International Scholars Journals

Advances in Food Science and Technology ISSN: 6732-4215 Vol. 13 (2), pp. 001-005, February, 2025. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research paper

Impact of Feeding Frequency on Growth and Feed Efficiency in African Catfish (*Clarias gariepinus*) Fingerlings and Juveniles

A. Z. Aderolu*, B. M. Seriki, A. L. Apatira and C. U. Ajaegbo

Aquaculture Nutrition Unit, Department of Marine Sciences, University of Lagos, Akoka-Lagos, Lagos State, Nigeria.

Accepted 16 December, 2024

Feeding frequency effect on growth performance, feed utilization and economic viability of *Clarias gariepinus* fingerlings and juveniles were studied under natural photoperiods of 12/12 h light/dark cycle using a complete random design. Triplicate group of 10 fish with an initial mean weight of 8.5 ± 0.1 g and 34.3 ± 0.1 g respectively per tank (measuring 52 x 33.5 x 21 cm). A commercial feed (COPPENS) with crude protein of 42% and ether extract 12% was fed for 8 weeks over four feeding frequencies studied (once, twice, thrice and four times). Mean weight gain, relative growth rate and the specific growth rate were all significantly different (P < 0.05) across feeding levels except at thrice and four times feeding levels. The feed conversion ratio was lowest on three times a day feeding level both for the juvenile and fingerling (0.66 and 0.73, respectively). Although net profit value, in both juvenile and fingerling group are not significantly different, the investment cost analysis and the gross profit between fish fed thrice and four times are equally not significantly (P > 0.05) different. The results of this experiment, both at the juvenile and fingerling stages indicate that fish could be fed three times a day with maximum growth and profit.

Key words: Feeding frequency, feed utilization, growth, economic viability, *Clarias gariepinus.*

INTRODUCTION

One problem facing fish culturists is the need to obtain a balance between rapid fish growth and optimum use of the supplied feed (Gokcek et al., 2008). There is also the need to establish the effect of number of feeding times or frequency on feed management, nutrient utilization and growth rate of fish. Since the feed cost accounts approximately 40 - 60% of the operating costs in intensive culture systems (Agung, 2004), the economic viability of the culture operation depends on the feed and feeding frequency. It means that nutritionally well-balanced diets and their adequate feeding are the main requirements for successful culture operations.

Each species has its particular food preferences and feeding behaviours. Feeding and ingesting are the final result of a number of interacting factors between the fish (senses and hormonal systems) and its environment (stock density, size range or variability, season, day length and time of the day). 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, *Heteropneustes fossilis* (Sundararaj et al., 1982), channel catfish, *Ictalurus punctatus* (Noeske et al., 1985) and black sea trout *Salmo trutta labrax* Pallas, 1811 (Bascinar et al., 2007).

Feeding frequency is one important consideration as it can affect growth, survival and fillet composition as well as water quality. Feeding also at the optimum frequency can result in tremendous savings in feed cost (Davies et al., 2006).

The amount of the daily feed intake, frequency and timing of the feedings and presentation of the predetermined ration are the key factors of feed management strategies, influencing the growth and feed conversion (Jobling, 1995; Goddard, 1995). Optimal feeding frequency

*Corresponding author. E-mail: dezaid@yahoo.com. Tel: +2348033225139

may vary depending on species, age, size, environmental factors, husbandry and feed quality (Goddard, 1995).

The objectives of this study are:

(1) Establishing maximum number of feeding times in *Clarias gariepinus* fingerlings and juveniles.
(2) Effect of feeding frequency on weight gain and nutrient utilization in both fingerlings and juveniles
(3) Establishing also the effect of feeding frequency on the economy of both juveniles and fingerlings productions of the *C. gariepinus.*

MATERIALS AND METHODS

Experimental fish, diet and husbandry conditions

This experiment was carried out at the Aquaculture Research Complex of Universityy of Lagos, Akoka-Lagos, Nigeria. African catfish *C. gariepinus* fingerlings and Juveniles (with average weight of 8.5 ± 0.1 g and 34.3 ± 0.1 g respectively) were obtained from a local hatchery in Alimosho Local Goverment Area, Lagos State, Nigeria and transported to the experimental unit in aerated polyethylene bags. Fish were acclimatized to laboratory conditions for two weeks in 3,000 L capacity canvas tank fitted to a flow-through system and fed a maintenance diet containing 42% crude protein and 12% lipid for 2 weeks. After this period, each size of fish (fingerlings and juveniles) were randomly distributed into twenty-four plastic tanks (measuring 52 x 33.5 x 21 cm) containing 30 L of borehole water. Trial conditions included ten fish per tank and four feeding frequencies, with each feeding frequency being experimentally tested in triplicate. Fish were kept under natural photoperiod of approximately 12/12 h light/dark cycle and fed a popular commercial catfish feed (Coppens®, Holland) once (at 11.00 h), twice (09.00 and 16.00 h), thrice (09.00, 13.00 and 16.00 h and four times (09.00,11.00,13.00 and 16.00 h) daily respectively, to apparent satiation for 8 weeks. The treatments were designated F1, F2, F3, F4, J1, J2, J3 and J4 respectively based on fish size (fingerlings, F and juveniles, J) and feeding frequencies (1 - 4) accordingly. Fish tanks were cleaned daily by siphoning out residual feed and faecal matter, water in the tanks were changed twice weekly and feed consumption was monitored weekly. Water quality parameters (temperature, dissolved oxygen and pH) were monitored twice weekly; temperature with Mercury- in-glass thermometer calibrated in degree centigrade (°C), dissolved oxygen (DO) was determined by using the Winkler's solution and pH was determined with a pH meter, to ensure they were within tolerant limits expected for the studied species. During the experiment, water temperature, pH and dissolved oxygen (DO) were within 26 - 29°C, 5.4 - 8.0 and 4.5 - 4.8 mg l^{-1} respectively controlled through the source of water supplied and regular water change.

All fish were weighed individually at the beginning and end of the experiment while batch weighing per tank was performed weekly to monitor growth performance.

Economic analysis

The economic analysis was performed to estimate the cost of feed required to raise a kilogram of fish (for both fingerling and juvenile) fed the popular commercial feed while being cultured under controlled conditions. The cost of feed and fish were the only economic criteria under consideration in this case and were based on the current market cost of the commercial feed and market value of a kilogram of fresh fish in Nigeria at the time of the experiment.

The economic evaluations were calculated based on the method of New (1989) as follows:

Estimated Investment cost analysis = Cost of feeding (₦) + Cost of fingerling (or juvenile) stocked (₦).
Profit index = Value of fish (₦)/ Cost of feed (₦).
Net profit = Sales – Expenditure.

Calculations and statistical analysis

The following formulae were applied to the data:

Specific growth rate (SGR %/day) = $[(\ln W_f - \ln W_i)/T] \times 100$.
Feed conversion ratio (FCR) = total feed intake (g)/total wet weight gain (g).
Where W_f refers to the mean final weight, W_i is the mean initial weight of fish and T is the feeding trial period in days.

Protein Efficiency Ratio (PER) = wet weight gain (g)/total protein intake.

The costs were based on the current cost of feed ingredients in Nigeria at the time of the experiment.

Statistical analysis

The data collected was analysed using one way analysis of variance (ANOVA) . Duncan's Multiple Range Test was used to compare the mean differences, which were deemed significant at $P < 0.05$.

RESULTS

The initial mean weight of both the fingerlings and juveniles used were not significantly different for each respective group. No mortality nor external clinical symptoms occurred in any treatment in this study. Mean live weights gain of the fingerlings in groups F1, F2, F3 and F4 reached 33.39, 51.33, 69.33 and 69.47 g at the end of the trial, while mean weight gain for the juvenile group are 48.93, 62.07, 72.67 and 77.73 g respectively. This translates into an average relative growth rate of between 400.56 and 815.25% for fingerling and 134.79 and 288.04%/fish for the juveniles over the study period (Tables 1 and 2, respectively).

Specific growth rates (SGR%/day) exhibited clear fluctuations ranging from 1.11 - 1.52 for fingerlings and 0.59 - 0.93 for juveniles respectively. No significant difference was found in the SGR between three and four times feeding frequency in both groups. The growth data clearly indicated that the final live weight, relative growth rate and SGR values of fish fed three times were not significantly different from those fed four times in both the fingerlings and juveniles groups respectively.

Feed intake and weight gain performances for both fingerlings and juveniles over the experimental period is presented in Figure 1. With increase in number of feeding times, weight gain and feed intake per week increased.

Economic parameters like investment cost analysis

Table 1. Variation in growth, food and economic factors of fingerling *C. gariepinus.*

Parameters	1	2	3	4
Initial weight (g)	8.47	8.53	8.53	8.53
Final weight (g)	42.40^{c}	59.87b	77.87 ^{a}	78.00 ^{a}
Mean weight (g/fish)	33.93^{c}	51.33^{b}	69.33 ^{a}	69.47 ^{a}
Relative growth rate (% fish)	400.55^{c}	601.88^{b}	812.72^{a}	815.25 ^{a}
Specific growth rate (% fish)	1.11^{c}	1.34^{b}	1.52 ^{a}	1.52 ^{a}
Voluntary food intake (g/fish)	7.84^{c}	6.92^{a}	7.15 ^{a}	7.27 ^{a}
Feed conversion ratio	0.90^{a}	0.74^{a}	0.73 ^{a}	0.75a
Protein intake	12.82^{b}	15.88^{b}	21.36 ^{a}	21.20 ^{a}
Protein efficiency ratio	2.65^{a}	3.30^{a}	3.27 ^{a}	3.33 ^{a}
Net profit vale (N/Kg)	19.05^{b}	19.20^{a}	19.20 ^{a}	19.20 ^{a}
Investment cost analysis (N)	84.16^{b}	86.34^{b}	90.26 ^{a}	90.14 ^{a}
Gross profit (N)	65.11^{b}	67.14^{b}	71.06 ^{a}	70.94 ^{a}

Table 2. Variation in growth, food and economic factors of juvenile *C. gariepinus*.

Parameters	1	2	3	4
Initial weight (g)	34.33^{c}	34.27	34.4	34.33
Final weight (g)	80.53 ^{c}	114.67 ^{b}	114.47 ^{a}	133.20 ^{a}
Mean weight (g/fish)	48.93 ^{c}	62.07 ^{b}	72.67 ^{a}	77.73 ^{a}
Relative growth rate (% fish)	134.79 ^{c}	234.61^{b}	319.96 ^{a}	288.04 ^{a}
Specific growth rate (% fish)	0.59 ^{c}	0.83 ^{b}	0.99 ^{a}	0.93 ^{a}
Voluntary food intake (g/fish)	6.47 ^{a}	5.84 ^{a}	5.46 ^{a}	6.36 ^{a}
Feed conversion ratio	1.07 ^{a}	0.78 ^{b}	0.66 ^{b}	0. 80 ^{b}
Protein intake	20.55 ^{c}	26.07 ^{b}	30.52 ^{a}	32.65 ^{b}
Protein efficiency ratio	2.25 ^{b}	3.14 $^{a\,b}$	3.61 ^{a}	3.05 $^{a\,b}$
Net profit value (N/Kg)	77.25 ^{a}	77.10 ^{a}	77.40 ^{a}	77.25 ^{a}
Investment cost analysis (N)	139.68 ^{c}	143.62 ^{b}	146.80 ^{a}	148.32 ^{a}
Gross profit (N)	62.43 ^{c}	66.52 ^{b}	69.40 $^{a\,b}$	71.07 ^{a}

and gross profit varies significantly with frequency of feeding in both fingerlings and juveniles, the only exception is between the tree and four times feeding level.

DISCUSSION

Studies conducted on other fish species have shown that feed consumption and growth generally increased with feeding frequency up to a given limit (Wang et al., 1998; Ba çınar et al., 2007) . This is in agreement with our findings in this study that feeding frequency had a significant effect on feed consumption and growth in the African catfish. Both feed consumption and growth rates appeared to increase with the number of meals per day up to three meals; further increases in feeding frequency did not result in significant growth both at the fingerlings and juveniles stages.

Feed conversion ratio and specific growth rate are at best at three times feeding in both the fingerlings and juveniles. It shows that this feeding frequency is optimal for the condition of this trial suggesting that both growth and feed utilization are most efficient at this frequency of feeding. However, the inter-individual size variation of fish in the treatment group fed four times daily was much lower than in the other treatment groups. This supports the hypothesis that more frequent feeding yields fish of more uniform sizes (Ba çınar et al., 2001); this could arise because dominant individuals are less aggressive under such circumstances, or because more food is distributed to locations occupied by subordinates. The same author equally stress the need to determine different feeding rates and frequencies for each species and different sizes of the same species, under varying culture condition.

The lack of difference in feed conversion rate among the treatments in the fingerlings group was consistent with the argument that the effect of feeding frequency on feed conversion is usually small (Hepher, 1988). This indicated that fish which were fed more frequently and consumed more food, utilized that food as efficiently as

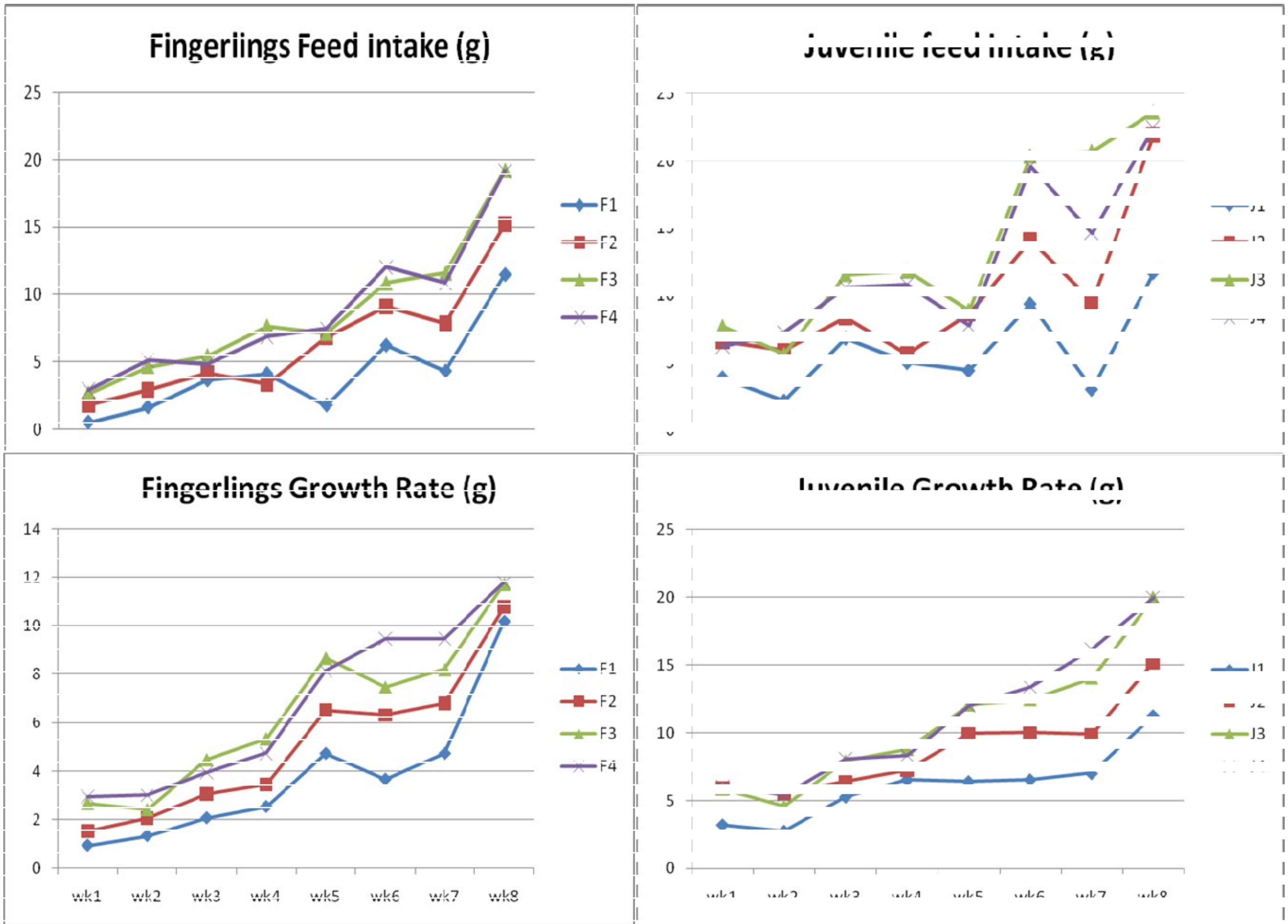

Figure 1. Average feed intake and growth rate of fingerlings and juveniles placed on different feeding frequency over a time period. F1 = Fingerling fed once daily, F2 = Fingerling fed twice daily, F3 = Fingerling fed thrice daily, F4 = Fingerling fed four times daily, J1 = Juvenile fed once daily, J2 = Juvenile fed twice daily, J3 = Juvenile fed thrice daily, J4= Juvenile fed four times daily.

the fish that were fed less frequently and that food consumption and not food conversion efficiency was the growth-limiting factor (Wang et al., 1998).

The ability of an organism to utilize nutrients especially protein will positively influence its growth rate (Sogbesan and Ugwumba, 2008). 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.

C. gariepinus is commonly produced in Nigeria because of its fast growth rate and profitability. Efficient production and growth of fish depend on feeding the best possible diets at levels not exceeding the dietary needs (Charles et al., 1984). In fish culture practices, studies on the amount and frequency of feeding are aimed at identifying the optimum levels of both. Increased feed digestibility and increased water quality are the benefits of using the correct feeding frequency. Two or three feeding a day have been found to be sufficient for maximum growth of a number of different fish species (Ruohonen et al., 1998). This generally agrees with the result of this study as depicted by the net and gross profit value obtained along side other parameters already mentioned.

The success of catfish culture both the fingerlings and the juveniles depends on effective feeding frequency, a feeding frequency of three times compare to once, twice or four times is sufficient for effective growth and nutrient utilization under the experimental condition carried out in this study.

REFERENCES

Agung S (2004). Comparism of Lupin meal based diets cost efficiency for juvenile *Penaeus monodon tested* under pond conditions. J. Coastal Dev., 8(1): 47–51.

Ba çınar N, Okumu , Ba çınar NS, Sa lam EH (2001). The influence of daily feeding frequency and feed consumption of rainbow trout fingerlings (Oncorhynchus mykiss) reared at 18.5 - 22.5°C. The Israeli J. Aquacult. –Bamidgeh., 53 (2): 80-83.

Ba çınar Nadir, Çakmak Eyüp, Çavdar Yahya, Aksungur Nilgün (2007). The effect of feeding frequency on growth performance and feed conversion rate of Black sea trout (*Salmo trutta labrax* Pallas, 1811). Tur. J. Fisheries. Aqua. Sci., 7: 13-17.

Charles PM, Sebastian SM, Raj MCV, Marian MP (1984). Effect of feeding frequency on growth and food conversion, *Cyprinus carpio* Fry. Aquacult., 40: 293-300.

Davies OA, Inko-Tariah MB, Amachree D (2006). Growth response and survival of *Heterobranchus longifilis* fingerlings fed at different feeding frequencies. Afr. J. Biotechnol., 5: 778-787.

Gokcek CK, Mazlum Y, Akyurt I (2008). Effects of feeding frequency on the growth and survival of *Himri barbell* and *Barbus luteus* fry under laboratory conditions. Pak. J. Nutr., 7(1): 66-69.

Goddard S (1995). Feed Management in Intensive Aquaculture. Chapman and Hall, New York. p. 194.

Hepher B (1988). Nutrition of Pond Fishes. Cambridge Univ. Press, Cambridge.

Jobling M (1995). Fish Bioenergetics, Chapman and Hall, London. p. 309.

New MB (1989). Formulated Aquaculture Feeds in Asia: Some Thoughts on Comparative Economics, Industrial Potential, Problems and Research Need in Relation to Small-Scale Farmer. In report of the Workshop on Shrimps and Fin Fish Feed Development, Bahru JE (Ed.) ASEAN/SF/89/GGEN/11.

Noeske TA, Spieler RE (1984). Circadian feeding time affects growth of fish. Rhythmicity in Fishes. 113: 540-544.

Noeske TA, Spieler RE, Parker NC, Suttle MA (1985). Feeding time differentially affects fattening and growth of channel catfish. J. Nutr. 115: 1228-1232.

Ruohonen K, Vielma J, Grove DJ (1998). Effects of feeding frequency on growth and food utilization of Rainbow trout *Oncorhynchus mykiss* fed low-fat Herring or dry pellets. Aquacult. 165: 111-121.

Sogbesan AO, Ugwumba AAA (2008). Nutritional evaluation of termite *Macrotermes subhyalinus.* Meal as animal protein supplements in the diets of *Heterobranchus longifilis* fingerlings. Tur. J. Fisheries and Aquatic sci., 8: 149-157.

Sundararaj BI, Nath P, Halberg F (1982). Circadian meal timing in relation to the lighting schedule optimizes catfish body weight gain. J. Nutr., 112:1085-1097.

Wang N, Hayward RS, Noltie DB (1998). Effect of feeding frequency on food consumption, growth, size variation, and feeding pattern of Age-0 hybrid Sunfish. Aquacult., 165: 261-267.