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GROWTH AND NUTRIENT UTILIZATION OF VARYING LEVELS OF TOASTED BAMBARA NUT (*VOANDZEIA SUBTERVANEA*) BASED DIETS FOR *CLARIAS GARIEPINUS* FINGERLINGS

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ABSTRACT

Growth performance of *Clarias gariepinus* fingerlings fed with isonitrogenous diets containing varying graded levels of bambara nut based diets at 0%, 10%; 20%; 30% and 40% inclusion levels were investigated. The five (5) experimental diets were formulated at 40% crude protein and were fed to the fingerlings for a period of 56 days. The fingerlings were fed at 5% body weight twice daily at 10.00hrs and 16.00hr. Each hapa was stock with 20 fingerlings of mean weight 11.60 ± 0.11g and each treatment was duplicated. Evaluation of growth and nutrient utilization parameters monitored differed significantly (P<0.05) for mean weight gain (MWG); specific growth rate (SGR), food conversion ratio (FCR); protein efficiency ratio (PER) and apparent net protein utilization (ANPU). Fish fed diet (T_3) had the highest MWG, SGR, PER, ANPU and lowest FRC, while those fed diet (T_5) responded poorly in terms of growth. The results obtained from this study suggests that toasted bambara nut incorporated at 20% inclusion level had the best growth while at 40% resulted in poor growth. This is indicative that at higher levels of incorporation, fish being a non-ruminant may not be able to digest and utilize the bambara nut meal. This may also be attributable to the fact that digestibility of energy feed is affected not only by the source and nature of the carbohydrate feed but also the level of its incorporation.

KEYWORD: Growth performance, Nutrient utilization, Bambara nut, *Clarias gariepinus*, Fingerlings.

INTRODUCTION

Every living organism including fish requires food for growth, reproduction and maintenance. To sustain fish under culture especially in high density culture systems, the importance of artificial feed supplementation cannot be over-emphasized if the three basic functions of growth, reproduction and maintenance of fish is to be met. Fish requires a higher percentage of protein in their diet than do most warm blooded animals. However, high quality protein of animal origin is often scarce and when available is beyond the reach of most fish farmer. It is in this light that there is a quest in aquaculture nutrition to source for plant protein which has nutritional qualities. Soybeans have been extensively studied in its processing techniques, and used to replace fish meal in aquaculture nutrition (Sadiku and Jauncey, 1995, Tiamiyu *et al.*, 2003).

As the search for alternative sources of plant protein continues, there is need to explore the potentials of other leguminous plants that are native to Africa such as Bambara ground nut *Voandzeia substervanea* (L) Thouars. Bambara groundnut is believed to be native to North East Nigeria and Northern Cameroun (Dalziel, 1937). The habit of eating this seed in these areas had been relegated to the background with the advent of groundnut, cowpea and soybean which are higher in crude protein and are equally high-yielding (Joseph *et al.*, 2000). However, bambara nut could play a dual role as protein and energy source.

Extensive work has been done on its composition, nutritional and biochemical properties (Balogun, 1984; Nwokolo, 1987; Apata and Ologhobo, 1994). These workers have shown that bambara nut ranged in crude protein between 17.3 and 22.9%; ether extract 5.7 to 7.0%; Ash 3.4 – 5.2%; nitrogen free extract 60.4 to 66.0% depending on the variety. Bambara nut seeds are virtually free from metabolic inhibitors and toxins a common phenomenon in most legume seeds (Joseph *et al*, 2000). The high fibre content of bambara nut amounting to about 13.66% had been reported by Oyenuga, (1968). With a seed of this potential, its use in fish feed is of great importance. This study was therefore designed to investigate the varying levels of inclusion of toasted bambara nut meal that will best support the growth of *Clarias gariepius* fingerlings.

MATERIALS AND METHODS

The feed ingredients including the bambara groundnut seeds were locally sourced from Wurukum market in Makurdi, Benue State. The bambara nut seeds and soybean were toasted to remove anti-nutritional factors. Five isonitrogenous diets were formulated at 40% crude protein with varying levels of the test ingredient (bambara nut seeds) at 0, 10, 20, 30 and 40% for Diets 1 to 5 respectively. The diets were pelleted using a Bohr-mill pelleting machine. They were sun dried and stored in polythene bag kept in a deep freezer until they were required for use.

Two hundred (200) *Clarias gariepinus* fingerlings of mean weight 11.60±0.11g were obtained from fish hatchery. They were acclimatized by holding them for 5 days in a plastic trough in the laboratory. Thereafter, 20 fingerlings were randomly allotted into the hapas of 1m^3. The hapa were submerged in a pond using Kuralyon rope with about ⅔ of its size immersed in water. The dietary treatments were completely randomized and each replicated. This fish were fed at 5% body weight, twice daily at 10.00hr and 16.00hr (Eyo, 1999).

Batch weighing of 20 fingerlings per hapa was carried out weekly and the feed ration adjusted based on their weekly body weight for a period of 8 weeks. The experimental diets and carcass were analysed for proximate composition according to AOAC (1990).

The biological parameters measured were subjected to analysis of variance (ANOVA) by Steel and Torrie, (1980), and mean comparison were according to Duncan (1955). Biological parameters were computed as follows:

(i) **Mean Weight Gain (MWG)** This was computed as the difference between initial and final mean weight values of fish in each hapa.

(ii) **Specific Growth Rate (SGR)** This was computed according to Brown (1957).

$$SGR = \frac{L_n(\text{Mean Final Weight}) - L_n(\text{Mean Initial Weight}) \times 100}{\text{Time (days)}}$$

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while L_n = natural logarithm.

(iii) **Food Conversion Ratio (FCR)** – was computed as

$$FCR = \frac{\text{Weight of Food Fed}}{\text{Weight gain of fish.}}$$

(iv) **Protein Efficiency Ratio (PER)** - Computed according to Osborne *et al.*, (1919) as

$$PER = \frac{\text{Weight gain of fish}}{\text{Protein fed.}}$$

(v) **Apparent Net Protein Utilization (ANPU)** – Computed as

$$ANPU = \frac{100 \times \text{Carcass Protein gain}}{\text{Protein Fed.}}$$

RESULTS

Table 1 shows the leveis of inclusion of various ingredients used in the study. Most especially the test ingredients of toasted bambara nut inclusion varying from 0% in diet (DT_1) to 40% in diet (DT_5). Similarly, the proximate composition of the experimental diets is shown in Table 1. The results of the proximate composition revealed that all the experimental diets met the target specification of 40% crude protein as the requirement for *Clarias gariepinus*. The moisture content of the diets ranged between 6.20 to 8%. The crude fibre content ranged between 14.10 to 16.85%. It increased with increase in level of inclusion of bambara nut. Similarly, the percentage nitrogen free extract (NFE) also increased with increase in the level of toasted bambara nut. Diet (DT_1) had the least (NFE) of 19.27 while Diet (DT_5) had the highest NFE of 24.15%.

Table 2 revealed the growth performance and nutrient utilization of the fish fed the experimental diets. The evaluation of various growth parameters differed significantly ($P<0.05$). The Mean Weight Gain (MWG) differed significantly ($P<0.05$). Fish fed diet (DT_3) had the highest MWG of 7.04g while that of DT_5 had the least of 4.98g. Similarly, the specific growth rate (SGR); food conversion ratio (FCR); protein efficiency ratio (PER); Apparent net protein utilization (ANPU) differed significantly. Fish fed Diet (DT_3) had the highest values for SGR (0.95% day^{-1}); PER (0.47); ANPU (45.99). While fish fed Diet (DT_5) had the least SGR (0.65% day^{-1}); PER (0.33). Conversely fish fed DT_5 had the highest FCR (7.66) while fish fed DT_3 had the least FCR (5.37).

There was no significant difference ($P>0.05$) of percentage survival of fish fed the experimental diet. Table 3, depicts the proximate composition of carcass of the experimental fish. The moisture content ranged between 72 and 74.20%. The highest moisture content was recorded in the initial fish body composition before being fed the experimental diet. The percentage crude protein varied significantly ($P<0.05$). The initial fish body composition had the lowest crude protein of 14.45% while fish fed DT_3 had the highest crude protein of 16.20%. However, the ether extract, crude fibre and nitrogen free extract values differed insignificantly ($P>0.05$).

DISCUSSION

The results of this study indicates that *Clarias gariepinus* grew well when bambara nut seeds were incorporated in the diet formulated at 40% crude protein specification. Similarly, the inclusion of bambara nut seeds at various level of 0%, 10, 20, 30 and 40% in the diet of *Clarias ganepinus* have shown to improve the growth performance and nutrient utilization without any adverse effect. Many workers, Balogun, (1984); Nwokolo, (1987); Apata and Ologhobo, (1994) have reported that bambara nut seed ranged in crude protein between 17.3 and 22.9% depending on the variety and its use in animal feeds are promising because they are virtually free from metabolic inhibitors and toxin, a common phenomenon associated with most leguminous seeds.

In most cases animal nutritionist formulates diets with the aim of meeting the protein requirement with less attention to the energy requirement. Although, no dietary requirement for carbohydrate has been demonstrated in fish (NRC, 1983), it has been suggested that appropriate level of carbohydrate in fish diet should be provided so that protein and lipids will not be catabolised disproportionately for the supply of energy and metabolic intermediate for the synthesis of other biological important compounds (Steffens, 1989).

The growth performance and nutrient utilization of *Clarias gariepinus* fed the experimental diets improved with increase in the level of inclusion with bambara nut meal. However, after 20% inclusion, it resulted in decreased in growth, feed intake and consequently in nutrient utilization. This finding is similar to that reported by Cowey and Sargent (1972) that inclusion of carbohydrates in isoproteinous diet not only produce higher weight gain but also improved PER, and ANPU values in comparison with fish fed carbohydrate free-diets.

Similarly, Kim and Kaushik, (1992) observed that an increase in the proportion of dietary non-protein energy leads to better protein utilization and that the incorporation of digestible carbohydrated may lead to significant protein savings. Thus the incorporation of bambara meal boost the level of energy in the diets. However, the poor growth performance and nutrient utilization of fish fed DT_5 might be because of its high crude fibre content and therefore lower digestibility. This is similar to the views expressed by Al-Ogalley *et al.*, (1996) who reported that the higher the crude fibre content in the diet of fish, the less the feed intake and therefore reduce in growth. Also Popma, (1982) reported that digestibility of energy feed is affected not only by the source and nature of the carbohydrate but also by the level of its incorporation. Stanton, (1968) reported that bambara nut meal has high energy density and that it is an energy giving seed. Perhaps this might have accounted for best growth performance of fish fed diet (DT_3) with 20% inclusion of bambara nut meal while beyond that level it resulted in decrease in growth Similarly, several workers have reported that higher level of inclusion of bambara nut meal led to reduce feed intake because the energy need of the fish will be satisfied with less feed intake (Richard, 1982; Beynen, 1988).

The knowledge of the body composition of fish and factors affecting it allows the assessment of fish health, determination of efficiency of transfer of nutrients from the feed to the fish and thus possibly to predictably modify carcass composition As reported by Shearer, (1994), the data on the body composition of the fish (carcass) has been reported on wet basis. The results of the body composition of fish fed the experimental diets are in accordance with the growth performance. The fish fed diet (DT_3) had the lowest moisture content but highest crude protein. This inverse relation between moisture and crude protein is as earlier reported by Murray *et al.*, 1977

Therefore, the result of the study showed that bambara nut meal incorporated in the diet of *C. gariepinus* at 20% (DT_3) has the best growth performance and nutrient utilization while at 40% (DT_5) resulted in reduced growth and utilization With a seed of this nature that is high in protein (18 – 22%) and equally high in carbohydrate (60%), its utilization in fish feed would be worthwhile especially with increasing cost and scarcity of most conventional animal feedstuff.

Table 1: Percentage Inclusion Levels and Proximate Composition of the Experimental Diets.

Ingredients	Dietary Level of Bambara Nut (%) Diet T_1 %	Diet T_2 10%	Diet T_3 20%	Diet T_4 30%	Diet T_5 40%
Bambara Nut	0	10	20	30	40
Fish meal	38.15	31.63	25.70	20.36	15.61
Soybean meal	22.36	18.54	15.06	11.94	9.15
Yellow Maize	34.50	34.83	34.24	32.70	30.24
Vitamin premix	2.50	2.50	2.50	2.50	2.50
Mineral premix	2.50	2.50	2.50	2.50	2.50
	100.01	100.00		100.00	100.00
Proximate Composition (%)	**Diet T_1**	**Diet T_2**	**Diet T_3**	**Diet T_4**	**Diet T_5**
Moisture	6.20	7.60	7.00	6.80	8.00
Ash	10.20	9.00	8.40	6.40	5.60
Ether Extract	10.60	9.40	8.80	8.40	7.40
Crude Protein	39.63	39.00	39.88	40.00	40.00
Crude Fibre	14.10	14.35	14.75	16.45	16.85
Nitrogen Free Extract	19.27	20.65	21.17	21.95	24.15
	100.00	100.00	100.00	100.00	100.00

Table 2: Growth Performance of *Clarias gariepius* Fed Experimental Diets.

Parameters	DIET TREATMENTS Diet T_1	Diet T_2	Diet T_3	Diet T_4	Diet T_5	± SEM
Mean Initial Weight (g) (MIW)	11.87^a	11.56^a	11.82^a	11.36^a	11.37^a	±0.11
Mean Final Weight (g) (MFW)	18.35^b	18.30^b	20.10^c	18.40^b	16.35^a	±0.59
Mean Weight Gain (g) (MWG)	6.46^b	6.74^b	8.28^d	7.04^c	4.98^a	±0.53
Specific Growth Rate (SGR)	0.77^b	0.82^c	0.95^d	0.86^c	0.65^a	±0.05
Food Conversion Ratio (FCR)	6.33^b	6.11^b	5.37^a	5.83^d	7.66^c	±0.38
Protein Efficiency Ratio (PER)	0.40^b	0.42^b	0.47^b	0.45^c	0.33^a	±0.02
Apparent Net Protein Utilization (ANPU)	43.20^c	38.18^b	45.99^c	34.41^{ab}	23.45^a	±3.94
% Survival	100^a	98^a	100^a	100^a	98^a	±0.01

Means of the data denoted by different superscript in the same row differed significantly ($P<0.05$)

Table 3: Proximate Composition of Fish Carcass Fed the Experimental Diets.

Parameters	Initial Fish Body Composition	Diet T_1	Diet T_2	Diet T_3	Diet T_4	Diet T_5	± SEM
Moisture	74.20^a	72.50^a	72.84^a	72.10^a	72.45^a	73.00^a	±0.20
Ash	4.25^a	4.60^a	4.50^a	4.50^a	5.00^a	4.25^a	±0.25
**Crude Protein	14.45^a	15.50^{ab}	15.76^{ab}	16.20^t	15.00^{at}	15.25^{ab}	±0.15
Ether Extract	4.47^a	5.00^a	4.50^a	5.00^a	5.10^a	5.10^a	±0.20
Crude Fibre	2.20^a	2.00^a	2.10^a	2.00^a	2.20^a	2.00^c	±0.10
*Nitrogen Free Extract	0.43^a	0.40^a	0.30^a	0.20^a	0.25^a	0.40^a	±0.05
	100.00	100.00	100.00	100.00	100.00	100.00	

*Determined by difference.

**Means of the data denoted by different superscript in the same row differed significantly ($P<0.05$)

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