EFFECT OF FEEDING FREQUENCIES ON GROWTH PERFORMANCE OF *Clarias gariepinus*

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Abstract

Investigations were carried out on the growth performance of juvenile *Clarias gariepinus* using four different feeding frequencies. Two hundred and forty juveniles (8.6 +0.0 g) were stocked in eight aquaria tanks (120 x 60 x 80 cm) to a capacity of 120 litres and fed 1,2,3 and 4 times a day respectively for 70 days. Final body weight, relative growth rate (RGR) and specific growth rate (SGR) were measured significantly lower at F1 (1 time/day) and F2 (2 times/day) than F3 (3 times/day) and F4 (4 times/day) treatment ($p<0.05$) in the decreasing order F3>F4>F1>F2. There were no significant differences for survival rates ($p>0.05$) within the treatments. The results showed that weight gain and growth performance of *Clarias gariepinus* juvenile increased with increased feeding frequency. The relative growth rate (RGR) of the experimental fish ranged from 972% (in twice daily feeding frequency) to 1,801% (in thrice daily feeding frequency) and the highest was in three times daily feeding frequency while the twice daily feeding frequency had the least. Specific growth rate was lowest in once daily feeding frequency 3.56% and highest value of 4.21% was recorded in thrice daily feeding frequency.

Keywords: specific growth rate, relative growth rate, *Clarias gariepinus.*

Introduction

Clarias gariepinus (Burchell, 1822) is prominent in African aquaculture because of its air-breathing and hardy nature as well as its suitability for artificial production, nutritional efficiency and attainment of large size within a short time (Huisman, 1986; Huisman and Ritcher, 1987; Heckt and Appelbaum, 1988 and Ritcher, 1997). The relationship between feeding frequency and growth varies between species. However, increased feeding frequency will not reduce growth rate but may improve growth rate. Evidence presented by Sena and Trevor (1995) showed that with increased feeding frequency of carp, specific growth rate, protein efficiency ratio, percentage protein retained in the carcass and percentage dietary energy retained in the carcass were all increased. In their study, feeding frequency was increased from four times daily to six times daily.

Stickney (1994) reported that a high feeding rate and frequent feeding lead to the best performance.

However, in a study on the effect of feeding frequency on the growth of plaice, *Pleuronectes platessa*, there was no difference between feeding once per day and having food continuously available (Sena and Trevor, 1995). One problem facing fish culturist is the need to obtain a balance between rapid fish growth and optimum use of the supplied-feed. Time of feeding and feeding frequency have been reported to affect feed intake and growth performance in goldfish, *Carassius auratus* (Noeske and Spieler, 1984). Indian catfish, *Heteropheustes fossils* (Sandararaj *et al* 1982), channel catfish *Ictalurus punctatus* (Noeske *et al* 1985) and Rainbow trout, O*ncorchyncus mykiss* (Hossian *et al* 2001). Over-feeding and under-feeding can be detrimental to the health of the fish and may cause a marked deterioration in water quality, reduced weight, poor food utilization and increased susceptibility to infection.

This study was carried out to determine the growth rate of *C. gariepinus* juvenile at four different feeding frequencies to provide information on the best frequency needed for optimal growth of the species.

This study was accepted on 3rd December 2010.

Material and method

Source of fish

Juveniles *C. gariepinus* (mean weight: 8.6+ 0.0 g) were obtained from Nigerian Institute for Oceanography and Marine Research (NIOMR) and acclimatized for a period of seven days after which they were redistributed into 120-L tanks. Thirty fish were kept in each tank. The experiment included four feeding frequencies and each treatment was replicated twice.

Feeding of fish

Fish were randomly distributed into experimental tanks, fed 1, 2, 3 and 4 times a day and the meal times were equally spaced throughout the day from 0700hr to 1900hr as described in (Table 1). A commercially produced fish diet of 45% crude protein was used during the experiment (Table 2) and fish were fed daily at 5% body weight (g/g) based on the allocated number of feeding frequencies.

Table 1: Feeding frequencies in the different treatments over the experimental period.

Treatment	Feeding	Timing (Hours)
Ff1	1	0700
Ff2	2	0700, 1500
Ff3	3	0700,1000, 1500
Ff4	4	0700,1100,1500,1900

Keys:
Ff1: Once daily feeding frequency.
Ff2: Twice daily feeding frequency.
Ff3: Thrice daily feeding frequency.
Ff4: Four times daily feeding frequency.

Table 2: Nutrient composition of the feed used for the experiment.

Nutrients	Proximate Composition
Crude Protein	45.00%
Fat	12.00%
Crude fibre	1.50%
Ash content	9.50%
Calcium	1.80%
Phosphorus	1.20%
Lysine	3.00%
Methonine	1.00%
Vitamin A	15000 1u(1E)/kg
Vitamin C	150mg/kg
Copper (CuSO4)	5.00mg/kg
Selenium (Na, Se)	0.30mg/kg

Note:
Ingredient: Fishmeal, soya meal, wheat, maize, fish oil and premix (lysine and methionine).

Vitamin C Source: Ascorbic acid polyphosphate.
Feed Size: 2.0 mm, 3.0 mm and 6.0 mm.

Experimental procedure

Feeding was done by hand and the rations were adjusted weekly after sampling, based on calculated total weight of the fish in each treatment tank. The weight and total length of individual fish in each treatment tank were taken at the beginning of the experiment. Five juveniles were randomly selected from each tank on weekly intervals and the length and weight measured. The pH, salinity, and the dissolved oxygen in each tank were monitored once daily while temperature was taken twice daily (Table 3).

Table 3: Water quality parameters in the fish tanks.

Parameters	F1	F2	F3	F4
Temperature (^{o}c)	26.0 + 0.2	26.5 + 0.1	27.0 + 0.1	25.83 + 0.1
Dissolved oxygen (mg/L)	5.56 + 0.2	6.3 + 0.3	6.3 + 0.3	6.0 + 0.4
pH	6.45	7.30,	7.20	6.40
Salinity (%^{o})	0.25	0.26	0.25	0.26

Keys:
Ff1: Once daily feeding frequency.
Ff2: Twice daily feeding frequency.
Ff3: Thrice daily feeding frequency.
Ff4: Four times daily feeding frequency.

Evaluation of growth performance parameter

From the experiment, data were obtained weekly and were used to calculate the following growth parameters:

Total weight gain (TWG): This is the difference between the final weight at the end of the experiment and initial weight at the beginning of the experiment as indicated in the equation below:

TWG = FW – IW.
FW = Final weight (at end of experiment).
IW = Initial weight (at the beginning of experiment).

Relative growth rate (RGR) (%): This is the percentage of the difference between the final weight and the initial weight per unit of the initial weight.

$$RGR = \frac{Wg - Wi}{Wi} \times 100$$

Wi = Initial average weight (g)
Wg = Final average weight (g)

Specific growth rate (SGR) (%): This is the percentage of the rate of difference between the natural logarithm of final weight and initial weight of the fish sample with time.

$$SGR = \frac{In\,Wf - In\,Wi}{t} \times 100$$

In = Natural logarithm.
Wf = Average final weight of fish (g).
Wi = Average initial weight of fish (g).
t = Duration of experiment in days.

Survival Rate (%): This is the percentage of the total number of fish at the end of the experiment per units of sort number of fish at the beginning of the experiment as shown in the equation below:

$$S = \frac{Ni \times 100}{No}$$

When Ni = Number of fish at the end of the experiment.
No = Number of fish stocked in the beginning of the experiment.

Data analysis

A one-way analysis of variance (ANOVA) was used to compare relative growth rate, specific growth rate, relative growth rate and survival among treatments.

Results

Weight-gain

The weekly changes in weight of all the experimental fish for the experimental period are shown in Table 4 and the growth performance of *C. gariepinus* at four feeding frequencies are shown in Table 5. There were progressive increases in growth of the fish samples on all the feeding frequencies throughout the experimental period. The mean weekly gains of the juveniles are illustrated in Figure 1. The highest mean weight-gain of 162.14 g was obtained for fish fed three times daily while the least mean value of 87.49 g was recorded for those fed twice daily. The values recorded for fish samples on once daily and four times daily were 99.75 g/fish and 146.36 g/fish respectively. There was significant difference in the treatment at $p<0.01$ of the mean weight-gain among the feeding frequencies.

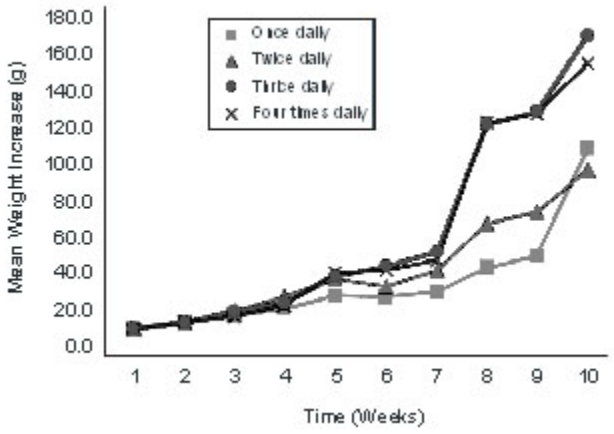

Figure 1: Mean weekly weight increase of *C. gariepinus* fed at different feeding frequencies.

The relative growth rate

The relative growth rate of the experimental fish ranged from 972% to 1,802% (Table 4). Twice daily feeding frequency had the lowest value while thrice daily feeding frequency had the highest value. There was no significance difference at $p<0.01$ in relative growth rate between the treatments.

The specific growth rate

The specific growth rate was lowest in fish samples fed once daily feed frequency with value of 3.56% while the highest value of 4.21% was recorded for the thrice daily feeding frequency.

Survival rate

Fish samples on once daily feeding frequency recorded the lowest survival rate of 91.67% while the highest survival rate of 100% was recorded for those feed four times daily.

Table 4: Mean weekly weight increase for ten weeks.

Week	1	2	3	4	5	6	7	8	9	10
Ff1	9.00	12.52	17.07	20.69	27.81	27.06	29.44	42.95	49.62	108.74
Ff2	9.00	12.34	19.40	26.61	36.63	32.66	41.62	66.77	73.08	96.43
Ff3	9.00	12.51	18.91	23.51	38.18	43.86	51.50	122.35	128.35	171.13
Ff4	9.00	12.58	15.96	22.27	40.06	41.72	47.45	122.57	127.97	155.35

Keys:
Ff1- Feeding frequency at one time daily.
Ff2- Feeding frequency at two times daily.
Ff3- Feeding frequency at three times daily.
Ff4- Feeding frequency at four times daily.

Table 5: Mean growth performance of *C. gariepinus* at different feeding frequency.

Growth Parameters	**F1**	**F2**	**F3**	**F4**
Number of fish stocked	60	60	60	60
Experimental period(days)	70	70	70	70
Mean weight gain (g/fish)	99.75 + 0.02	87.49 + 0.03	162.14 + 0.02	146.36 + 0.01
Mean initial weight (g/fish)	9.00 + 0.02	9.00 + 0.03	9.00 + 0.011	9.00 + 0.021
Mean final weight (g/fish)	108.74 + 0.11	96.49 + 0.23	171.13 + 0.02	155.35 + 0.04
Mean daily weight gain (g/fish)	1.43 + 0.21	1.25 + 0.02	2.32 + 0.02	2.09 + 0.02
Specific growth rate (%)	3.56	3.96	4.21	4.07
Relative growth rate (%)	1,108	972	1,802	1,626
Survival rate (%)	91.67	95.0	95.0	100

Keys:
F1: Once daily feeding frequency.
F2: Twice daily feeding frequency.
F3: Thrice daily feeding frequency.
F4: four times daily feeding frequency.

Water quality parameters

The water quality for the four treatments fell within tolerance limits for *C. gariepinus*. However the pH and dissolved oxygen in treatment 1 (once feeding frequency) was lower than others.

Discussion

The differences in growth and feed efficiency when different species of fish are fed at varying frequencies underscore the importance of considering different feeding schemes for the various fish cultured so that feed costs can be minimized. Teshima *et al* 1984 showed that milkfish fingerlings, fed with various artificial diets, grew significantly faster when fed twice each day than when fed once each day, although rate of feeding and type of diets were more important factors affecting fingerlings growth.

The present result showed that feeding frequency significantly affected growth performance of *C. gariepinus* and revealed that feeding rate was the more important variable in determining weight gain. In this study, fish on the three times daily frequency demonstrated improved growth over the other feeding frequencies and the trend in decreasing order was three times daily> four times daily> once daily>twice daily. The best growth in three daily feeding frequencies might have been due to feed intake which was also highest in this feeding frequency. The result was at variance with the finding of Gokcek *et al* (2008) who reported that weight gain and growth performance of *Himri barbe*, *B. iutens*, fry were decreased with increased feeding frequency and there were no significant differences for the feed conversion ratio (FCR) and survival rates.

Different workers have however, reported that feeding frequency affect growth performance of different fish species. Tung and Shan (1991) reported that the optimum feeding frequency for hybrid Nile tilapia,

Oreochromis niloticus and Blue tilapia *O. aureus* was six times per day while twice per day for channel catfish *Ictalurus punctatus* (Webster *et al* 1992), rainbow trout *Oncorhynchus mykiss* (Grayton and Beamish 1977) and fry of common carp *Cyprinus carpio* (Charles and Sebastian 1975). However, Cui *et al* 1997 reported that continuous feeding for 24 hour per day was obtained for white sturgeon *Aupencer transmontanus*. Minton (1978) reported that when feeding frequency was restricted, fish required higher energy diet. Survival rate was generally high in all the different feeding frequencies and the mortalities observed during the experiment were less than 10%. This showed that all the feeding frequencies favoured higher survival of fish. However, survival was enhanced with increasing feeding frequencies.

Knowledge of feeding frequency helps in reducing food wastage, improving water quality, maximizing production efficiency and bridging the gap between food consumption and growth of cultured fish.

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