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Effects of two feeding rates on the growth performance and survivability of *Clarias gariepinus* fingerlings fed on Skretting fish feed

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ABSTRACT: Two feeding rates; 5% body weight and feeding to satiation were evaluated to determine their effects on the growth performance and survivability of *Clarias gariepinus* fingerlings. The objective of the study was to determine which feeding rate was more beneficial to the fish farmer in terms of fish weight gain, length gain, specific growth rate, feed conversion ratio and survivability of the catfish fingerlings. The study was carried out with 600 *Clarias gariepinus* fingerlings of mean weight 2.23 ± 0.10 g and mean length 6.58 ± 0.01 cm kept in six 1 m^3 rectangular tanks labeled A to E and containing 100 fingerlings each. Fingerlings in tanks A, B and C were three replicates fed with 1.8 mm Skretting fish feed at 5% body weight while fingerlings in tanks D, E and F also three replicates, were fed to satiation with the same feed for 30 days. Water quality parameters; temperature, pH, and dissolved oxygen were monitored. Body weight, length, and survivability were recorded every 5 days at 0, 5, 10,15, 20, 25, and 30 days. Results showed that water quality parameters and survival rates did not significantly differ($p>0.05$) between the 5% body weight feeding rate group and the group fed to satiation. The average weight gain (26.11± 3.65 g), length gain (6.11± 0.20 cm), specific growth rate (5.96 ± 0.15%) and feed conversion ratio (1.1) of the 5% body weight feeding rate group differed significantly ($p< 0.05$) from those of the group fed to satiation; 16.16 ± 3.04 g, 4.44 ± 0.40 cm, 4.58 ± 0.17% and 1.3 respectively. It was concluded that feeding fingerlings by 5% body weight was of better economic importance to the fish farmer and was therefore recommended to be practiced for profitability and sustainable fish culture development.

Keywords: *Clarias gariepinus*, Feed Conversion Ratio, weight gain, length gain, specific growth rate.

INTRODUCTION

Fish consumption is growing at the rate of 2.4% per annum while the human population is increasing at the rate of 1.2% per annum (FAO, 2018). Thus, the growth of population is outpacing that of fish as food since 1980; creating increasing market demand (Ayeloja et al., 2013). This has led to the over exploitation of capture fisheries due to over capacity and over fishing. African catfish, *Clarias gariepinus,* from a biological perspective, is an ideal aquaculture species in the world (Peterson et al., 2012). It is widely distributed, thrives in diverse environments (temperate to tropical), and is hardy, adaptable, and an ecological pioneer species, principally as a major consequence of its air-breathing ability (Dan-Kishiya, 2012). They are very adaptive to extreme environmental conditions and can thrive in pH range of 6.5 to 8.0, they are able to live in very turbid waters and can tolerate temperatures of 28 to 35°C, their optimal temperature for growth is 28 to 30°C. It feeds on a wide array of natural prey and can adapt to its feeding habits depending on food availability. It is highly fecund and easily spawned under captive conditions (Nanninga et al., 2010).

Good feed management is the result of good feed conversion which is the result of adequate knowledge about energetic needs of the fish, adequate distribution of feed and good feeding techniques (Nyina-Wamwiza et al.,

2010). In order to optimize production, a fish farmer has to ensure optimal feed management to ensure good growth and minimal feed waste. Estimates of daily feed requirements based on theoretical considerations can serve as a control of aquaculture systems but they should be combined with visual observations of feeding activity to 'fine-tune' feed ration (Abdullah et al., 2013).

Several works have been done on feeding rates and growth performance of *Clarias gariepinus* fingerlings using different fish feed such works include; Orina et al. (2016), Asuwaju. et al. (2014), Auta et al. (2013), Abdullah et al. (2013), Cho and Lee (2012), Denge et al. (2011).

Fish farming in Nigeria is still developing and as such there is a need for farmers to develop feeding regimes for adequate feed management, sustainable development as well as meeting the demand for fish consumption, hence the need for this study. Therefore, this study aims to determine the effects of feeding 5% body weight feeding rate and feeding to satiation on the growth performance and survivability of *Clarias gariepinus* fingerlings using Skretting fish feed.

METHODOLOGY

This 30 days study was carried out at Nnamdi Azikiwe University (fish farm) Awka, Anambra State, Nigeria. The farm is behind First Bank Plc. It is located between latitude 6°N and longitude 7°E. It lies in the Guinea Savannah experiencing an annual rainfall of 1000 to 1500 mm with seasons – the dry and wet seasons.

The experimental fish, *C. gariepinus* fingerlings with mean initial weight of 2.23 ± 0.10 g and mean initial length of 6.58 ± 0.01 cm were obtained from CHI farms Ibadan and transported to the study area in a black container with freshwater. The fingerlings were acclimatized for 14 days and fed with commercial diet (Skretting fish feeds) of 1.8 mm pellet size.

The culture unit was made up of six 1 m^3 rectangular plastic tanks purchased at Onitsha, Anambra state, Nigeria. Volume of water used was 700 litres. The tanks were labeled A, B, C, D, E and F. The tanks were supplied with water from the farm's borehole with the following water quality parameters: DO 7.8±0.04 mg/ml, pH 7.45 ±0.01 and Temperature 28 ± 0.01°C.

Total of 600 *C. gariepinus* fingerlings were used for the experiment and the tanks were stocked with 100 fingerlings per tank in three replicates with water filled up to 700 litres. Complete water change was carried out twice every week throughout the 30 days study period. Tanks A, B and C were fed at the rate of 5% body weight, while tanks C, D and E were fed to satiation. Feeding frequency of twice daily was adopted (60% at 9 am and 40% at 5.00 pm). Uneaten feed was collected with scoop net, dried and weighed. The diet (Skretting extruded fish feed of 1.8 mm) used for this study contained 45% crude protein, 3% crude fiber, 9% crude fat, 6% crude ash, 0.6% phosphorus, 0.8% calcium, 2.28% lysine and 1.28% Methionine.

Sampling was accomplished at the 5, 10, 15, 20, 25 and 30th day of the experiment. Prior to weighing, the fishes were caught with a 1 mm fine mesh scoop net and their average length and weight were recorded. After 30 days of rearing, the final length (cm) and weight (g) of the individual fish were recorded using an electronic sensitive measuring scale (Phocee'nne Mod. PH-SF 40) and graduated measuring board (Model OHAUS 2010) were employed for measuring the weight in grams, and the length in centimeter respectively.

The physicochemical parameters of water were analysed as a management practice and the parameters that were used to ascertain the water quality are temperature, pH and dissolved oxygen (DO) using described standard methods (Rahmanian, 2015).

Experimental data collected during the growth trial were used to determine the following growth parameters.

$$\text{Average Weight Gain (AWG)} = \frac{M_1 - M_0}{N}$$ (According to De-Silva and Anderson, 2005).

Where: M_0 = Initial mean body weight, M_1 = final mean weight and N = Number of fish

$$\text{Specific Growth Rate (SGR)} = \frac{\mathbf{InW_1 - InW_0}}{\mathbf{T}} x\ 100$$ (According to El-Sayed and Kawanna, 2004).

Where**:** In = Natural log**,** W1 = final mean weight**,** W_0 = Initial mean weight and T = Time interval (culture period).

$$\text{Survival Rate \% (S)} = \frac{\mathbf{N_1}}{\mathbf{N_0}} x100$$ (According to Biswas et al., 2005).

Where: N_1 = final number of fish at the end of experiment and N_0 = initial number of fish at the beginning of experiment.

$$\text{FCR} = \frac{\text{Feed (g) consumed by the fish}}{\text{Total weight gained by fish (W2} - \text{W1)}}$$ (According to Ridha and Cruz, 2001).

Where: FCR = Feed Conversion Ratio, W2 = Final weight and W1=Initial weight

Data obtained from the study were presented as mean ± standard error of mean (SEM) and were analyzed using one-way analysis of variance (ANOVA). Differences between means were detected using least significant differences (LSD). A difference in values less than a probability of 0.05% was considered significant.

RESULTS AND DISCUSSION

Results showed that temperature (°C) of 26.80 ± 0.07^a to

Table 1. Water quality parameters monitored during the experimental period.

Water quality parameters	Mean value ± SEM		Range (WHO, 2012)
	5 % body weight	Satiation	
Temperature (^{0}C)	27.00±0.03[a]	26.80±0.07[a]	25.00 – 32.00
pH	6.76±0.01[a]	6.84±0.04[a]	6.50 – 8.50
Dissolved oxygen (mg/l)	4.00±0.01[a]	4.20±0.08[a]	1.50 – 5.00

Table 2. Mean growth data of *C. gariepinus* fingerlings in the two feeding rates, SGR (specific growth rate) and FCR (feed conversion ratio).

Parameters	5% body weight	Satiation
Initial length (cm)	11.11± 0.40[a]	10.90 ± 0.60[a]
Final length (cm)	17.21 ± 0.60[a]	15.34±1.00[b]
length gain(cm)	6.11±0.20[a]	4.44±0.40[b]
Initial weight (g)	9.63 ± 0.35[a]	9.32 ± 0.18[a]
Final weight (g)	35.74± 4.00[a]	25.48± 3.22[b]
Weight gain (g)	26.11±3.65[a]	16.16±3.0 4[b]
SGR (%)	5.96±0.15[a]	4.58±0.17[b]
FCR	1.1±0.01[a]	1.3±0.03[b]
Survival rate (%)	100	100

Columns sharing similar superscripts are not significantly different (p>0.05).

27.00 ± 0.03[a], pH of 6.76 ± 0.01 to 6.84 ± 0.04[a] and dissolved Oxygen (mg/L) of 4.00 ± 0.01 to 4.20 ± 0.08[a] (Table 1) values obtained were favourable for fish culture and are within the acceptable range for optimal fish culture in the tropics; temperature 25 to 32°C, pH 6.5 to 8.5, and DO 1.50 to 5.00 mg/l as reported by WHO (2012). This agrees with the work of Auta et al. (2013) who reported that temperature varied from 25.5 to 28.0°C, pH ranged from 6.6 to 7.2 while dissolved oxygen ranged from 6.3 to 8.2 mg/l in a study carried out to determine the growth responses of *Clarias gariepinus* to imported and local fish feeds in Nigeria. The water quality parameters were not significantly affected (p>0.05) by the two feeding rates as well as the survival rates as shown in Table 2. This was also reported by Auta et al. (2013).

Results revealed that there was a significant length gain increase (p<0.05) of (1.67 cm) in the fingerlings fed at 5% body weight feeding rate when compared to those fed to satiation (Table 2). This is in line with the findings of Enwemiwe (2017) who reported increased mean body length in *Clarias gariepinus* fed at 5% body weight with local integrated fish feed. There was a significant difference (p<0.05) in the weight gain of the fingerlings fed at 5% body weight feeding rate and those fed to satiation. Higher weight gain was attained in the fingerlings fed at 5% body weight feeding ration. This agrees with study of Abdullah et al. (2013) and Cho and Lee (2012) who reported higher weight gain in *Epinephelus polyphekadion* and *C. gariepinus* fingerlings fed at 4% body weight feeding rate. The result of the feed conversion ratio (FCR) was higher in fingerlings fed to satiation (1.3) compared to fingerlings fed at 5% body weight feeding rate with FCR of 1.1. The implication is that fish fed to satiation would need 1.3 kg of feed to yield 1 kg of fish while those fed at 5% body weight would need 1.1 kg of feed to yield 1 kg of fish. Therefore, the results from this study showed that the fish fed at 5% body weight gave a better FCR (1.1) which implies that feed given was well utilized and that the fish was able to convert more feed to flesh. The specific growth rate was higher (5.96%) in the fingerlings fed at 5% body weight feeding ration when compared to the fingerlings fed to satiation (4.58%) as shown in Table 2. The results support the findings of Nyina-Wamwiza et al. (2010) who reported a better feed conversion ratio (1.1) and increase in specific growth rate (5.92 %) in post larvae of *Clarias* hybrid fed increased level of protein. Abdullah et al. (2013) also reported increased specific growth rate in *Epinephelus polyphekadion* fed 4% body weight of a commercial diet.

The results showed that significantly higher (p<0.05) mean weight gain (26.11±3.65 g) was attained by the fingerlings at 5% body weight feeding rate when compared with the fingerlings fed to satiation (Table 3). This agrees with the work of Solomon and Okomoda (2012) and Abdullah et al. (2013) who reported higher mean weight gain in *Oreochromis niloticus* fingerlings fed at 5% body weight feeding rate and *Epinephelus polyphekadion* fingerlings fed 4% body weight of a commercial diet respectively.

Table 3. Mean weight gain (g) at 5 days interval for two feeding rates.

Feeding rates	Days interval Mean Weights of fish (g) ± SEM						Weight gain (g)
	5	10	15	20	25	30	
5% body weight	9.63±0.35[a]	10.98±0.19[a]	15.05±1.20[a]	20.43±2.71[a]	27.75±3.10[a]	35.74±4.00[a]	26.11±3.65[a]
Satiation	9.32±0.18[a]	10.34±0.08[a]	13.02±1.59[b]	18.41±2.80[b]	21.05±3.00[b]	25.48±.3.22[b]	16.16±3.04[b]

Columns sharing similar superscripts are not significantly different (p>0.05).

Conclusion

The water quality parameters (temperature 26.8 to 27.0°C, pH 6.76 to 6.84 and dissolved oxygen 4.00 to 4.20 mg/l) were not significantly affected by both feeding rates and were within the acceptable range when compared to the recommended range for catfish production. This created a conducive aquatic environment that resulted in increase in length gain, weight gain, specific growth rate and adequate feed conversion ratio (for both the 5% body weight feeding rate group and the fingerlings fed to satiation. However, the FCR of the 5% body weight feeding rate group was statistically better than that of the fish fed to satiation. Other growth parameters; average weight gain, average length gain, and specific growth rate were significantly higher in the 5% body weight feeding rate group than in the fish fed to satiation. The survival rates of the experimental fish were not affected by both feeding rates. It was therefore concluded that feeding at 5% body weight would be of better economic importance and should be adopted by fish farmers since it gave better growth parameters when compared to feeding by satiation.

Feeding by 5% body weight is a quantitative method while feeding to satiation is qualitative. The gap in the parameters between the two feeding rates could be attributed to error of measurement and the farmer's perception of what 'complete' satiation actually is. This therefore gives room for further research in developing the standards for determine satiation.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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