International Journal of Fisheries and Aquatic Research
www.fishjournals.com
ISSN: 2456-7248
Received: 10-09-2024, Accepted: 11-10-2024, Published: 26-10-2024
Volume 9, Issue 2, 2024, Page No. 14-18

Growth response and nutrient utilization of *Heterobranchus longifilis* fingerlings reread in Hapa

Mohammed YS[1], Abdussalam I[2], Odedere AO[2], Logodi MM[1], Shehu AG[1]
[1] Department of Research Operations, National Institute for Freshwater Fisheries Research, New Bussa, Nigeria
[2] Department of Biological Oceanography, Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria

Abstract
Fingerlings of *Heterobranchus longifilis* of mean body weight of 26.30+0.12g were fed with different crude protein diets of 30%, 35%, 40% and 45% respectively in hapa nets and randomly allocated into four different treatments with two replicates each with 25 fingerlings per unit. The fish fingerlings were fed at 5% body weight for 56 days. At the end of the feeding trial, growth performance and nutrient utilization were evaluated. The results revealed that fish fed with 40% CP diets had the highest Mean Weight Gain (MWG) of 30.89g, Specific Growth Rate (SGR) of 1.04%/day, and Food Conversion Ratio (FCR) of 3.75. The fingerlings fed with the 30% CP diets gave the least growth performance. It could be concluded from this study that 40% CP diet is optimal for growth of *Heterobranchus longifilis* fingerlings.

Keywords: Nutrient utilization, *Heterobranchus longifilis,* aquaculture

Introduction

Fish feed account for about 70% of aquaculture operation (FAO, 1983) and most fish farmers in Nigeria do not make use of standard fish feeds due to high cost (Eyo, 1995) [13]. Fish feeds were developed on the concept of fish eat fish; this is why fishmeal is often a traditional component of fish feeds. However, in recent times the cost of fishmeal has made scientists suggest the possibility of replacing plant protein feedstuff in fish feed production to reduce cost of producing the feed and the cost per kilogram of producing fish weight (Falaye. 1992) [15].

Among the potential plant protein feedstuffs are soybeans, groundnut cake, maize and vegetable oil. With crude protein ranging from 24-48 percent, crude lipids 15-50 percent and very high nitrogen free extract (NFE) (Shiau *et al*, 1990; Aduku and Olukosi, 1991) [2]. Both are abundantly produced in Nigeria especially in the guinea savannah region of Benue and Oyo States.

Catfish is highly cherished in Nigeria because of its fast growth and the high taste value of the fish (Oladosu *et al*, 1994). The wild and the local fingerlings do not grow as fast as those that have been improved genetically through manipulations. This is a major constrain to rapid development of aquaculture industry and stock management in Nigeria (Aluko, 1994) [4]. As the culture of catfish (*Heterobranchus longifilis*) becomes more intensive, strategies for supplementary feeding will have to be assessed for maximum economic returns. Feeding levels of protein is one of the important considerations as it can affect growth, survival and body composition as well as the water quality. Feeding at the optimum protein levels can result in tremendous savings in feed costs. Diet cost represents 30-70% of the total operating cost of an aquaculture enterprise thus over feeding would mean economic waste and could adversely affect water quality.

The *Clariid* catfishes *Clarias* and *Heterobranchus,* widely distributed in tropical Africa have gained prominence as important culturable fish species for fish farming (Teugels, 1986) [36]. The mudfish are highly esteemed group of commercial value in Nigerian markets (Welman, 1948; Olatunde, 1983) [29, 38]. They exhibit many qualities that make them suitable for aquaculture. These include ability to withstand stress, disease resistance, fast growth, high yield potentials, high fecundity and good taste. They can also withstand low dissolved oxygen (DO) and pH level and can grow on a wide range of natural and low-cost artificial feeds. It is hardy and adaptable principally because of its air breathing ability. Lastly, it can withstand adverse environmental conditions and relatively tolerant to poor water quality (Huisman and Richer, 1987; Haylor 1993; Nwadukwe, 1995) [19, 26]. These good qualities coupled with their high commercial demand and ability to virtually feed on anything makes them highly recommendable for farming in Nigeria (Reed *et al,* 1967; Bard *et al,* 1976; Olatunde, 1983) [29, 33].

This study, therefore, is aimed at studying the growth response and nutrient utilization of *Heterobranchus longifilis* fingerlings fed with different crude protein diets in hapa.

Materials and methods

Experimental site

The experiment was conducted at the Federal College of Freshwater Fisheries Technology in pond D ($324m^2$) New Bussa.

Experimental fish

The experimental fish (*Heterobranchus longifilis*) were obtained from the genetic laboratory of the National Institute for Freshwater Fisheries Research (NIFFR), New Bussa. The fish were acclimatized for three days inside the hapa before the commencement of the experiment.

Experimental design

The hapa (L x B x H: 1m x 1m x 1m) were constructed using net along with Koralon rope and mounting twine. The hapa were arranged in one row towards the pond dike. Each hapa was staked using four sticks and anchored to the bottom of the pond. The hapa were tied to the sticks by means of Koralon ropes. About 2/3 of the hapa depth was submerged in the water, leaving the remaining 1/3 as freeboard.

Twenty-five (25) fishes were randomly stocked into each hapa with two replicates per treatment in a completely randomized design (CRD). The treatments are Treatment. I, 30% CP; Treatment II, 35% CP; Treatment III, 40% CP; and Treatment IV, 45% CP.

Experimental diet

Fish feed ingredients were procured at New Bussa Monday Market. Five different diets were compounded from soyabean meal, fish meal, groundnut cake, yellow maize along with bone meal, lysine, methionine, vitamin premix, and vegetable oil. The ingredients were accurately weighed according to their percentage composition as shown in Table 1. The fish feed ingredients were thoroughly mixed. After grinding, warm water was added, after which it was pelletized by using the improvised pelleting machine. The wet pelleted feed was immediately sun-dried and packaged into polythene bags.

Table 1: Percentage composition of the formulated diet fed to *Heterobranchus longifilis* fingerlings in hapa

Ingredients	Diet I	Diet II	Diet III	Diet IV
	30%CP	35%CP	40%CP	45%CP
Yellow maize	46.00	34.00	22.00	10.00
Fish meal	16.00	20.00	24.00	28.00
Groundnut cake	16.00	20.00	24.00	28.00
Soyabean meal	16.00	20.00	24.00	28.00
Vitamin premix	2.00	2.00	2.00	2.00
Bone meal	1.00	1.00	1.00	1.00
Lysine	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50
Vegetable oil	2.00	2.00	2.00	2.00
Total	100	100	100	100

Fish stocking, feeding and sampling

The experimental fish fingerlings of average weight of 26.52g were randomly stocked into the hapa in the morning. The fish were fed with pelleted feeds at 5% of their body weight for the eight (8) weeks of the experimental period. The feed for each treatment and their replicates were weighed into small-labeled nylon bags for easy identification and feeding was done in all seven days of the week, twice daily in the morning (8.00-9.00) and evening (6.00-7.00) by broadcasting the feed on the water surface inside the hapa. The compounded feed was crushed into powder before feeding it to the fish.

Fish sampling was carried out weekly. This was usually conducted in the morning between 7.30 and 9.00 using a scoop net. During sampling all the stocked fish in each hapa was scooped out and weighed using OHUS-400 model weighing balance. Immediately after weighing, the fish were returned to their respective hapa.

Water quality parameters

During the culture period, the water quality parameters such as, Temperature, Dissolved Oxygen, pH and Conductivity within the culture mediums were monitored using the standard methods of the examination of water and waste water (APHA, 1980) [5].

Data collection

Growth response and nutrient utilization indices were calculated as described by Olvera-Nooa *et al*. (1990) as follows: Mean Weight Gain (MWG), Feed Conversion Ratio (FCR); Relative Growth Rate (RGR) specific Growth Rate (SGR), protein efficiency ratio (PER); Mortality and Survival Rate.

Mean Weight Gain (MWG)

$$MWG = W_2 - W_1$$

Where W_1 = Initial mean weight of fish at time T1

W_2 = Final mean weight of fish at time T2

Feed Conversion Ratio (FCR)

$$FCR = \frac{\text{Weight of feed given (g)}}{\text{Fish weight gain (g)}}$$

Relative Growth Rate (RGR)

$$RGR\,(\%) = \frac{(Wf - Wi) \times 100}{Wi}$$

Wf = Final average weight at the end of the experiment.

Wi = Initial, average weight at the beginning of the experiment.

Protein Efficiency Ratio

$$P\,E\,R = \frac{\text{Fish Weight Gain (g)}}{\text{Protein intake (g)}}$$

Specific Growth Rate (SGR)

$$S\,G\,R = \frac{\text{Loge } Wf - \text{Loge } Wi \times 100}{\text{Time (days)}}$$

Where

Wf = Final average weight at the end of the experiment

Wi = Final average weight at the beginning of the experiment

Loge = Natural logarithm reading

Time = Number of days for the experiment (56 days)

Mortality and survival Rate (%)

$$\text{Survival Rate (\%)} = \frac{\text{Number of fish that survived} \times 100}{\text{Total number of fish stocked}}$$

Mortality Rate (%) = 100% - survival Rate (%)

Statistical analysis

The data collected were analyzed using analysis of variance technique (Steel and Torrie, 1980) [35]. Where significant difference exists, means were separated using Duncan Multiple Range Test (Duncan, 1955). The entire statistical analysis was done on SPSS for windows.

Results

All tested diets were accepted and actively fed upon by the fish and no pathological symptom resulting from nutritional deficiency was observed among the fish used for the experiment. Proximate analysis of the experimental diets in percentages are shown in Table 2. The results revealed that there was an increase in protein content of the diets along the four treatments. Diet 3 had the second highest crude protein content of 39.25%, followed by diet 4 with CP content of 43.64%, and least was diet 1 with 30.15% CP.

The proximate analysis also shows that as the crude protein increases along the treatments, the carbohydrate content (Nitrogen free extract) decreases. Diet 1 (30% CP) had 30.15% along with 48.49% carbohydrate, Diet 2 (35%CP) had 35.13% along with 43.13% carbohydrate, Diet 3 (40%CP) had 39.25% along with 37.875 carbohydrate, and Diet 4 (45%CP) had 43.64% along with 34.04% carbohydrate.

Table 2: Proximate analysis of the experimental feed (%)

Components	Diet I	Diet II	Diet III	Diet IV
	30%CP	35%CP	40%CP	45%CP
Dry matter	90.09	90.09	90.08	90.17
Moisture content	9.91	9.90	9.92	9.83
Crude protein	30.15	35.13	39.25	43.64
Crude fibre	3.36	3.38	3.28	3.27
Crude fat (EE)	5.13	5.58	6.22	5.39
Ash	12.87	12.78	13.38	13.66
Sub-total	51.51	56.87	62.13	65.94
Nitrogen free extract	48.49	43.13	37.87	34.04

- NFE is calculated as 100-(CP+ASH+CF+EE)

Mean increase in weight (g) of *Heterobranchus longifilis* fingerlings fed different crude protein diets in hapa for 56 days is shown in Table 3. At the end of 56 days culture period, it was observed that diet 3 had the highest final weight of 57.09g, while diet 1 had the least final weight of 41.93%.

Table 3: Mean increase in weight (g) of *Heterobranchus longifilis* fingerlings fed different crude protein diets in hapa for 56 days

Treatments	Culture period (weeks)								
	Initial day	1st	2nd	3rd	4th	5th	6th	7th	8th
Diet 1	26.40	28.55	30.80	32.82	34.77	36.51	38.35	40.25	41.93
Diet 2	26.19	28.54	31.69	34.61	37.19	40.08	43.00	45.41	48.42
Diet 3	26.20	30.45	34.10	39.55	44.61	48.10	51.49	51.62	57.09
Diet 4	26.40	28.68	31.03	34.68	38.48	41.67	44.30	47.10	50.38

The growth performance and nutrient utilization of *Heterobranchus longifilis* fingerlings fed the different crude protein diet in hapa-net for 56 days is presented in Table 4. The mean value of all the four treatments were significantly different ($p<0.05$).

The 40% crude protein diet under treatment III was observed to have the best mean final weight of 57.09g; best mean weight gain of 30.89; best mean daily growth rate of 1.40%/day; lowest feed conversion ratio of 3.73 and best mean survival rate of 98%.

The fish fed with 45% crude protein diet under treatment IV, had the second-best mean weight growth performance while fish under treatment I was the least (worst). The second-best result was reported in diet 4, under treatment IV with mean final weight of 23.98g; daily growth rate of 0.4283g/day and specific growth rate of 1.16%/day.

Table 4: The growth performance and nutrient utilization of *Heterobranchus longifilis* fingerlings fed different crude protein diets in hapa-nets for 56 days

Treatments	Mean initial weight (g)	Mean weight gain (g)	Mean final weight (g)	Specific growth rate (%/day)	Feed intake (g)	Feed conversion ratio (FCR)	Survival rate (%)
Diet 1 (30%CP)	26.40	41.93	15.53	0.83	93.96	6.06	94.0
Diet 2 (35%CP)	26.19	48.42	22.23	1.10	100.21	4.51	95.0
Diet 3 (40%CP)	26.20	57.09	30.89	1.40	115.59	3.75	98.0
Diet 4 (45%CP)	26.40	50.38	23.98	1.16	102.30	4.27	95.0

Mean water qualities of the earthen pond monitored at weekly intervals during the experimental period are shown in Table 5. Water quality during the study showed mean temperature of 27.72^{0}C, mean dissolved oxygen of 5.92mg/l; pH value of 7.8 and conductivity of 125.7μmhos/cm^3.

Table 5: Mean water quality parameters of the College earthen pond monitored at weekly interval during the experimental period

Day	Water temperature (^{O}C)	Dissolved Oxygen (mg/l)	pH	Conductivity ($\mu mhos/cm$)
0	28.00	5.01	7.2	120.0
7	28.30	5.26	7.1	122.0
14	28.50	5.14	7.0	120.0
21	28.05	6.61	7.5	122.0
28	28.05	6.61	7.5	122.0
35	27.20	6.52	7.6	130.0
42	27.50	6.45	7.4	134.0
56	26.51	6.48	7.3	132.0
Mean	27.72	592	7.3	125.7

Discussion

Experimental diets

The experimental diets: 30%, 35%, 40% and 45% crude protein diets did not pose any problem to catfish *Heterobranchus longifilis* because all the fishes selected for the treatments increased in body weight. Water stability of all the diets was suitable for fast and competitive feeders such as *Heterobranchus longifilis* as it ensured optimum feed uptake before disintegration of pellets. High fish survival was attributable to favourable water quality in the experimental systems. The best result was reported for fish fed with diet 3, 40% crude protein content (mean weight 57.09g and mean weight gain of 30.89g). 40% crude protein diet has proved to be a very reliable and efficient feed for catfish fingerlings production. The results confirmed the observations reported in most studies that catfish fingerlings performed better when fed with 40% crude protein content diet than diets with above 40% crude protein. (Faturoti *et al*., 1987; Fagbenro, 1990 and Eyo 2001) [12, 16].

Growth Response

Growth responses by fish fed different crude protein diets showed that 40% crude protein diets was appropriate as dietary protein in dry diets for *Heterobranchus longifilis*. This agrees with reports that 40% of the crude protein diets was accepted and gave good growth responses in Catfishes *Clarias gariepinus* and *Heterobranchus longifilis* (Phromkunthong and Chetanon, 198) and *C. batrachus* and *C. macrocephalus*.

Conclusion

Based on the results obtained from this experiment, 40% crude protein diet is considered the optimum dietary level for the growth of Catfish (*Heterobranchus longifilis*) fingerlings production in hapa-nets. This result should be basic information extended to fish feed millers and fish hatchery operators. Therefore, 40% crude protein should be formulated as feed for *Heterobranchus longifilis* fingerlings. The use of 40% crude protein diet is highly recommended for catfish *Heterobranchus longifilis)* fingerlings production in net hapa as an effective conventional fish feed composition.

References

1. Adikwu IA. Aquaculture in Nigeria: People constraint. J Fish Tech,1999:1(1):16-27.
2. Aduku AO, Olukosi JO. Management in the Tropics. G.U. Publication, 1991, 52.
3. Abel H, Becker K, Mesko C, Fredrick W. Possibilities of using heat treated full-fast soyabeans in crop feeding. Aquaculture,1984:42:97-108.
4. Aluko PO. Preliminary experiment in Triploidization of C. *gariepinus* by cold and warm shocks. NIFFR Annual Report, 1994.
5. APHA. Standard Method for Examination and Waste Water,15th ed, 1980, 1027-1033.
6. Anonymous. Aquaculture in Africa. Fish Farming, 1985, 28-29.
7. Bruton MN. The breeding biology and early development of *Clarias gariepinus* (Pisces, Clariidae) in Lake Sibaya, South Africa, with a review of breeding in species of subgenus *Clarias* (*Clarias*). Trans 2001 Soc Cond,1979:35:1-45.
8. Copin Y, Lazard J, Oswald M. Orientation, des techniques d’elevage de la Pisciculture artisanale dans le centre-Quest de la Côte d’Ivoire. Euro Aqua. Soci Spec Publ,1993:18:407-419.
9. Dabrowaki J, Kozak B. The use of fish meals as protein source in the diets of grass carp fry. Aquaculture,1979:18:107-114.
10. Dupree HK, Hunner JV. The study of warm water fish farming and progress in fish farming. U.S. Dept. of the Interior, Fish and Wildlife Services. Washington, D.C, 1984, 270.
11. Egwai PC. Yield of the African catfish, *Clarias gariepinus* (Burchell) from a low input homestead, concrete pond. Aquaculture,1986:55:87-91.
12. Eyo AA, editor. Fish nutrition and fish feed tech. Chemical composition and amino acid content of the commonly available feedstuffs used in fish feeds in Nigeria, 2001, 14-25.
13. Eyo AA. Fish feeds and feeding practices in Nigeria. In: Report of National Aquaculture Diagnostic Survey (May-June 1994). NIFFR. New Bussa, 1995, 41-51.
14. FAO. Fish feed and rearing in developing countries. An interim report on the ADCP feed development programme. FAO: Rome, 1993, 8700.
15. Falaye AE. Utilization of agro-industrial wastes as fish feed stuffs in Nigeria. In: Eyo AA, Balogun AM, editors. Proc of the Annual Conf of the Fish Soc of Nigeria: 1992 Nov 16-20: Abeokuta, 47-57.
16. Fagbenro OA. Food composition and digestive enzymes in the gut of pond-cultured *Clarias* isheriensis (Sydenham, 1980), (Siluriformes: Claridae). J Appl Ichthyol,1990:6:91-98.
17. Haylor G. Some aspects of the biology and culture of African Catfish *Clarias gariepinus* with particular references to developing African countries. In: Recent advances in Aquaculture. Vol. IV. Robert RJ, Muir JF, editors. Blackwell Scientific Publication: Oxford, 1992, 60-65.
18. Husma EA, Richer CJ. Reproduction, growth, health, control and aquaculture potentials of African Catfish *Clarias gariepinus* (Burchell 1922). Neth J Agric Sci,1987:35(1):63-66.
19. Huisman EA, Richter CJ. Reproduction growth heat control and aquaculture potential of African Catfish, C. gariepinus (Burchell, 1922). Aquaculture,1987:63:1-14.
20. Husaman EA, Richter CJJ. Reproduction, growth, health, control and aquaculture potentials of African Catfish *Clarias gariepinus* (Burchell 1922). Neth J Agric Sci,1987:35(1):63-66.
21. Kolo RJ, Yisa M. Preliminary impact assessment of fertilizer from Morris Fertilizer Company on the water quality of the River Suka. J Fish Tech,2000:2:91-106.
22. Legendere M. Seasonal changes in sexual maturity and fecundity H.O. Induced breeding of catfish *Heterobranchus longifilis*. Aquaculture,1986:55:207-213.
23. Levell RT. Status of penaid shrimp nutrition and feed practices. Aquaculture,1982:18:107-114.
24. Levell RT, Stickney RR. Nutrition and feeding of channel catfish. 80 Coop Bull.
25. Oladusu GA, Ayinla OA, Adeyemo AA, Yakubu AF, Ajani AA. Comparative study of the reproductive capacity of the African Catfish species Heterobranchus bidorsalis (Geoffrey), *Clarias gariepinus* (Burchell) and their hybrids. NIOMR Technical Paper No. 92, 1994.
26. Nwadukwe FO. Analysis of producing yearly growth and survival of *Clarias gariepinus* (B) and *Heterobranchus longifilis* (v) (Pisces: Clariidae) and their E.L. hybrids in pond. Netherland J Ecol,1995:29(2):177-182.
27. Okoye FC, Opeloyeru G, Mohammed N. Polyculture of *Clarias gariepinus* and *Oreochromis niloticus* in earthen ponds at various stocking densities using pelleted feed. NIFFR Annual Report, 1997, 50.
28. Olasebikan BD, Raji A. Field guide on Nigeria Freshwater Fishes,2nd ed. Unilorin Press, 2004, 52.
29. Olatunde JO. Length-weight relationship and diet of *Clarias lazera* (C&V) in Zaria. 3rd Annual Conference of Fisheries Society of Nigeria (FISON): 1983 Feb 22-25: Maiduguri, 183-192.
30. Olowyeye JA. Preliminary investigation on source aspects of the biology of *Heterobranchus longifilis*.
31. Olufeagba SO. Induced triploid *Heterobranchus longifilis* and its aquacultural potentials. Unpublished Ph.D. thesis, University of Ilorin, 1999, 166.
32. Otubusin SO, Bello SH, Mbonw CG. The effect of stocking density on Tilapia production in floating bamboo net-cages. NIFFR Annual Report, 1988, 138.
33. Reed W, Burchard AJ, Hapson J, Henes Y, Yaro. Fish and fisheries of Northern Nigeria. Ministry of Agriculture, Northern Nigeria Fisheries, 1967, 1st ed, 226.
34. Salam AA, Fagbenro OA, Sydrenhen DHJ. The production and growth of clariidae catfish hybrids in

concrete tanks. The Israel Journal of Aquaculture,1993:45(1):18-25.
35. Steel RG, Torrie JH. Principles and procedures of statistics. New York: McGraw-Hill Book Company, 1980, 663.
36. Teugel GG. A systematic revision of the African species of the genus *Clarias* (Pisces: Claridae). Kominklijk Museum Voor Midden-Afrika: Tervuren, Belgium, 1986, 255.
37. Teugel GG. Preliminary results of morphological study of five African species of the subgenus *Clarias* (*Clarias*) (Pisces: Clariidae). Nat Hist,1982:16:439-464.
38. Welman JB. Preliminary survey of the freshwater fisheries of Nigeria. Government Printers: Lagos, 1948, 42.
39. Wonah CO. Effect of stocking density on growth and survival of exotic *Clarias gariepinus* (Burchell 1992) fry in outdoor concrete nursery ponds. HND dissertation, FCFFT: New Bussa, Niger State, 1996.