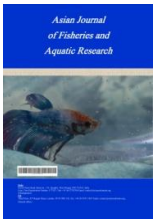

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Effect of Feeding Rate on the Growth and Nutrient Utilization of African Catfish *Clarias gariepinus* (Burchell 1822) Juveniles

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Authors' contributions:

This work was carried out in collaboration among all authors. Author ANF designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author AOB managed the analyses of the study. Author DKO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted to examine the effect of feeding at different time intervals of the day on the growth efficiency of African catfish (*Clarias gariepinus*, Burchell 1822). Juveniles of African catfish *Clarias gariepinus* with an average weight of 16.0±0.20g were randomly stocked into four treatment groups (T1, T2, T3 and T4) at 10 fish per group using a completely randomized design (CRD). The treatment groups were T1 (Fish fed once daily), T2 (Fish fed twice), T3 (Fish fed Thrice daily) and T4 (Fish fed four times daily). They were all fed 3% of their body weight. Data obtained was analysed using Genstat package while means where separated using Duncan Multiple Range Test. The result of the study showed that the highest weight gains of 104.49g was recorded in Treatment 3, this was followed by Treatment 2 with a mean weight gain value of 92.42g. The least value of weight gain (76.74g) was recorded in Treatment 1. Also, the highest feed intake value of 142.83g was recorded in Treatment 3, this was followed by Treatment 2 with a mean feed intake value of 135.12g. The least value of feed intake (112.95g) was recorded in Treatment 1. The feed conversion ratio and Protein Efficiency ratio (PER) also followed similar

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trend as that of weight gain and feed intake. The highest PER value of 2.10 was recorded in Treatment 3, this was followed by Treatment 2 with a mean PER value of 1.69. The least PER value (1.39) was recorded in Treatment 4. ANOVA showed that there was significance difference ($P<0.05$) in the PER value between Treatment 1, 2 and 3. However, Treatment 1 was not significantly different ($P>0.05$) from Treatment 4. At the end of the Study, three times feeding per day was found to be sufficient for maximum growth as it recorded the highest value for growth parameters monitored and was significantly different from other treatments.

Keywords: Feeding; mealtime; growth; Clarias gariepinus.

1. INTRODUCTION

Fish supply is mainly of four major areas; artisanal, Trawlers, aquaculture and imported frozen fish [1]. The Niger Delta region contributes more than 50% of the entire domestic supply of Nigerian fish, due to the abundance of both fresh, brackish and marine water bodies inhabited by a wide array of both fin fish and non-fish fauna that supports artisanal fisheries [2]. Nigeria spends over N100 billion on fish importation annually and the current fish demand consumption in Nigeria stands at over 2.66 million tons per annum, while the present importation rate is over 750,000 metric tons. With importation of more than 750,000 metric tons of fish, more than USD 600 million are spent in hard currency as thousands of jobs are exported [3]. The continuous importation of fish portends a colossal loss of foreign exchange earnings to Nigeria. The United Nations Food and Agriculture Organization (FAO) defined aquaculture as the farming of individually or corporately owned aquatic organisms such as fish, molluscs, crustaceans, and aquatic plants with intervention in the rearing process to enhance production [4]. Aquaculture practices as a business venture can bring significant development in the rural and urban areas by improving family income, providing employment opportunities, and reducing problems of food supply and security [1]. The vast Nigerian aquatic medium of numerous water bodies like rivers, streams, lakes, reservoirs, flood plains, irrigation canals, coastal swamps offer great potentials for aquaculture production in Nigeria.

Feeding frequency is essential in aquaculture as it can affect growth, survival, composition, and water quality. Feeding at optimum frequency can result in tremendous savings in cost of feed [5]. The daily feed intake, frequency and timing of the feedings and presentation of the already determined ration are the key factors of feed management strategies, influencing the growth and feed conversion [6]. This study was therefore conducted to determine the effect of feeding at different time intervals of the day on the growth efficiency of *Clarias gariepinus* juvenile.

2. MATERIALS AND METHODS

The experiment was carried out in the Fisheries Unit of Forest Research Institute of Nigeria, Benin City, Edo State. 120 juveniles of *C. gariepinus* were sourced from ROYEX FARMS. It was acclimatized for a period of 7days and then used for the study which lasted for 10 weeks.

2.1 Management of the Experimental Fish

A total of 120 juvenile of African Catfish weighing 16.0 ± 0.20g on the average were randomly divided into four treatment groups (T1, T2, T3 and T4) of 10 fish per group using a completely randomized design (CRD). The treatment groups were designated as follows: T1 (Fish fed once daily), T2 (Fish fed twice), T3 (Fish fed Thrice daily) and T4 (Fish fed four times daily). They were all fed 3% of their body weight. The feed used for treatment 2,3 and 4 was divided into two, three and four parts respectively so that the fish received a ration of the 3% body weight at each feeding time. Each group was in triplicate of 10 fish per plastic tanks measuring 0.6 m x 0.6 m x 0.9 m filled 2/3rd with water. The fish were fed with Bluecrown extruded commercial feeds. The composition of the diet is presented in Table 1.

2.2 Growth and Nutrient Utilization Indices

Fish was weighed at the beginning of the experiment and then weekly for 10weeks. From the data obtained the following were determined:

Weight gain = $W_1 - W_0$ (g)

Relative Weight Gain (RWG%) = $(W1 - W0)/W0 \times 100$ (%)

Specific Growth Rate (SGR %) = $\frac{(\text{In W1} - \text{In W0})}{T} \times 100$ (%/week)

Where:

W_0: mean initial weight (g)

W_1: mean final weight (g)

T: time in 7 days between weightings

Feed conversion ratio (FCR) = $\frac{\text{feed intake (g)}}{\text{wet weight gain}}$ (g)

2.3 Statistical Analysis

The data on weight gain; feed conversion ratio and survival rates for the dietary treatments were analysed using one-way ANOVA (Analysis of variance) using GENSTAT version 12 software. The differences in mean values were compared by Duncan Multiple Range Test. All test was carried out at 5% probability level.

3. RESULTS

The mean weight gain increased with increase in feeding time up until Treatment 3 after which the weight gain decreased. The highest weight gain of 104.49g was recorded in Treatment 3, this was followed by Treatment 2 with a mean weight gain value of 92.42g. The least value of weight gain (76.74g) was recorded in Treatment 1. ANOVA showed that there was significance difference ($P<0.05$) between Treatments. Treatment 2 was not significantly different ($P>0.05$) from Treatment 4 (Table 2).

The specific growth rate varied with increase in feeding times, Treatment 4 had the highest SGR value 1.82 and Treatment 2 (1.52) with the least. The SGR were significantly different at $P < 0.05$.

The feed Intake value increased with increase in feeding time up until Treatment 3 after which the Feed intake decreased. The highest feed intake value of 142.83g was recorded in Treatment 3, this was followed by Treatment 2 with a mean feed intake value of 135.12g. The least value of feed intake (112.95g) was recorded in Treatment 1. ANOVA showed that there was significance difference ($P<0.05$) between Treatment 1, 2 and 3. However, Treatment 2 was not significantly different ($P>0.05$) from Treatment 4.

The feed conversion ratio followed similar trend as that of weight gain and feed intake. The value improved with increase in feeding time up until Treatment 3 after which the value declined. The best Feed conversion ratio of 1.46 was recorded in Treatment 3. The worst feed conversion ratio value (1.60) was recorded in Treatment 1. There was no significant difference ($P>0.05$) among the four treatments though feed conversion was highest in T3.

The Protein Efficiency ratio (PER) value increased with increase in feeding time but decreased by Treatment 4 which was fed four times daily. The highest PER value of 2.10 was recorded in Treatment 3, this was followed by Treatment 2 with a mean PER value of 1.69. The least PER value (1.39) was recorded in Treatment 4. ANOVA showed that there was significance difference ($P<0.05$) in the PER value between Treatment 1, 2 and 3. However, Treatment 1 was not significantly different ($P>0.05$) from Treatment 4.

Result showed that the test fished survived very well. Survival rate ranged from 86.6% to 90.0%.

Table 1. Nutritional composition of the experimental diet

	Minimum	Maximum
Crude Protein	45.00	
Fat	8.00	12.00
Ash		8.00
Crude Fibre	2.00	4.00
Moisture		8.00
Calcium	1.5	2.5
Phosphorus	1.10	
Sodium	0.3	

Table 2. Growth efficiency and feed utilization parameters of *C. gariepinus* Fingerling's juveniles fed at different intervals

Parameters	T1	T2	T3	T4	SEM
Weight Gain	76.74^{c}	92.42^{b}	104.49^{a}	90.54^{b}	1.87
Specific Growth Rate (SGR)	1.66^{b}	1.52^{c}	1.64^{b}	1.82^{a}	0.03
Feed Intake	112.95^{c}	135.12^{b}	142.83^{a}	133.17^{b}	0.57

Parameters	T1	T2	T3	T4	SEM
Feed Conversion Ratio (FCR)	1.60	1.54	1.46	1.52^{NS}	0.32
Protein Efficiency Ratio (PER)	1.49^{c}	1.69^{b}	2.10^{a}	1.39^{c}	0.14
Survival (%)	86.6	88.3	90.0	86.6	

4. DISCUSSION

The mean weight gain increased with increase in feeding time up until Treatment 3 after which the weight gain decreased. This is in line with other studies conducted on other fish species which showed that feed consumption and growth generally increased with feeding frequency up to a given limit [7,8]. Feed consumption and growth rates increased with the increase in feeding time per day up to three times; further increases in feeding frequency did not result in significant growth. Fish fed three times per day had the highest growth efficiency like fish feed with three and four meals/day for Russian sturgeon [9], and African catfish [10]. Feed conversion ratio and specific growth rate were best at three times feeding which shows that this feeding frequency is optimal for the condition of this trial suggesting that both growth and feed utilization were most efficient at this frequency of feeding. The average sizes of fish in the Treatment groups also support the report that more frequent feeding yields fish of more uniform sizes [11]; this could arise because dominant individuals are less aggressive under such circumstances, or because more food is distributed to locations occupied by subordinates. The lack of significant difference ($P<0.05$) in feed conversion rate among the treatments was similar with the report that the effect of feeding frequency on feed conversion is usually small [12]. This indicated that fish which were fed more frequently and consumed more food, utilized that food as efficiently as the fish that were fed less frequently and that food consumption and not food conversion efficiency was the growth-limiting factor [7]. The ability of an organism to utilize nutrients especially protein will positively influence its growth rate [13]. This is justified by the highest PER and low FCR in the treatments fed thrice daily. This suggested that fish must have efficiently converted feed consumed to growth. Efficient production and growth of fish depend on feeding the best possible diets at levels not exceeding the dietary needs [14].

5. CONCLUSION

Studies on the frequency of feeding in fish culture are aimed at identifying their optimum levels. Increased feed digestibility and increased water quality are the benefits of using the correct feeding frequency. Three times feeding a day have been found to be sufficient for maximum growth of *Clarias gariepinus* juveniles in this study. Thus, a three times daily feeding is recommended.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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