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GROWTH RESPONSE OF *Heterobranchus Bidorsalis* POST FINGERLINGS FED VARIOUS DIETARY PROTEIN AND ENERGY LEVELS

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ABSTRACT

A feeding trial of four dietary crude protein levels (25, 30, 35 and 40%) at two digestible energy levels (2800 and 3000kcal/kg diets) factorial design with three replicates was conducted to determine the appropriate dietary protein and energy levels for the growth response of *Heterobranchus bidorsalis* post fingerlings sourced from Molly Ventures, Ikorodu, Lagos State. Fish were fed the experimental diets for 70 days. Proximate analysis was performed on feed and fish carcass. Data collected from feeding trials were analysed using GenStat Software Twelfth Edition in a two way ANOVA test. All the means were compared at 5% level of probability with Duncan's multiple range tests. Total weight gain of fish fed 40% crude protein diets with 3000kcal/kg diet was significantly ($P < 0.05$) higher than that of fish fed with other diets. Diet containing 40% protein level and 3000kcal/kg energy level appeared to be utilized more efficiently in term of feed Conversion Ratio (1.14) than diets containing other dietary protein and digestible energy levels, ranging 1.55 – 4.94. The results of this study indicate that a diet containing 40% dietary protein and 3000kcal/kg digestible energy level is recommended for post fingerlings of *H. bidorsalis* growth.

Keywords: Clariid catfish, fingerlings, optimum energy, protein levels, fish diet.

INTRODUCTION

In the recent years, world consumption of fish has increased simultaneously with the growing concern of their nutritional and therapeutic benefits. It provides superior quality protein compare to that of meat, milk and eggs and well balanced essential amino acid profile (Hossain, 1996). It has rich contents of essential minerals, vitamins. Fish flesh is tasty and highly digestible, it minimizes the risk of heart diseases and increases life expectancy (Ashraf *et al.,* 2011). The American Heart Association recommended eating fish at least twice per week in order to attain the daily intake of omega-3-fatty acids (El-Moselhy *et al.,* 2014).

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Aquaculture practices in Nigeria have been identified as one of the tools that can help in closing the gap between demand and supply of fish and fisheries products (Owodeinde and Ndimele, 2011). This is particularly important in the culture of acceptable fish species (*Clarias gariepinus* and *Heterobranchus species*) in commercial quantities (Ndome*et al*., 2011). The clariid catfishes constitute an excellent food fish of high commercial value in Nigeria and some other tropical countries of the world (Huda *et al.,* 2002). *Heterobranchus bidorsalis* is one of the two main genera of the African mud catfish (*Clarias* and *Heterobranchus*) widely cultured in Africa, Asia and Europe (Adewolu and Adoti, 2010). This is due to their outstanding culture characteristics such as ability to withstand unfavorable environmental conditions, efficient in utilizing various types of locally formulated fish feed, resistance to diseases, high economic potential and simple techniques in the propagation of their fingerlings (Owodeinde and Ndimele, 2011).

The purpose of this study is to ascertain the optimum growth and utilization responses to crude protein and caloric variation of *Heterobranchus bidorsalis* post fingerlings

MATERIALS AND METHODS

Feeding trials were conducted to determine the optimum protein and digestible energy levels for the Clariid catfish post fingerings using *Heterobranchus bidosarlis*.

Experimental Diets

Eight (8) diets were used for the feeding trials. This experiment comprising of four protein levels (25, 30, 35 and 40C%P) by two energy levels (2800 and 3000Kcal/kg) diets. The layout of the dietary treatment is shown in Table 1.

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Table 1: Gross Composition of Experimental Diets (%)

INGREDIENTS	DIETS							
	1	2	3	4	5	6	7	8
Yellow maize(9.5% CP)	24.79	22.29	19.79	19.79	20.44	17.44	13.44	10.94
Fish meal (65.5 % CP)	7.00	7.00	14.50	14.50	21.40	21.40	26.40	26.40
Soyabean meal(44.0% CP)	16.77	16.77	18.77	18.77	20.20	20.20	24.20	24.20
Brewer's yeast (50% CP)	12.77	12.77	14.77	14.77	16.40	16.40	18.10	18.10
Wheat bran (12.5% CP)	27.58	27.58	22.58	22.58	14.10	14.10	14.40	14.10
Palm oil	7.63	10.13	6.13	8.13	4.00	7.00	0.00	2.50
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Vitamin premix	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Vitamin E	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

Each diet constituted a treatment. The details of nutrient composition of feedstuffs of experimental diets and proximate analysis are shown in Table 2.

In preparing the diets, ingredients were milled, mixed and prepared as described by Martinez-Palacios *et al*, (1996). The milled ingredients were sieved through standard sieve Nos. 16 and 20 (maximum of 1.19mm). The homogenous feed mixes were processed into pellets or granules (2 mm) with gelatinized corn starch component as the binder. After preparation, pelleted diets were oven-dried at 70^0c for 24 hours. Feed samples were stored in polythene bags in cupboard at laboratory temperature. Dried granules of feed samples were taken for proximate analysis. All ingredients were locally sourced for the trial conducted.

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Table 2: Proximate Composition of Experimental Diets (on as-fed basis)

DIETS	%MC	%ASH	%EE(FAT)	%FIBER	%CP	%NFE
1	9.720	8.216	21.133	4.570	39.666	16.690
2	5.263	9.350	17.523	3.216	37.916	26.730
3	4.750	8.756	18.130	4.223	56. 583	7.556
4	5.000	10.200	17.000	4.000	51.333	12.466
5	5.213	9.210	17.250	4.523	60.666	3.136
6	4.526	10.323	18.310	3.473	61.833	1.533
7	5.353	8.776	12.246	3.440	46.666	17.516
8	5.000	9.756	17.756	4.213	39.666	23.690

There were four trials, one trial for each type of feed. Glass tank was used for the trials. Each tank was connected to a central aerator. Water supplied by the university of Benin Campus domestic water services was maintained at 35 litre mark/level throughout the experiment. Fingerings were fed test diets twice daily during daylight (9:30 am and 4:00pm). At each time of feeding, animals were fed to satiation i.e. hand fed access to food, during which diet was provided in small amount at a time, so that the fish will eat nearly all the diet offered. Water temperature was measured twice daily during feeding. Dissolved oxygen (DO) was measured once a week using Winkler's method. Daily observations were made to detect any abnormality and fish mortality. Unconsumed diets and faecal wastes were removed by siphoning daily. Each trial lasted 70days. Weight of fish per treatment and per replicate was recorded weekly. Weight of food consumed by fish was also recorded weekly for each replicate. In order to obtain the weights of the fish, fish were batch weighted in a dish containing pre-weighed water.

Heterobranchus bidosarlis fingerlings were obtained from outdoor fish tanks of the Department of Fisheries, University of Benin, Benin city

Carcass Analysis

All the diets and carcasses were subjected to proximate analysis at the end of the trials. Crude protein (N X 6.25) was determined by the micro-kjeldahl method and crude fibre (CF) was by

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the system based on acid-alkaline digestion. Lipids, ash and moisture were determined using standard methods in triplicate.

Growth and Nutrient Utilization indices

Weights of fish and feed consumption were obtained at weekly intervals. From the fish weights and feed consumption, the following were determined:

Weight gain = $W_1 - W_0$ (g)

Relative Weight Gain (RWG%)=$(W_1 - W_0) / W_0 \times 100$ (%)

Specific Growth Rate (SGR %)= $\{(\text{In } W_1 - \text{In } W_0)/ T\} \times 100$ (%/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)= feed intake (g) / wet weight gain (g)

Protein efficiency ratio (PER)= weight gain (g) / protein intake (g)

Net protein utilization (NPU)= $\{(BP_1 - BP_0)/ CP\} \times 100$

Where;

BP_0: Initial body protein content (g)

BP_1: Final body protein content (g)

CP: Protein intake (g)

Statistical Analysis

At the end of the experiments, recorded data were subjected to two-way ANOVA test using a Genstat software eight edition, 2005 package for statistical problems. All the means we're compared at 5% level of probability with Duncan multiple range tests. Similarly, responsiveness of fingerlings to treatments was evaluated.

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RESULT

The results obtained for *Heterobranchus bidorsalis* post fingerlings were summarized in Table 8. The various fish fed with these various treatments based on total weekly weight are significantly different ($p<0.05$). The highest total weight gain was achieved at 40%CP, 3000DE next by 40%CP, 2800kcal/kg DE while the minimum value was at 30%CP, 3000DE. The results show that 40%CP with DE 3000kcal/kg was significantly different from all other treatments, so also 35%CP, 3000DE. 35%CP, 2800DE and 40%CP, 2800DE were not significantly different ($p>0.05$). 25% and 30%CP through both DE levels were also not significantly different from each other.

The highest SGR is obtained at 35%CP with 2800DE and the lowest at 30%CP, 3000DE. There was no significant difference between 25%CP and 30%CP at both energy levels (2800 and 3000DE). Also at 40%CP, 2800DE with 35%CP, 3000DE and at 35%CP, 2800DE with 40%CP, 3000DE. Other parameters such as TWG and RWG had their highest value obtained at 40%CP with 3000DE and the lowest value constantly achieved for TWG, SGR, RWG at 30%CP with 3000DE. There is an increase in the RWG across the crude protein levels except at 40%CP with 2800DE and 30% with 3000DE. Ranking the various responsiveness of the fishes fed with these various diets, each diet maintained the same position as regards TWG and SGR but different at RWG.

Table 8: Effects of dietary protein and energy levels on the growth performance and feed utilization by post fingerlings of *Heterobranchus bidorsalis*.

Dietary treatments	TWG	SGR	RWG	FEED INTAKE	FCR	PER	NPU
2800kcal/kg diet							
25% protein	10.16^{a}	1.15^{a}	7.67^{a}	23.18^{a}	1.78^{a}	1.53^{ab}	63.42^{cd}
30% protein	12.57^{a}	1.30^{ab}	9.79^{ab}	25.10^{a}	2.70^{ab}	1.84^{b}	19.86^{ab}
35% protein	16.41^{bc}	1.71^{c}	12.92^{c}	29.57^{b}	1.93^{ab}	1.66^{ab}	26.98^{b}
40% protein	16.54^{bc}	1.49^{bc}	12.20^{bc}	23.48^{a}	1.55^{a}	1.71^{b}	78.79^{d}
3000kcal/kg							
25% protein	12.07^{a}	1.20^{ab}	9.80^{ab}	25.56^{a}	3.69^{ab}	1.94^{b}	10.37^{a}

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30% protein	9.77^{a}	1.12^{a}	8.50^{a}	24.23^{a}	4.94^{b}	1.20^{a}	50.53^{c}
35% protein	15.93^{b}	1.50^{bc}	11.22^{bc}	24.51^{a}	2.30^{ab}	1.81^{b}	52.44^{c}
40% protein	19.11^{c}	1.71^{c}	13.44^{c}	23.97^{a}	1.14^{a}	1.87^{b}	66.83^{cd}
SEM	1.32	0.14	1.20	1.21	1.39	0.24	7.72

N.B: Values with the same superscript on the same column are significantly different ($p<0.05$).

TWG: Total weight gain (g)

SGR: Specific growth rate (% per day)

RWG: Relative weight gain (%)

FCR: Feed conversion ratio

PER: Protein Efficiency ratio

NPU: Net Protein Utilization (%)

DE: Digestible energy (kcal/kg)

DISCUSSION

The experimental diet of 40%CP at digestible energy level of 3000kcal/kg had the highest total weight gain (TWG), specific growth rate (SGR) and relative weight gain (RWG). Increasing the protein content gradually improves fish growth. Under the experimental conditions, fish fed with diet containing 40% protein had high growth with low food intake and feed conversion ratio of 1.14. This indicated the capacity of this species to accept and utilize compounded diet as reported by Jamabo and Alfred-Ockiya (2008).

The feed conversion ratio of 1.14 obtained in this study was close to that observed (1.28) in *Clarias gariepinus* of 6.37g weight fed with 40% protein and 13.76% fat (palm oil) (Sotolu, 2010). Jamabo and Alfred-Ockiya (2008) reported that the growth rate and weight gain increased progressively with dietary protein level to a maximum at 40% in *Heterobranchus bidorsalis*. Jana *et al.,* (2006) also reported high growth in terms of live weight gain and specific growth rate in milkfish (*Chanoschanos*) fry fed at 40% protein level. For juveniles of *H. longifilis* (15g), the optimal growth was obtained when the protein content range from 33.5 to 60.7% (Kerdchuen,

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1992), while Degani *et al.*, (1989) showed that among the tested diets (23 to 40% protein) in *Clarias gariepinus* (10 to 12g), the high growth rate was obtained in the diet containing 40% protein. In *Heteropneutres fossilis* fingerlings of 0.8g weight, the optimal growth was observed when the diets contained 27.7 to 35.4% protein (Akand *et al.,* 1989). In addition, Alatise *et al.,* (2005) reported that catfish fingerlings (8.34g) fed with 40% protein gave the best growth (SGR: 1.06% day^{-2} and FCR: 0.62). Inter specific differences noted, however, can partly be explained by the variety of methodologies used (feed formulation and feeding rate tests).

This work is also in conformity with Suphada and Anut (2012) which evaluates the growth, feed utilization, survival and body composition of fingerlings of Slender walking catfish (*Clarias nieuhofii*) fed diets containing different protein levels, at the end of the experiment body weight, weight gain, and specific growth rate increased as dietary protein level was increased from 32% to 40% protein. Nwanna *et al*., (2014) in his results also suggested the protein requirement of fish to be above 35% and about 40%. Fagbenro *et al*. (1992) reported the protein requirement of *Heterobranchus bidorsalis* as 40%. Adebayo (2005) reported the maximum growth performance of hybrid catfish (*Clarias gariepinus*× *Heterobranchus bidorsalis*) fingerlings in the fish fed 40% protein diet with 5% feeding rate daily which also support my findings during the course of this work.

Hossain *et al.,* (2012) also worked on optimum dietary protein requirement of a Thai Strain of Climbing Perch, *Anabas testudineus*, fry. In the study, weight gain of *A. testudineus* increased at increasing protein levels of (25-40%) and decreased when the protein level further increased to 45-50%. Based on the weight gain, SGR, feed and protein efficiency of *A. testudineus* observed in the study, a diet with 40% protein with a protein to energy ratio of 92.63 is recommended for maximum growth of *A. testudineus*.

Energy requirements for catfish, which have generally been expressed as a ratio of digestible energy (DE) to crude protein (DE/P), range from 31.0 to 50.2 kJ/g. The best diet of this work having a protein to energy ratio of 40%CP to 3000Kcal/kg digestible energy which is 7.5kcal/g falls between the range of 7.4 – 12kcal/g as reported by Robinson and Li (2007) is adequate for use in commercial catfish feeds. Above this rate will lead to fat deposition while below this rate will cause slow growth rate of fish (Nematipour *et al.,* 1992).

On the other hand, insufficient dietary protein levels resulted in poor growth performance in many fish species (Kim and Lee, 2005) due to insufficiency of amino acids supplied to maintain the body composition (Halver and Hardy, 2002). In view of the results obtained in this work, it is obvious that *H. bidorsalis* fingerlings performed best when fed on 40% crude protein diet. It is believed that a compounded diet of 40% crude protein would provide nutrients that will ensure

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optimum growth of *H. bidorsalis* in production systems without natural food. The results of this experiment therefore could provide useful assistance to fish farmers especially in the culture and management of *H. bidorsalis.*

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