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Nutrient Utilization and Growth response of *Clarias gariepinus* Fed African Breadfruit (*Treculia africana*) Seed Meal Diets

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Abstract: The nutrient utilization and growth response of fingerlings of *Clarias gariepinus* to cooked African Breadfruit Seed Meal (ABSM) diets was investigated. Cooked ABSM which is the test ingredient was included at 0, 20, 40, 60 and 80% in 5 diets formulated at 40% crude protein level and the diets were used to feed the fish. Each treatment was replicated twice and the experiment lasted for 70 days. Fish fed D2 (20% inclusion level) had the best growth rate with SGR of 1.66±0.04, FCR of 2.04±0.06 and PER of 0.61±0.03 followed by the fish fed the control diet (0% inclusion level) while fish fed diets D5 (80% inclusion level) had the least growth rate with SGR of 1.31±0.04, FCR of 2.95±0.08 and PER of 0.42±0.01. It can be concluded that African breadfruits seed meal can replace maize at 20% inclusion level as an energy source in the diet of *Clarias gariepinus* fingerlings.

Key words: African breadfruit seed meal, nutrient utilization, *Clarias gariepinus*, FCR, diet

INTRODUCTION

Fish is very important to humans because it contains protein of very high quality and also has sufficient amounts of all the essential amino acids required by the body for maintenance of lean tissues. Low quality protein does not contain all essential amino acids required for use in protein synthesis (Fagbenro and Adeparusi, 2003).

Feed accounts for the highest proportion of the floating input in livestock husbandry (Ejidike and Ajileye, 2007). In minimizing cost of feeding and providing steady food supply to the animals under captivity, locally available feedstuffs should be identified, harnessed and utilized. Farmers usually discard various locally available feedstuffs with great potentials for animal feed annually among which are the *Treculia africana* Seeds (TAS). For sustaining fish farming, consideration should be given to the use of feedstuffs that are not normally competed for by other users.

African bread fruit (*Treculia africana*) is a deciduous tree species belonging to the family Moraceae (mulberry). It is a native of many parts of African countries (Lawal, 1997). The plant is a common feature of the evergreen and deciduous forest often found along streams. In Nigeria, it is very common in the Western and Eastern States, especially in Onitsha area where it is an important food item and other parts of West Africa but the crop is highly underutilized.

Research has shown that TAS is rich in amino acids, minerals and fatty acids. However, the presence of some antinutritional factors like hydrocyanic acid, oxalates, phytates and tannins have also been revealed (Aletor, 1993). Fortunately, these antinutritional factors can be inactivated by employing different processing methods, hence the cooking method used in this study.

In this study, the nutrient value of *Treculia africana* seed meal is being investigated for optimum yield of *Clarias gariepinus*. There is presently no known competition in its usage unlike maize which is a staple food in this part of the world and is being competed for, for human consumption, industrial use and livestock feed making it quite costly for the usage of the average fish farmer.

MATERIALS AND METHODS

Diet preparation: About 7 kg mature African breadfruit seeds were purchased from a local market in Akure, Ondo State, Nigeria while other ingredients were purchased in a feedstuff market at Ado-Ekiti, Ekiti State, Nigeria. Following the method of Ejidike and Ajileye (2007), the seeds were parboiled for 25 min, poured in a sieve of 7 mm die size to drain the hot water used in parboiling. The seeds were then dehulled manually and the hulls were separated from the seeds. The seeds were sun dried at 28°C for 2 days to moisture content of about 12% and milled into fine powder and were used to replace maize meal at 0, 20, 40, 60 and 80% inclusion levels in the experimental diets.

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Table 1: Gross and proximate compositions of experimental diets

Ingredients	D1	D2	D3	D4	D5
Fish meal (72%)	28.10	27.62	27.00	26.60	26.10
Soybean meal (45%)	28.10	28.58	29.10	29.60	30.10
Blood meal (80%)	4.62	4.62	4.62	4.62	4.62
ABSM (11.15%)	-	6.84	13.67	20.51	27.34
Maize (10%)	34.18	27.34	20.51	13.67	6.84
Vit./min.premix	4.0	4.0	4.0	4.0	4.0
Methionine	0.3	0.3	0.3	0.3	0.3
Starch	0.7	0.7	0.7	0.7	0.7
Crude protein	40.10±0.07[a]	40.30±0.07[a]	40.24±0.22[a]	40.38±0.11[a]	40.15±0.07[a]
Moisture	2.12±0.11[d]	2.98±0.00[a]	2.18±0.03[d]	2.34±0.06[c]	2.66±0.01[b]
Ash	13.42±0.02[a]	13.11±0.01[c]	12.97±0.03[d]	13.23±0.04[b]	13.12±0.03[c]
Ether extract	8.89±0.06[d]	9.14±0.06[c]	9.27±0.04[c]	9.68±0.06[b]	9.81±0.03[a]
Crude fibre	6.57±0.08[ab]	6.39±0.12[bc]	6.50±0.07[ab]	5.96±0.03[d]	6.67±0.09[a]
NFE	28.91±0.03[a]	28.08±0.03[c]	28.84±0.06[a]	28.41±0.03[b]	27.59±0.13[d]

Mean and SD within the same row and followed by the same superscripts are not significantly different ($p>0.05$)

Diet D1 was the control and contained no African Breadfruit Seed Meal (ABSM). Diets D2, 3, 4 and 5 were formulated with ABSM replacing maize at 20, 40, 60 and 80%, respectively. For each diet, the whole ingredients (Table 1) were mixed thoroughly together in a bowl with warm water and starch was added to act as binder before it was pelleted using a Hobert A-200 pelleting machine with a die size of 2.0 mm, the pellets were then sun dried and packed in well labeled cellophane bags and stored in a cool and dry condition.

Growth experiment: Fingerlings of *Clarias gariepinus* were purchased from Agricultural Development Project (ADP) office, Akure, Ondo State, Nigeria with mean weight of 11.24±0.08 g. The fish were acclimated for 7 days in plastic tanks in the laboratory before the commencement of the experiment. After acclimation, the fish were randomly stocked at the rate of 10 fish per tank in rectangular plastic tanks with dimension 70×45×40 cm and water was maintained at 2/3 of the capacity of the tank. The experiment lasted a total of 70 days and 5 diets were fed to the fish in each corresponding tank within this period. The treatments were replicated twice to minimize experimental errors and all treatments were subjected to the same environmental conditions. The fish were fed twice at 3% of their body weight at 09:00-09:30 and 17:00-17:30 h for the entire period of the experiment.

Weight measurements of the experimental fish were carried out at 2 weeks interval and weights per tank were recorded and used to evaluate the performance of each diet. Also, feeding rates were adjusted according to increase in body weight. Uneaten feed and feaces were siphoned out every morning. Water temperature, pH and dissolved oxygen were measured at 2 weeks interval using a mercury-in-glass thermometer for temperature and a dissolved oxygen meter for dissolved oxygen while pH was monitored using a pH meter. The experiment was conducted between January to March, 2012.

Proximate analysis: The 5 diets whole body samples of the experimental fish before and after the experiment and mature seed samples of African breadfruit (*Treculia africana*) before and after boiling were analyzed for their proximate composition using the method of AOAC (1990).

Biological evaluation: Diet performance was determined as follows:

$$\text{Weight gain} = \text{Final weight of fish}\left(W_2\right) - \text{Initial weight }\left(W_1\right)$$

$$\text{Specific Growth Rate }\left(\text{SGR}\right) = \frac{\text{Log}_e\text{ final weight} - \text{Log}_e\text{ initial weight} \times 100}{\text{Time period }\left(\text{Days}\right)}$$

$$\text{Protein Efficiency Ratio}\left(\text{PER}\right) = \frac{\text{Fish weight gain }\left(g\right)}{\text{Protein consumed }\left(g\right)}$$

$$\text{Feed Conversion Ratio}\left(\text{FCR}\right) = \frac{\text{Weight of feed }\left(g\right)}{\text{Fish weight gain }\left(g\right)}$$

Statistical analysis: Data collected from the experiment were subjected to one-way Analysis of Variance (ANOVA) using SPSS (Statistical Package for Social Science version 15) and the differences were separated using duncan multiple range test.

RESULTS

The gross and proximate composition of experimental diets is given in Table 1, showing the level of substitution of ASBM for maize in the diets. All the diets were formulated at 40% crude protein level which is the requirement for *Clarias gariepinus* fingerlings. All the

Table 2: Performance evaluation of *Clarias gariepinus* fed cooked African breadfruit seed meal

Parameters	D1	D2	D3	D4	D5
Mean initial weight (g)	11.29±0.09^{a}	11.24±0.78^{a}	11.34±0.02^{a}	11.29±0.01^{a}	11.21±0.07^{a}
Mean final weight (g)	34.01±0.19^{b}	35.81±1.07^{a}	31.80±0.17^{c}	30.62±0.16^{d}	28.16±0.41^{e}
Mean weight gain	22.72±0.09^{b}	24.58±0.99^{a}	20.47±0.51^{c}	19.33±0.15^{c}	16.96±0.49^{d}
Survival	100±0.00^{a}	90±0.00^{b}	100±0.00^{a}	85±7.07^{b}	90±0.00^{b}
Average daily weight gain	0.33±0.01^{b}	0.35±0.01^{a}	0.30±0.01^{c}	0.28±0.01^{c}	0.25±0.03^{d}
Specific growth rate	1.58±0.01^{b}	1.66±0.04^{a}	1.47±0.03^{c}	1.43±0.01^{c}	1.31±0.04^{d}
Protein efficiency ratio	0.57±0.00^{a}	0.61±0.03^{a}	0.51±0.01^{b}	0.48±0.01^{b}	0.42±0.01^{c}
Feed conversion ratio	2.20±0.01^{c}	2.04±0.08^{c}	2.44±0.06^{b}	2.59±0.02^{b}	2.95±0.08^{a}

Mean and SD within the same row and followed by the same superscripts are not significantly different (p>0.05)

Table 3: Carcass composition of experimental fish

Carcass	Initial	D1	D2	D3	D4	D5
Crude protein	62.24±0.06^{e}	65.60±0.14^{c}	67.30±0.14^{a}	65.02±0.00^{d}	66.42±0.03^{b}	66.30±0.07^{b}
Ether extract	3.25±0.07^{cd}	3.52±0.03^{b}	3.36±0.08^{cb}	4.21±0.03^{a}	3.48±0.11^{b}	3.10±0.03^{a}
Ash	16.23±0.04^{a}	14.29±0.13^{d}	14.35±0.07^{cd}	14.80±0.07^{b}	14.89±0.13^{b}	14.55±0.07^{c}
Moisture	12.80±0.07^{a}	11.30±0.07^{ab}	11.40±0.07^{bc}	11.49±0.13^{b}	11.20±0.07^{c}	11.50±0.07^{b}
NFE	5.48±0.11^{b}	5.29±0.13^{a}	3.59±0.13^{d}	4.48±0.11^{b}	4.01±0.00^{c}	4.55±0.07^{b}

Mean and SD within the same row and followed by the same superscripts are not significantly different (p>0.05)

values for the proximate composition are closely related, indicating that no bias was introduced through the diets. The growth and nutrients utilization values for the experiment are given in Table 2. The initial mean weight of fish was 11.27±0.07 while the final mean weight was 32.08±2.82.

All the parameters recorded followed the same trend. The highest Weight Gain (WG) of 24.58±0.99 was found in fish fed with diet D2, followed by that fed the control diet (D1) with a value of 22.72±0.09 while the least value of 16.96±0.49 was found in fish fed D5. Also, the highest Specific Growth Rate (SGR) was found in fish fed D2 followed by fish fed D1 while the least SGR was in the fish fed D5. There were significant differences (p<0.05) in weight gain and specific growth rate values for all the diets except D3 and 4 which did not differ significantly (p>0.05) from each other.

The highest Protein Efficiency Ratio (PER) was found in fish fed D2, followed by that fed D1 while the lowest was found in fish fed D5. Fish fed with diets D2 had the best Feed Conversion Ratio (FCR), followed by that of D1, 3, 4 and 5 in that order. PER and FCR values for D1 and 2 did not differ significantly (p>0.05) from each other and that of D3 and 4 were not significantly different (p>0.05) from each other but differed significantly (p<0.05) from that of the other diets. Percentage survival was highest in fish fed with D1 and 3 followed by that fed D2 and 5 with 100 and 90%, respectively, diet D4 had the least survival of 85%.

The carcass composition of the experimental fish is given in Table 3. Among those fed the experimental diets, fish fed D2 had the highest protein value while fish fed D3 had the least value. Crude protein levels of all the fish fed with the experimental diets increased compared to the initial protein level and differed significantly (p<0.05) from each other except that of D4 and 5 which were not significantly different (p>0.05) from each other. Ether extract for fish fed with diets D3 was the highest while fish fed D5 had the lowest ether extract. Ash content was highest in fish fed with diet D4 and the lowest was found in fish fed with diets D1.

Table 4: Water quality parameters recorded during the experimental period

Tanks	Temperature (°C)	DO (mg L^{-1})	pH
D1	28	6.8	8.6
D2	28	7.2	8.7
D3	28	7.1	8.5
D4	28	7.2	8.7
D5	29	7.5	8.5

Table 4 shows the result of water parameters recorded during the period of the experiment. The temperature ranged between 28-29°C, dissolved oxygen ranged from 6.8-7.5 while pH values ranged between 8.5-8.7 mg L^{-1}.

DISCUSSION

The efficacy of African breadfruit seed meal as a potential replacement for maize in enhancing productivity in partially substituted fish meal diets for the African clariid catfish, *Clarias gariepinus* is demonstrated by the result of this study. All the fish fed on the experimental diets showed no dietary related mortality or morphological symptoms of nutrient deficiencies, such as dorsal or caudal fin erosion and colour pigmentations.

The proximate composition of African breadfruit seed meal in the present study revealed that the crude protein content was 11.15±0.21 (Table 1). This value was lower than the values reported by some researchers (Onweluzo and Odume, 2007; Osabor *et al.*, 2009; Ijeh *et al.*, 2010). The differences might be attributed to differences in environmental conditions such as soil types, harvesting time and processing methods.

The temperature, pH and dissolved oxygen values were within the range recommended for African catfish culture (Bruton, 1979; Landau, 1992). There was a general increase in weight gain from the first week to the last week of the experiment. The fish showed good appetite to all the diet, attested to by the increase in body weight and length.

The best performance in terms of Weight Gain (WG), Average Daily Weight Gain (ADWG), Specific Growth Rate (SGR), Protein Efficiency Ratio (PER) and Feed Conversion Ratio (FCR) was recorded in fish fed D2 followed by that fed the control diet, then D3, 4 and 5 in that order. This is an indication that ABSM is well utilized by the fish as D2 performed better than the control diet (D1). However, the optimal maize replacement level with ABSM appears to be 20% as higher inclusion levels' performances were not as good as that of the control diet. This trend observed for WG, ADWG, SGR, PER and FCR were similar to the trend obtained for *Oreochromis niloticus* fed cassava peels by Faturoti and Akinbote (1986), a similar trend was also reported by Mary *et al*. (2010) for *O. niloticus* fed mango peel based diets. However, this is contrary to the result obtained by Oladele *et al*. (2010) who recorded the best performance in *Clarias gariepinus* fed tigernut at 100% substitution of maize meal with tigernut meal.

The fish accepted all the experimental diets readily. This might be attributed to the good processing techniques which involved cooking and drying that might have reduced the antinutrient of African breadfruit seed meal and increased its palatability. This same observation was reported by several authors (Faturoti and Akinbote, 1986; Orescgun and Alegbeleye, 2001; Fagbenro *et al*., 2007).

The percentage survivals recorded in the study were good throughout the experimental period. This could be as a result of good handling and good water quality management and the suitability of African breadfruit seed meal as a dietary component in *Clarias gariepinus* diet.

The result of the carcass composition shows that the crude protein was highest in fish fed D2, even higher than that in the control diet (D1). This could mean that the inclusion of ABSM increased the protein retention in the flesh of the fish while the lowest value recorded at 40% inclusion level could be an indication that the fish could not tolerate an inclusion level that high or it did not have a positive effect on protein retention in the fish flesh.

CONCLUSION

This study shows that good results can be obtained when maize is partially substituted (20%) with cooked African breadfruit seed meal in the diet of *Clarias gariepinus* as an energy source since results obtained at 20% level of substitution are better than that of 0%. Furthermore, African breadfruit is readily available, cheap and easily propagated as a backyard pulse as against maize which is expensive, scarce and difficult to process. Therefore, the use of Africa bread fruit seed meal is by far more economical than using maize diet in feeding *Clarias gariepinus*.

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