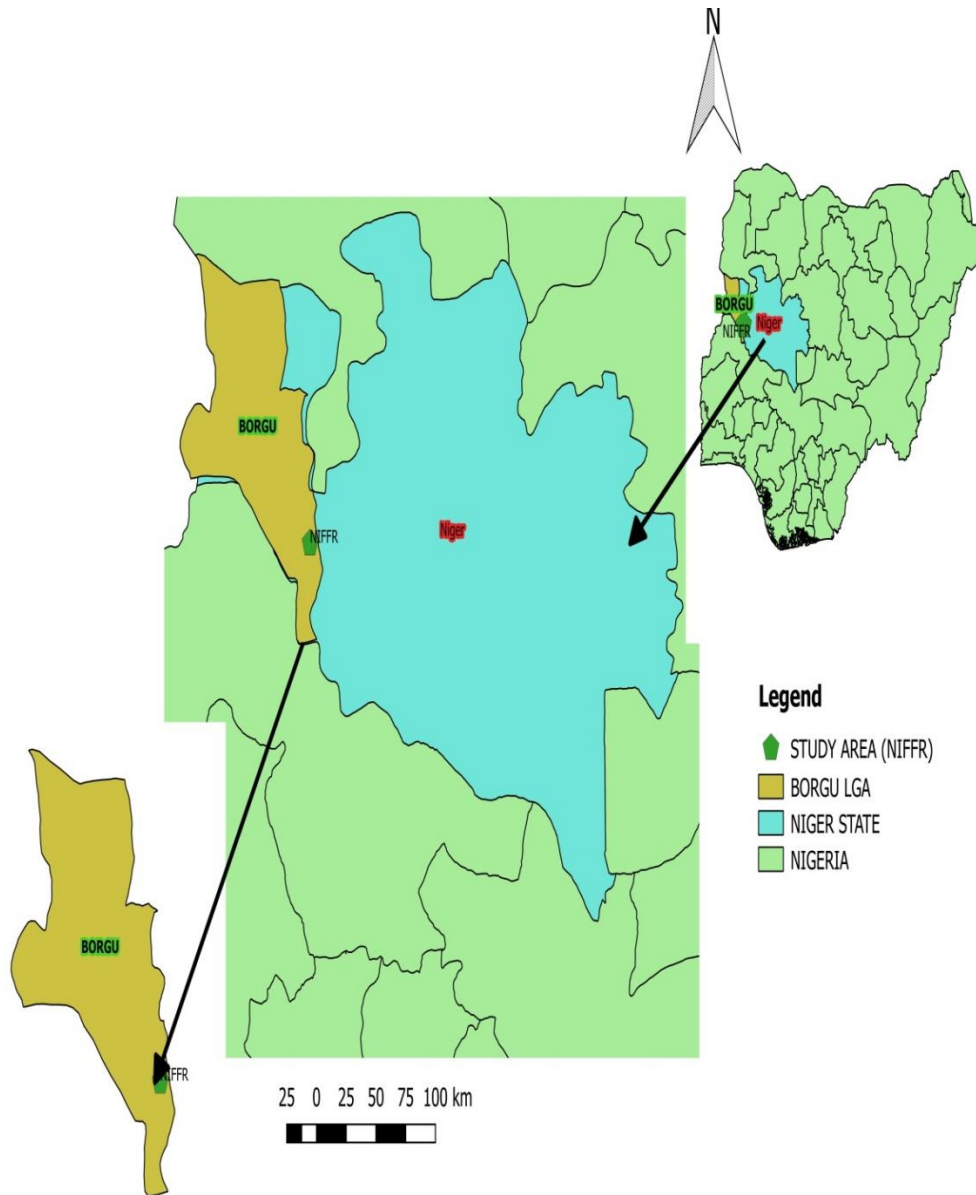
**Table 6**

**LENGTH-WEIGHT RELATIONSHIP REGRESSION OF *Clarias gariepinus* BROODSTOCKS FED FEED MIXED WITH 17  $\alpha$  –METHYLTESTOSTERONE (MT) IN STAGNANT CONCRETE SYSTEMS**

Specie/Treatments/SL/TL	Intercept (a)	Growth pattern (b)	Coefficient of determination R <sup>2</sup>
<i>Clarias gariepinus</i>			
<b>Standard length (cm)</b>			
<b>TC 50</b>	5.95	4.68	1.71
<b>TC 100</b>	3.50	2.11	0.81
<b>TC 0</b>	1.89	1.44	0.61
<b>Total length (cm)</b>			
<b>TC 50</b>	7.58	5.35	1.98

<b>TC 100</b>	3.71	2.17	0.90
<b>TC 0</b>	2.44	1.73	0.86

Treatments: <sup>1</sup>TC 50 Treatment *Clarias gariepinus* fed 50 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (50 mgKg<sup>-1</sup> /MT) in feed <sup>2</sup>TC 100 Treatment *Clarias gariepinus* fed 100 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (100 mgKg<sup>-1</sup> /MT ) in feed <sup>3</sup>TC 0 Treatment *Clarias gariepinus* fed 0 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (0 mgKg<sup>-1</sup> /MT) in feed



Source: NIFFR Archives, (2015) and Robert *et al.*, (2019a)

Figure I: Map of Borgu Local Government Area with headquarters at New Bussa



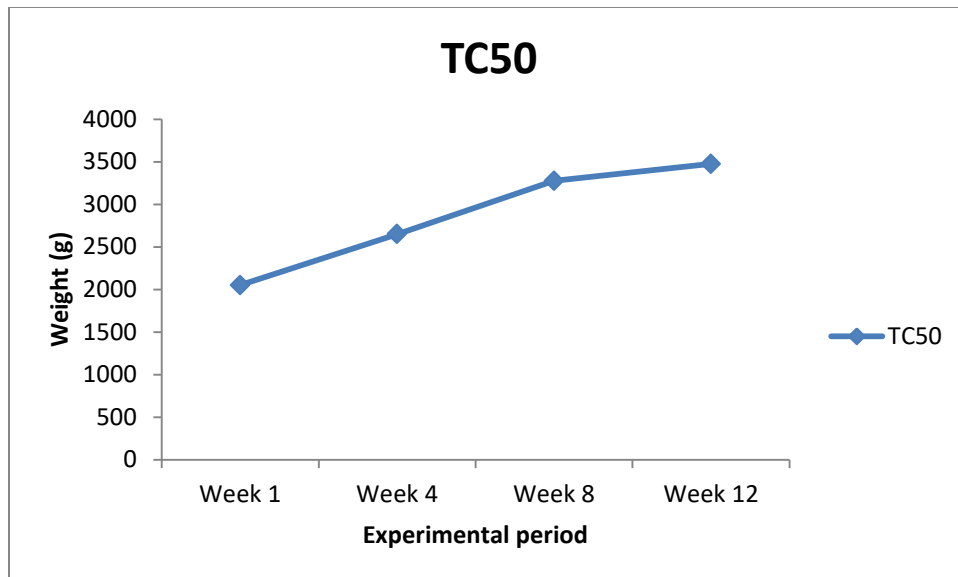


Figure 2: Growth patterns of *Clarias gariepinus* broodstocks fed feed mixed with 17  $\alpha$  –MethylTestosterone in stagnant concrete systems

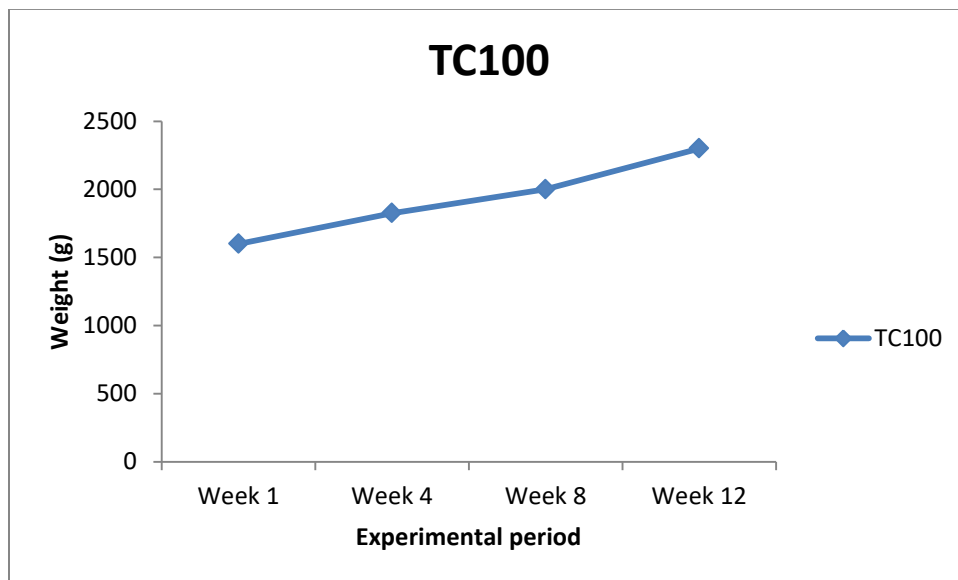


Figure 3: Growth patterns of *Clarias gariepinus* broodstocks fed feed mixed with 17  $\alpha$  –MethylTestosterone in stagnant concrete systems

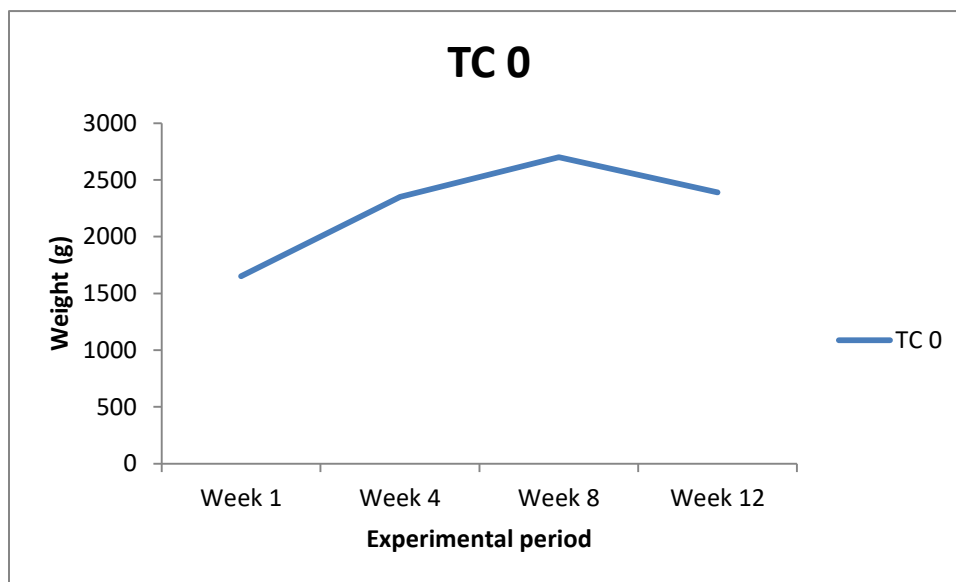


Figure 4: Growth patterns of *Clarias gariepinus* broodstocks fed feed mixed with 17  $\alpha$  –MethylTestosterone in concrete stagnant systems

Table 7

**WATER QUALITY PARAMETERS OF *Clarias gariepinus* BROODSTOCKS FED FEED MIXED WITH 17  $\alpha$  – METHYLTESTOSTERONE (MT) IN STAGNANT CONCRETE SYSTEMS**

Water quality parameters	Treatments		
	TC 50	TC 100	TC 0
pH	7.37±0.26 <sup>a</sup>	7.25±0.12 <sup>a</sup>	7.4±0.16 <sup>a</sup>
DO (mg/l)	5.3±0.46 <sup>a</sup>	5.35±0.56 <sup>a</sup>	6.12±0.81 <sup>a</sup>
CONDUCT (µS/cm)	27.5±17.07 <sup>a</sup>	46.25±17.97 <sup>a</sup>	52.5±44.25 <sup>a</sup>
TDS (mg/l)	13.22±8.21 <sup>a</sup>	22.22±8.64 <sup>a</sup>	25.23±21.27 <sup>a</sup>
AIR TEMP (°c)	24.35±1.66 <sup>a</sup>	24.35±1.66 <sup>a</sup>	24.35±1.66 <sup>a</sup>
WATER TEMP (°c)	27.47±1.41 <sup>a</sup>	27.47±1.41 <sup>a</sup>	27.47±1.41 <sup>a</sup>

Means in the same column (for each section) with different superscript are statistically different (p<0.05).

Treatments: <sup>1</sup>TC 50 Treatment *Clarias gariepinus* fed 50 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (50 mgKg<sup>-1</sup> /MT) in feed <sup>2</sup>TC 100 Treatment *Clarias gariepinus* fed 100 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (100 mgKg<sup>-1</sup> /MT ) in feed <sup>3</sup>TC 0 Treatment *Clarias gariepinus* fed 0 mgKg<sup>-1</sup> of 17  $\alpha$  –MethylTestosterone (0 mgKg<sup>-1</sup> /MT) in feed.

**DISCUSSION**

**Growth Performance of *Clarias gariepinus* broodstocks fed feed mixed with 17  $\alpha$  – methyltestosterone (MT) in concrete stagnant systems**

*Clarias gariepinus* male and female broodstocks had initial weights ranging from 1.60g to 2.05g. Fish fed with MT are known to show improved growth than non-treated fish (Mocintosh *et al.*, 1985 and Marjani *et al.*, 2009). In this experiment, fish fed with MT

showed improved growths, thereby agreeing with Mocintosh *et al.*, (1985) and Marjani *et al.*, (2009). There was no significant difference ( $p < 0.05$ ) among the treatments for MIW.

The lowest mean final weight was observed in treatment TC 100 tank. A number of mortalities occurred in week one, week two, week four, week five and week eleven. These mortalities were due to cannibalism, and the fight for survival in the tanks in weeks one, two, four and five; mortalities in the tanks for week eleven occurred due to environmental heat. As a measure, fresh water was added to the tanks to reduce heat in the tanks. Highest mean final weight was observed in the treatment tank TC 50. It is therefore suggested that the mean final weight in this study were similar in treatments TC 100, TC 0; while not similar in treatment tank TC 50. Mubarik *et al.*, (2011) reported final weight for *Cyprinus carpio*, for 281 days fed with MT in concentration or inclusion level of 50 mgKg<sup>-1</sup>/MT (T50) as 653.9g and 738.1g for MT inclusion level of 100 mgKg<sup>-1</sup>/MT. Mean Final weight in this study stood at 3.47g for 50 mgKg<sup>-1</sup>/MT and 2.30g for 100 mgKg<sup>-1</sup>/MT fed twice daily. There was no significant difference between treatment TC 100, TC 0; yet, there was a significant difference between treatment TC 50 and TC 100.

The Specific growth rate (SGR %) observed in this study showed highest values for TC 50. This means the fish responded to the feed better than the other treatments. However, SGR values in this study were lower than those reported by Mubarik *et al.*, (2011). Mubarik *et al.*, (2011) reported SGR for *Cyprinus carpio*, for 281 days fed with MT in concentration or inclusion level of 50 mgKg<sup>-1</sup>/MT (T50) as 0.572% and 0.586% for MT inclusion level of 100 mgKg<sup>-1</sup>/MT. There was no significant difference among the treatments.

Percentage Survival (% survival) values in this study were highest for TC 100. Marjani *et al.*, (2009) however reported highest values of survival rate of *Tilapia Oreochromis niloticus* fed for 21 days with MT in concentration 50 mgKg<sup>-1</sup>/MT as 100%, while for concentration 100 mgKg<sup>-1</sup>/MT, 92.48%. The control tanks recorded a 100% survival rate. Mubarik *et al.*, (2011) also recorded values of 100% survival for control tanks fed without MT, T 50 tanks fed with 50 mgKg<sup>-1</sup>/MT mixed with feed and T 100 tanks fed with 100 mgKg<sup>-1</sup>/MT mixed with feed. This attests to *Clarias gariepinus*' ability to withstand disease and survive under any culture system (Viveen *et al.*, 1985). Percentage Survival showed no significant difference among the treatments.

Food conversion ratio as seen on Table 4 depicts *Clarias gariepinus* broodstocks used less feed to gain more weight. The results of the study for FCR corroborate the results for the study conducted by Mubarik *et al.*, (2011) which stated similar, yet lower FCR values of 0.020 for T 50 tanks fed with 50 mgKg<sup>-1</sup>/MT mixed with feed and 0.009 for T 100 tanks fed with 100 mgKg<sup>-1</sup>/MT mixed with feed. Mubarik *et al.*, (2011)'s result showed *Cyprinus carpio* fingerlings use even lesser feed to gain more weight. There was evidence of significant difference between treatment TC 50, TC 100; and significant difference between treatment TC 100, TC 0.

Feed conversion efficiency (FCE) also seen on Table 4 shows highest FCE in treatment TC 0. This means treatment TC 0 were excellent at feed conversion compared to all the treatments. Ndome *et al.*, (2011) and Robert *et al.*, (2019a) suggested that FCE values are always a reflection of FCR values. Robert *et al.*, (2019a) established highest value of 14.92 were seen in the stagnant control tanks in an experiment to test for the growth of monosex cultured *Heterobranchus longifilis* juveniles in concrete flow-through and stagnant water systems. There was no significant difference among the treatments.

Performance Index (PI) in this study were highest in treatment TC 0, compared to the study conducted by Robert *et al.*, (2019a) which showed highest PI in stagnant tanks of the study as 7.95 and 6.08 respectively. This also proves *Clarias gariepinus*' ability to thrive under any condition, desirable or not (Viveen *et al.*, 1985). Performance Index showed no significant difference among the treatments.

### **Morphometric measurements and Condition factor of *Clarias gariepinus* broodstocks fed feed mixed with 17 $\alpha$ - methyltestosterone (MT)**

The morphometric measurements and condition factor of *Clarias gariepinus* broodstocks are seen on Table 5 show minimum and maximum weights for treatment TC 50 as ranging from 2.05 to 3.47g, TC 100 weights as ranging from 1.60 to 2.30g and TC 0 weights as ranging from 1.65 to 2.70g. There was no significant difference between the treatments in terms of weight.

Total length depicted minimum and maximum values of 109.5cm and 121.25cm for TC 50' TC 100 showed minimum and maximum values in total length of 88.7cm and 110.75cm; while TC 0 showed minimum and maximum values of 101.2cm and 122cm. There was no significant difference in total length among the treatments.

Standard length emphasized minimum and maximum values of 96.75cm and 107.5cm for TC 50' TC 100 showed minimum and maximum values in total length of 79.75cm and 99.5cm; while TC 0 showed minimum and maximum values of 91.5cm and 106.5cm. There was no significant difference in total length also, among the treatments.

Condition factor K for treatment TC 50 showed minimum and maximum values of 5.15 and 7.20, TC 100 also showed minimum and maximum values of 3.13 and 5.28; while TC 0 depicted minimum and maximum values of 3.14 and 5.39. Condition factor K in this study showed values greater than 1, emphasizing that the fishes were in a state of well-being. This result agrees with (Chandra and Jhan 2010; Robert *et al.*, 2019a) who stated in their previous studies that fishes in states of well-being should show higher condition factors K of between 1.05 to 1.89. Condition factor K, reported in a study by Robert *et al.*, (2019a) showed condition factor of between 1.0 to 2.42. The values in this study reported Condition factor values as being in the region of 3.13 to 7.20. There was no significant difference in terms of Condition Factor K, for all the treatments in this study.

### **Growth patterns of *Clarias gariepinus* broodstocks fed feed mixed with 17 $\alpha$ – methyltestosterone (MT) in stagnant concrete systems**

When the b-value is less than 3, the fish is said to have negative allometric growth. When the b-value is more than 3, the fish exhibits positive allometric growth. But when the b-value is equal to 3, the fish is said to grow isometrically (Khairnazam and Norma-Rashid, 2002; Robert *et al.*, 2019a).

The b-value in this study reveals for TC 50 values 4.68 to 5.35 indicating that the fishes for TC 50 grew positively allometric. TC 100 revealed b-values such as: 2.11 to 2.17 indicating the fishes grew negatively allometric; while TC 0 revealed b-values such as: 1.44 to 1.73 indicating the fishes grew negatively allometric as well.

The growth patterns shown in figure 2 for treatment TC 50 clearly highlights fast and progressive growth from stocking to the eighth week before dipping slightly and continuing slowly till end of the experiment.

Treatment TC 100 as shown in figure 3 highlights slow-growth from stocking; yet progresses steadily till end of the experiment.

Treatment TC 0 on the other hand, grew fastest from stocking, progressing throughout the weeks but dipped immensely from week eight till end of the experiment.

### **Length-weight relationship regression of *Clarias gariepinus* broodstocks fed feed mixed with 17 $\alpha$ – methyltestosterone (MT) in stagnant concrete systems**

Coefficient of determination ( $R^2$ ) results on Table 6 from this study have indicated values for regression as follows: TC50 1.71-1.98, TC100 0.81-0.90, TC0 0.61-0.86. These values highlighted highest values for Coefficient of determination as ( $R^2$ ) in treatment TC 50, with closely similar values for TC 100 and TC 0.

Coefficient of determination ( $R^2$ ) results in this study revealed highest values for TC 50 indicating the strongest regression in the study, followed by TC 100 with a strong regression while TC 0 showed also a strong regression similar to TC 100.

Strong Coefficient of determination ( $R^2$ ) results should be from 0.5 and more (Davies *et al.*, 2013; Robert *et al.*, 2019a). Robert *et al.*, (2019a) also reported strong values for regression in their study as 0.85 for females, 0.85 for males and 0.84 for mixed sex *Heterobranchus longifilis* juveniles in monosex culture.

### **Water quality parameters of *Clarias gariepinus* broodstocks fed feed mixed with 17 $\alpha$ – methyltestosterone (MT) in stagnant concrete systems**

The water quality parameters in the study presented on Table 7, showed non-significant difference throughout the treatments for pH, DO, Conductivity, Total Dissolved Solids, Air temperature and Water temperature.

pH values in this study ranged from 7.37-7.4 for treatments TC 50, TC 100, TC 0. These values were within range for freshwater fish culture. Boyd and Lichtkoppler (1979) stated ideal pH range of 6.7 to 8.6. Robert *et al.*, (2019a) also stated pH range of 7.16 to 8.20 in their study on monosex culture of *Heterobranchus longifilis* juveniles.

DO values in this study ranged from 5.3mg/l to 6.12mg/l for treatments TC 50, TC 100, TC 0. These values were within range for freshwater fish culture as stated by Ovie and Adeniji (1990), who confirmed that fish do not grow well when dissolved oxygen remains at 4mg/l in another study, Robert *et al.*, (2019a) also confirmed that at 4.40mg/l, fish deaths were not seen.

Conductivity values in this study ranged from 27.5  $\mu$ S/cm to 52.5  $\mu$ S/cm for treatments TC 50, TC 100, TC 0. These values were within range for freshwater fish culture. These values agree with Boyd, (1990) and Robert *et al.*, (2019a) who stated freshwater conductivity ranges are from 212  $\mu$ S/cm to 436  $\mu$ S/cm. Ayanwale *et al.*, (2018) also indicated conductivity ranges of 100.60 to 338.00  $\mu$ S/cm for artificial fish culture.

Water temperature for this study stayed at 27.47 °c throughout the treatments. This result was in agreement with Chakroff (1976) and Robert *et al.*, (2019a) who indicated optimal water temperature range should be from 25 °c to 31.36 °c.

Air temperature for this study stayed at 24.35 °c throughout the treatments. High water temperatures have otherwise been reported to range from 23°c to 25 °c. This range of water temperatures have been reported to be responsible for high mortality rates of fishes (Lee and Rinne, 1980; Bjorn and Reiser, 1991; Hodgson and Quinn, 2002).

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