GROWTH PERFORMANCE AND FEED UTILIZATION OF *Heterobranchus Bidorsalis* X *Clarias Gariepinus* FINGERLINGS FED BOILED *Vigna Subterranean*

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ABSTRACT
Growth and nutrient studies were carried out on the hybrid of Heterobranchus bidorsalis x *Clarias gariepinus totaling 150 fingerlings of mean initial weight 7.28-7.30g stocked at 10 fingerlings into rectangular plastic aquarium tanks 30x15cmx15cm for 120 days. This study examined five treatments; diet T_1 (control diet) contained raw bambara nut meal (BNM) while diets T_2 - T_5 contained bambara nut seed boiled at 30, 60, 90, and 120 minutes respectively and then processed into a meal before inclusion. The effect of varied boiled BNM was evaluated on the growth performance and feed utilization by the experimental fish. The result showed that daily weight gain of 0.35g and nutrients utilization were significantly ($p<0.05$) better in fish fed with bambara nut meal boiled at 90 minutes (dietT_4) than the control (diet T_1) and others. The protein efficiency ratio was not significantly different ($P>0.05$) among all the treatments, while daily weight gain of 0.35g, mean weight gain of 26.40g, and feed intake of 3.03 were all lowest in fish fed with diet T_1. Water change was effected every two days, dissolved oxygen (5.50mg/l) temperature (25^0c) P^H (7.7-7.8) and conductivity (2.30) were all within the optimal range for fish culture. It is recommended that the 90 minutes boiling time is adequate to enhance the nutritive value of bambara seed in fish feed.*

Keyword: Plant protein, hybrid fish, nutrient utilization, processed Bambara nut

INTRODUCTION

Clariid hybrid fish culture in ponds began in Nigeria in 1973 and the fish combines the speedy growth traits of *Heterobranchus bidorsalis* and fast-maturing traits in *Clarias gariepinus* (Adeogun *et al*., 1999). Heterobranchus species is a commonly cultured fish in most parts of Nigeria (Adewumi, 2005). Khaleg (2000) stated that it would be better if farmers take Heteroclarias culture as the main source of their family income because its culture is a thriving and prosperous business capable of alleviating poverty and getting additional income. Bambara nut ranks third in terms of consumption after groundnut (*Arachis hypogea*) and cowpea (*Vigna unguiculata*) in Africa (Sellscope, 1962). Brough and Azam-Ali (1992) explained that Bambara seed is a balanced food because it is rich in carbohydrate (63%) protein (16.25%) and fats (6.3%) with relatively high proportions of lysine and methionine making up the protein content (6.6 and 1.3% respectively).

The essential amino acid combination of Bambara seed such as lysine 6.82g/16gN, methionine 1.85g/16gN, and cysteine 1.24g/16gN can be compared to that of soya bean (6.24g/16gN lysine, 1.14g/16gN methionine, and 1.80g/16gN cysteine) (Fetuga *et al*.,1975). Varying methods have been adopted in the treatment of leguminous plants to make them fit for fish consumption and to ascertain their nutritive value. Soya bean has been the most used legume plant protein being used in human nutrition and heavily depended upon as an essential protein source in fish feed. Therefore, it is necessary to source other plant protein to help lessen the over-dependence on soya bean. Several studies have been carried out on the nutritional value of Bambara nut meal on Clariid fish species, Brough and Azam-Ali (1992) reported that Bambara nut makes an ideal food as it contains enough quantities of Carbohydrate, Proteins, and Fats with high amounts of Lysine and Methionine as a percentage of the protein. Amarteifor *et al.,* (2006) stated that Bambara seed is a very good source of essential minerals and can be useful in formulating a balanced diet. Banyigyi *et al.,* (2001) utilized heat-treated Bambara seed meal to feed *Clarias gariepinus* juveniles and to determine its effect on growth and feed utilization, also Aliyu and Ikoko (2016) administered decorticated Bambara nut to fingerlings of *Clarias gariepinus* and observed a good increase in terms of weight gain in the fish. The study was designed to observe the effect of boiling time on the nutritive value of Bambara nut (*Vigna subterranea*) on the growth performance of *Heterobranchus bidorsalis* x *Clarias gariepinus* hybrid.

MATERIAL AND METHODS

Study Area

The feeding trial was conducted in the Fisheries Laboratory of the College of Agriculture and Animal Science, Ahmadu Bello University, Mando Road, Kaduna state, Nigeria located at latitude 11° 10°N, 07°, 38°E it has an elevation of 623m above sea level, with an average rainfall of 1200mm, with 95% falling between 26°C-35°C. The humidity during the harmattan period is 21 and 27% in the wet season.

Experimental Design

Bambara nut seeds were purchased at the Agro-Allied section of the station market, stadium road Kaduna. The bambara nut was divided into five groups of 0.5kg each. The first group was raw Bambara seed while the second, third, fourth, and fifth groups were boiled in water in a wide aluminum pot heated on an electric hot plate for 30, 60, 90, and 120 minutes respectively at a temperature range of 100°C. The boiled seeds were strained off the water and then sun-dried at an atmospheric temperature of 28°C for five days to obtain a constant moisture content of 10.00%. Fifteen plastic rectangular aquarium tanks (30cm × 15cm × 15cm) were used for this experiment, it contains five treatments and three replicates using the completely randomized design (CRD) at a stocking rate of 10 fingerlings per tank, making it a total of 150 fingerlings.

Feed Formulation

The Pearson's square method was employed in balancing protein as described by Sado (1988), this involves the use of crude protein and energy values. Ingredients used for the diet formulations are yellow maize, groundnut cake, bone meal, Bambara nut, fishmeal, vitamin premix, palm oil, and salt. The weighed ingredients were poured into a plastic bowl, then mixed with starch of cassava origin, and water was added to make dough then pelleted using a screw-type pelletizer to 2mm diameter sizes. The pelleted feeds were collected and air-dried for 2 days and stored in plastic containers before taken for analysis. The formulated diets were compounded to have 40% crude protein. The proximate analysis of the experimental diets was carried out as described by the Association of Official Analytical Chemist method (AOAC, 2000) Crude protein, crude lipid, moisture content, crude fibre, ash content, and Nitrogen free extract were analyzed.

Experimental Fish

A total of two hundred fingerlings of *Heterobranchus bidorsalis* x *Clarias gariepinus* fingerlings were purchased from Abu Farms New Bussa, Niger State. They were transported in a 100litre plastic-filled halfway with water. They were taken to the laboratory and acclimatized for two weeks before being stocked into experimental plastic tanks.

Water quality parameters such as dissolved oxygen, temperature, conductivity, and pH of the water were measured daily. Dissolved oxygen was measured using Dissolved oxygen analyzer model JPB- 60, the temperature was measured using mercury in glass thermometer, conductivity was measured using digital conductivity model 4520, and P^H value was determined with a P^H model HI8424 HANNA, water change was effected every two days to ensure a hygienic environment. The Mortality rate was monitored daily and recorded accordingly.

Feeding Regime

The experimental diets were offered to the fish thrice daily at 7 a.m., 2 p.m., and 6 p.m. The feeding rate adopted was 5% body weight per day. The feed was divided into three portions. The fish ate almost all the feed given and the leftover was removed the next day before another feed was given. The diets were compounded as follows;

Diet T1 – Raw Bambara nut meal (BNM) inclusion
Diet T2 – 30 minutes boiled BNM inclusion
Diet T3 – 60 minutes boiled BNM inclusion
Diet T4 – 90 minutes boiled BNM inclusion
Diet T5 – 120 minutes boiled BNM inclusion

DATA ANALYSIS

The experimental data arising from the treatments were subjected to Analysis of Variance (ANOVA) and the means were separated using the least significant difference (LSD).

Analysis of Data

Growth responses and nutrient utilizationparameters were calculated as described by Musa *etal* (2016)

(a) Average daily growth rate (DGR)

$$DGR = \frac{(Wf - W1)}{T}$$

Where, Wf = Final average weight at the time of the experiment

W1 = Initial average weight at the beginning of the experiment

T = Culture period in days

(b) Specific Growth Rate (SGR) % per day

$$SGR = 100 \times \frac{(InWf\ InW1)}{T}$$

Where, Wf= Final average weight at the end of the experiment

W1 = Initial average weight at the beginning of the experiment

T = Culture period in days

(c) Protein Efficiency Ratio (PER)

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

(d) Feed Conversion Ratio (FCR)

$$FCR = \frac{\text{Dry weight of diet (g)}}{\text{Weight gain by fish (g)}}$$

(e) Survival Rate (SR) %

$$SR = \frac{N1 \times 100}{No}$$

Where N1 = Total number of fish at the end of the experiment

No = Total number of fish stocked at the beginning of the experiment

RESULTS

The Temperature of the water was 25°C and the P^H range was from 7.7-7.8 throughout the experiment. The proximate composition of the

experimental diet is presented in Table 2. The crude protein is highest in diet T_4 (41.10) and lowest in dietT_1 and dietT_2 (37.20) the crude fat content was highest in diet T_4 (5.81) and lowest in diet T_5 (4.97). Ash content value was recorded to be highest in diet T_1 (8.45) and dietT_2 (7.42) was second in ash content value. The crude fibre was highest in diet T_5 (5.01) followed by diet T_2 (4.96). The Nitrogen free extract (NFE) was highest n diet T_5 (33.89) and lowest in diet T_4 (33.32).

The result of the growth performance and feed utilization of Heteroclarias fingerlings fed different boiled BNM is shown in Table 3. The result showed that diet T_4 (90 minutes boiled Bambara nut meal) gave the highest weight gain of 45.01g. This was followed by diet T_4 with a weight gain of 30.60g. Diets T_3 and T_2followed closely with weight gain of 29.73g and 27.90g. Based on weight gain diet T4 with a weight gain of 45.01g performed better than the remaining diets. Average daily weight gain is highest in fish fed with diet T_4 with a value of 0.67 and followed by the other diets, there was a significant difference ($p>0.05$) between diet T_4 and the other diets. The protein efficiency ratio (PER) showed that diet T_4 had the highest value of 8.38 followed by diet T_3 (30minutes boiled BNM) diet T_4 and T_3 are significantly different ($p>0.05$). The lowest feed conversion ratio is seen in fish fed with diet T_4 with a value of 5.22 indicating that the diet was suitable for an increase in weight and growth of the fish.

The physicochemical parameters are presented in Table 4 and it was measured for fish culture during the experiment.

DISCUSSION

In the present study, the fish fed with a varied range of boiled BNM was observed to grow actively without any external sign of nutritional deficiency. This shows that the boiled BNMcontains all the necessary growth nutrients required by the hybrid fish. The fish also showed a good appetite for all the treatment diets as seen by the increase in body weight. This shows that the fingerlings of the hybrid fish were able to utilize theboiled BNM efficiently like other fish fed with soybean meal.

Based on weight gain, the fish fed with diet T_4 with a weight of 45.01g performed better followed by the fish fed diet T_5 This showed that the longer the cooking time the better the performance of the fish in relation to growth and feed utilization. The performance of the fish fed with Bambara nut meal cooked for 60 minutes and above (T3, T4, T5) is suspected to be a result of the removal of anti – nutrient substances present in the seeds by the various cooking periods. Cooking can render significantly the availability of nutrients in Bambara seeds as seen in this study. It could be suggested that cooking Bambara seeds for 90 minutes at 100°C will lead to good nutrient availability to fish. This agrees with the work of Brene *et al*., (1973) who found the optimum cooking time and temperature for pigeon pea to be 120 minutes at 120°C. The protein content of diet T_1 (raw Bambara nut meal) could have been as a result of the presence of some anti–nutrient substance (Oke *et al*., 2004). Also, Jackson and Capper (1992) asserted that feed ingredients of plant origin have shown to contain various anti-nutritional factors. For example, soya bean is known to contain haemoglutinin, while groundnut contains aflatoxin (Rayfeltwel and Sydfox, 1998), and wheat offal is high in fibre with low amino acid content (Gohl, 2005). However, these nutritional defects in these plant seeds can be ameliorated by heat and/or chemical treatment Musa *et al.*, (2016). The fish showed a good appetite for all treatment and especially the 90minutes boiled Bambara nut meal as attested by an increase in body weight. The observation shows that fish were able to utilize Bambara nut diet efficiently, this agrees with the work of Amarteifio *et al.* (2006) that asserted that Bambara nut meal is a good source of minerals and can be useful in formulating a balanced diet, also Brough and Azam-Ali (1992) stated that Bambara nut seed makes a balanced food as it contains sufficient quantities of Carbohydrate, Protein, and Fats with a relatively high proportion of Lysine and Methionine as percentage protein. Banyigyi et al (2001) have suggested that extension of the duration of heat processing of bambara nut or employment of feed processing methods such as boiling or fermentation may enhance better growth and feed utilization.

CONCLUSION AND RECOMMENDATION

Boiled Bambara nut provides the nutrient available for the growth and nutrient utilization of the diet to the fish. It is seen that boiling time of 90minutes significantly improved the nutritive value of Bambara nut to performance and nutrient utilization. Therefore, it is recommended that Bambara nut be boiled for 90 minutes to reduce the effect of nutrient inhibitors and enhance the bioavailability of component nutrients and performance of the fish.

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Table 1: Gross composition of experimental diets

100 Grammes (g)					
Ingredients	Treatments				
	T1	T2	T3	T4	T5
Fish meal	31.18	31.18	31.18	31.18	31.18
Raw Bambara nut	-	-	-	-	-
Wheat	10.5	10.5	10.5	10.5	10.5
Groundnut cake	10.5	10.5	10.5	10.5	10.5
Maize	10.5	10.5	10.5	10.5	10.5
30 minutes cooked Bambara nut	-	35	-	-	-
60 minutes cooked Bambara nut	-	-	35	-	-
90 minutes cooked Bambara nut	-	-	-	35	-
120 minutes cooked Bambara nut	-	-	-	-	35
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Bone meal	0.125	0.125	0.125	0.125	0.125
Vegetable oil	0.5	0.5	0.5	0.5	0.5
Salt	0.2	0.2	0.2	0.2	0.2

Table 2: Proximate composition of the formulated diets

Nutrient Contents (%)	T1	T2	T3	T4	T5
Crude Protein	37.20	37.20	40.75	41.10	39.70
Crude Fat	5.45	4.98	5.25	5.81	4.97
Crude Ash	8.45	7.42	7.38	6.68	7.40
Crude Fibre	4.00	4.96	3.98	4.09	5.01
Moisture	9.04	9.00	8.98	9.05	9.05
Nitrogen Free Extract	32.86	33.68	33.66	33.32	33.89

Diet T1 (Raw groundnut meal)
Diet T2 (30 minutes boiled Bambara nutmeal)
Diet T3 (60 minutes boiled Bambara nut meal)
Diet T4 (90 minutes boiled Bambara nut meal)
Diet T5 (120 minutes boiled Bambara nut meal

Table 3: Growth performance and feed utilization of Heteroclarias fingerlings fed different boiled BNM

	TREATMENT						
Growth Parameter	T1	T2	T3	T4	T5	SEM	LOS
Average daily wt. gain(g)	0.35	0.37	0.40	0.67	0.43	0.03	-
Avr. daily feed intake(g)	3.03	3.03	3.54	3.50	3.40	0.13	-
Avragedailyproteinintake(g)	0.05	0.05	0.05	0.08	0.06	0.04	-
PER	7.00	7.40	8.00	8.38	7.17	0.47	
FCR	8.66	8.19	8.85	5.22	7.95	0.53	-
Mean initial weight (g)	7.30^{a}	7.30^{a}	7.30^{a}	7.29^{a}	7.28^{a}	0.60	NS
Mean final wt (g)	33.70^{c}	35.20^{b}	37.03^{b}	52.30^{a}	37.88^{b}	0.20	-
Mean wt gain(g)	26.40^{b}	27.90^{b}	29.73^{b}	45.01^{a}	30.60^{ab}	1.9	-
Mean daily wt gain(g)	0.35^{b}	0.37^{b}	0.40^{b}	0.67^{a}	0.45^{b}	0.03	-
Percentage wt gain	115.00^{c}	150.32^{bc}	144.73^{bc}	258.96^{a}	181.82^{ab}	13.53	-
Survival rate %	85	85	100	100	100	-	-

Mean in the same row having the same superscript are not significantly different (P>0.05).
Diet T1 (Raw groundnut meal)
Diet T2 (30 minutes boiled Bambara nut meal)
Diet T3 (60 minutes boiled Bambara nut meal)
Diet T4 (90 minutes boiled Bambara nut meal)
Diet T5 (120 minutes boiled Bambara nut meal)
SEM = Standard Error of Mean
LOS = Level of significant
Wt = Weight

Table 4: Physicochemical parameters recorded during the experimental period

	TREATMENT				
Parameters	T1	T2	T3	T4	T5
Temperature	25.0	25.0	25.0	25.0	25.0
pH	7.8	7.8	7.8	7.7	7.8
Dissolved oxygen (mg/l)	5.50	5.60	5.50	5.50	5.55
Conductivity	2.30	2.30	2.30	2.30	2.30