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DIETARY PROTEIN REQUIREMENTS AND GROWTH PERFORMANCE OF *CLARIAS GARIEPINUS* (BURCHELL, 1822) FINGERLINGS

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ABSTRACT

Fingerlings of *Clarias gariepinus* were fed six isocaloric diets at different crude protein levels at 5% of body weight to determine the growth and survival of the species. Growth rate and weight gain increased progressively with dietary protein level to a maximum at 35%. Significant differences ($p<0.05$) were recorded for the growth indices, weight gain and average daily growth rate. Nutrient utilization parameters had variable results among the treatments. There was no significant difference ($p> 0.01$) in apparent feed conversion ratio, but the nitrogen metabolism showed significant variations. The results obtained indicated that fish fed 35% crude protein diet performed best in weight gain, food conversion ratio and nitrogen metabolism.

KEYWORDS: Dietary protein, growth performance, *Clarias gariepinus*

INTRODUCTION

With the increase intensification of cat fish culture in Nigeria, it has become necessary to provide an adequately well balanced ratio to meet their nutrient requirements. Dietary protein is used by fish for growth, energy and maintenance (Kaushik and Medale, 1994). Protein requirement for maximum growth of any species is a logical step to the development of a cost-effective feed for the fish, and entails determining the minimum amount required to produce maximum growth (Sang-Min and Tae-Jun (2005). Hence, any reduction in dietary protein level without affecting fish growth can substantially reduce the cost of feed.

The production of fast- growing fingerlings is very vital for the development of a viable aquaculture venture. African walking catfish *Clarias gariepinus* is a successful aquaculture species in Nigeria. The species is widely accepted by fish farmers and consumers because of its taste, fast growth rate and moderate price.

Although a lot of studies have been carried out in its nutritional requirements on this species nation wide, (Faturoti *et al*; 1986 and Akegbejo-Samsons; 1999) but owing to its popularity in the Niger Delta, there is need to complement existing knowledge. This study was therefore designed to investigate the dietary protein requirement and growth performance of *Clarias gariepinus* fingerlings with a view of complementing existing information to assist fish farmers.

MATERIALS AND METHODS

Six isocalorific diets were formulated at different crude protein levels, 20, 25, 30, 35, 40 and 45% (Table 1) for the experiment. The various ingredients were mixed and pelleted with a manual meat mincer and then air dried. The fingerlings used for the experiment were procured from Jay-Ess Consultants fish farm in Port Harcourt Rivers State. Individuals of fairly uniform size (cm) and initial body weight of 0.60grams were used. The feeding trials were conducted in aquarium tanks with a dimension of $62.5x29.5x30cm^3$ supplied with aerated water. Ten fingerlings of the species were weighed and stocked in each tank in three replicates.

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Table 1: Composition of experimental diets

	(% Crude protein)					
	20	25	30	35	40	45
Fish meal	8.61	10.77	13.89	17.02	20.15	23.27
Shrimp meal	9.46	10.18	15.61	16.54	19.72	21.85
Soya bean meal	12.50	14.35	21.39	24.46	26.85	28.15
Yellow maize	34.74	33.05	20.69	19.32	15.74	11.60
Vitamin premix	0.60	0.60	0.60	0.60	0.60	0.60
Rice bran	27.82	24.75	20.76	15.75	10.73	8.65
Vegetable oil	5.00	5.00	5.00	5.00	5.00	5.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Starch(Binder)	1.00	1.00	1.00	1.00	1.00	1.00
Proximate Composition (% Dry Matter)*						
Crude protein (%)	20.27	25.61	31.07	36.82	42.15	46.87
Crude fibre (%)	8.21	8.46	8.06	7.28	8.36	8.48
NFE	41.32	38.73	35.65	32.30	25.16	22.76
Ash (%)	22.75	19.64	18.73	18.24	19.54	16.74
Crude lipid (%)	7.45	7.56	6.49	5.36	4.79	5.15

The experimental fish were fed their respective diets at 5% body weight per day. The daily ration was split into two and dispensed at 0900hrs and 1600hrs. The fish in each aquaria tank was batch-weighed fortnightly and from the data the quantity of feed to be dispensed was adjusted to reflect the new weight. During this period undigested food particles and waste products were siphoned out with rubber hose daily. The experiment lasted for 12 weeks after which the fish were individually measured for standard length and weight. Thereafter growth indices and nutrient utilization parameters were calculated for each treatment. (Weight gain, specific growth rate, apparent feed conversion ratio, apparent protein efficiency ratio, nitrogen metabolism). The indices were calculated using the following formulae:

Weight gain = Final average weight – initial average weight

$$\text{Specific growth rate} = \frac{\text{Loge } W_2 - \text{Loge } W_1 \times 100}{T}$$

W_2 = Final body weight W_1 = Initial body weight of fish T = duration of study in days.

$$\text{Average daily growth rate} = \frac{\text{Average Wt gain (g)}}{T \text{ (days)}}$$

$$\text{Apparent feed conversion ratio} = \frac{\text{Wt of dry feed dispensed}}{\text{Live weight gained}}$$

$$\text{Apparent protein efficiency ratio} = \frac{\text{Wt gain (g)}}{\text{Apparent Protein intake}}$$

$$\text{Nitrogen metabolism} = \frac{(0.54)(b-a)h}{2}$$

a = initial weight, b = final wt, h = experimental period (days)
0.54 = experimental constant.

The results of the feeding trial were statistically analysed using the one-way analysis of variance (ANOVA). The Duncan' multiple range test (Duncan, 1955) was also used in separating the means.

Table 2: Summary of physico-chemical parameters

Parameters	Initial reading	Final reading	Mean
Temperature (^{o}C)	26.00	27.00	26.2 ± 0.4
pH	6.97	7.45	7.1 ±0.2
Dissolved oxygen (mg/l)	5.19	5.82	5.47± 0.4

Table 3: Growth Performance and Nutrient utilization of *C. gariepinus* Fingerlings Fed at Different Crude Protein Level (*Treatments with the same superscripts are not significantly different)

Parameters	**% Crude protein**					
	20	25	30	35	40	45
Mean initial body weight (g)	0.60	0.60	0.60	0.60	0.60	0.60
Mean final body weight (g)	1.31^{a}	1.52^{a}	1.90^{ab}	2.20^{a}	1.96^{b}	1.78^{a}
Mean weight gain (g)	0.71^{a}	0.92^{a}	1.30^{ab}	1.60^{a}	1.36^{b}	1.18^{a}
Specific growth rate	0.27^{a}	0.38^{a}	0.47^{a}	0.59^{a}	0.49^{a}	0.42^{a}
Apparent feed conversion ratio	2.46^{a}	2.60^{a}	2.79^{a}	2.93^{a}	2.58^{a}	2.41^{a}
Apparent protein efficiency ratio	1.19^{b}	1.07^{ab}	0.99^{a}	0.96^{a}	0.84^{b}	0.71^{a}
Nitrogen metabolism	106.96^{b}	116.14^{bc}	122.25^{a}	147.54^{b}	112.93^{a}	103.18^{c}

The regression line of the best fit for predicting or defining the protein requirement of the fish was computed using quadratic model (SAS software) and found to be 35%.

RESULTS

The results of the physico-chemical parameters are shown in Table 2. The mean temperature value was 26.22 ± 0.4^{o}C; mean pH was 7.1 ± 0.2 and mean dissolved oxygen value was 5.47 ± 0.4 mg/l. The summary of growth responses is presented in Table 3. The results show significant differences among treatments in the growth indices-weight gain. Mean weight gain increases as protein level increases to a maximum of 1.60 at 35% protein, thereafter decreased to 1.18 when protein level was 45%.

Specific growth rate follows the same trend, it increases as protein level increased to a maximum of 0.59 when protein was 35% and decreased to 0.42 when protein level was 45%. However, the values for the apparent protein efficiency ratio decreases as protein level increased from 1.19 to 0.71 when protein was 45%. Feed conversion ratio showed no significant statistical variation among the treatments. However, *Clarias gariepinus* fingerlings fed with 35% crude protein diet performed significantly better (P > 0.05) than fish fed at lower or higher protein level diets.

DISCUSSION

The mean water quality parameters values observed (temperature, DO, pH) i.e. 26.22^{0}C, 5.47mg/l and 7.10 are within the recommended range for effective fish culture (Boyd and Lichtkoppler, 1979, Viveen et al. 1985). Also the recorded increasing growth rate and nutrient utilization values with increase protein level are similar to the observations of Faturoti *et. al.* (1986) for *Clarias lazera* fingerlings, Obasa and Faturoti (2000) for *C. walkeri* and Erondu *et. al.* (2006) for *Chrysicthys nigrodigitatus*.

The dietary protein requirement of *C. gariepinus* from the study on the growth and nutrient utilization indices from the quadratic regression is 35%. This is in conformity with EIFAC standards on fish nutrition studies. This structure specifies that the optimal nutrient requirement of fish should be determined at the maximal possible rates of growth using polynomial regression analysis. The decline in growth performance protein level at above 35% can be attributed to the fact that beyond that limit, the fish body cannot use all of the available protein for protein purposes after the optimum level has been reached (Phillips, 1972). Akegbejo-Samsons (1999) reported that excess protein could reduce growth performance due to energy requirement for metabolism, rather for protein deposition. These postulations are applicable to the results of the present study as all the diets were isocaloric.

The low food conversion ratio values in all the treatments are indicative of the capability of this species to accept and utilize compounded diets as reported by Faturoti *et. al*. (1986) in a related study. The higher protein efficiency ration and nitrogen metabolism followed the same trend as the growth indices. Protein was more efficiently utilized by *C gariepinus* at 35% crude protein level than others. This trend is in tandem with results observed by Degani *et al*. (1989) on *C. lazera*.

In view of the results obtained in this work, it is obvious that *C. gariepinus* fingerlings performed best when fed on 35% crude protein diet. It is believed that a compounded diet of 35% crude protein would provide nutrients that will ensure maximum growth of *C. gariepinus* in production systems without natural food. The results of the present study could provide useful assistance to fish farmers especially in the production of *C. gariepinus*.

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