Journal of Research in Biology

An International Scientific Research Journal

Journal of Research in Biology

Original Research

Nutritive value and utilization of Baobab (*Adansonia digitata*) seed meal as plant protein source in the diet of juveniles of *Clarias gariepinus* (Burchell, 1822) (Pisces: Clariidae)

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ABSTRACT:

This paper aimed at evaluating the potentials of boiled Baobab (*Adansonia digitata*) seed meal as plant protein source in the diet of juveniles of *Clarias gariepinus.* A sixty-day feeding trial was conducted in 40L plastic aquaria tanks. Boiled baobab seeds meals were incorporated in diets at 0, 25, 50, 75 and 100% designated as diets D1 (Control), D2, D3, D4 and D5 respectively. All diets were iso-nitrogenous and iso-caloric. Juvenile *Clarias gariepinus* with initial mean weight 101.24±34g were fed *ad lib* on allotted diets twice per day for 60 days. Mean body weight gain in fish fed on D1 was highest with a value 901.22g and lowest in Diet 5 with a value of 250.39g. The mean daily weight gain in fish was highest in Diet 1 with a value of 15.4% and lowest in Diet 5 with a value of 4.17%. Specific Growth rate (SGR) of experimental fish was highest with a value of 3.62% in Diet 1 and lowest in Diet 5 with a value of 2.09%. Proximate composition of fish fillets fed on test diets show that the protein level in diet 21.88±0.11% in Diet 3 and 21.00±1.00% in D4 were significantly higher than the other diets while the crude fiber was highest in Diet 4 with a value of 2.90±0.17% and lowest in Diet 3 with a value of 1.93±0.12%. This study shows that up to 25% of boiled baobab seeds can be incorporated into the diets of juvenile *C. gariepinus* without any negative effects on growth of fish.

Keywords:
Nutritive value, *Adansonia digitata*, *Clarias gariepinus.*

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Article Citation:
Afamdi Anene, Olivia C. Afam-Anene and Chisom Onyekachi.
Nutritive value and utilization of Baobab (*Adansonia digitata*) seed meal as plant protein source in the diet of juveniles of *Clarias gariepinus* (Burchell, 1822) (Pisces: Clariidae).
Journal of Research in Biology (2012) 2(4): 348-354

Dates:
Received: 03 Dec 2011 **Accepted:** 12 Dec 2011 **Published:** 31 May 2012

INTRODUCTION

Catfish species are very popular to fish farmers and consumers, they command a very good commercial value in Nigerian markets (Ezenwaji, 1985). *Clarias* species is one of the commercially important catfish. This is because, the fish is good as food, has the capability to grow fast especially in intensive culture system, produce thousand of eggs in a breeding period, withstand both handling and environmental stress. It can withstand diseases and many other adverse conditions that can kill fish. Ayinla (2003) reported that feed accounts for at least 60% of the total cost of fish production in Africa, which to a large extent determines the viability and profitability of fish farming enterprise. Fish production is facing many problems including the availability of suitable and economical feed for rearing young and adult fish (Adeyemo *et al.,* 1994).

Conventional protein sources for fish feed production include soybean, groundnut cake and cotton seed meal and these constitute the major vegetables protein sources. These protein sources are scarce, expensive and highly competed by man and other animals. These legumes are produced by rain fed agricultural systems which make them scarce and very expensive, thereby leading to high cost of fish feeds and consequently fish production (Ayinla, 2003).

Adansonia digitata is a desert crop which is resistant to draught and produce all year round. The seeds are not consumed by man who rely on their leaves for food, and are not subjected to various other uses. *A. digitata* seeds are unknown in fish feeding and generally underutilized. With this background, the study aims at:

- Investigating the nutritional quality of baobab seeds
- Investigating the effect of boiled baobab seed meal on the growth performance of *C. gariepinus.*
- Determining the optimal replacement levels of boiled baobab seed meal in the diets of *C. gariepinus* fingerlings based on growth performance.
- Assessing the quality of fish fillets fed on the different experimental diets.

MATERIALS AND METHODS

The experiment was conducted inside the Animal Nutrition Laboratory at the Department of Agriculture, Abia State University, Umuahia Campus. Two hundred (200) juvenile (one month old) *C. gariepinus* fish were obtained from a private fish farm in Owerri, Imo State, Nigeria. They were then transported in two 50 liter plastic containers to the Laboratory. They were acclimatized for 21 days during which period they were fed ad-lib on “Coppes” a commercial feed.

Preparation and Analysis of experimental diets:

Raw seeds of baobab were sourced from a local market in Katsina State, Nigeria. The seeds were soaked for 24 hours in water and boiled for 1 hour at 105°C without change of water. The baobab seeds were oven dried at 60°C before milling which was achieved using hammer miller. Each of the diet was compounded and mixed separately as shown in Table 1. The mixture was manually made into pellets using a machine, sun dried and stored in sack bays for further use.

Ash, crude lipid, crude fiber and protein of baobab seeds, fruits and experimental diets were

Table 1: Level of replacement of baobab seed meal in fish diets.

Ingredient	D1 0% BBSM	D2 25% BBSM	D3 50% BBSM	D4 75% BBSM	D5 100% BBSM
Maize	49.80	49.80	49.80	49.80	49.80
Soybean	28.50	24.50	14.24	4.00	0.00
BBSM	00.00	4.00	14.25	24.50	28.50
Wheat offer	11.00	11.00	11.00	11.00	11.00
Palm kernel cake	5.10	5.10	5.10	5.10	5.10
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	1.00	1.00	1.00	1.00	1.00
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Palm oil	1.00	1.00	1.00	1.00	1.00
Total	100	100	100	100	100

similarly determined using AOAC methods (1995). The carbohydrate content was calculated by difference. Nitrogen Free Extract (NFE) was calculated as the remainder of crude protein +crude fat +ash and assuming crude proteins 5.85=N (Gnaiger and Bitterlich, 1984). All reagents used for the analyses were of analytical grades and were not subjected to further purification.

At the end of the feeding trial, fish fed on the different experimental feeds were analyzed for their proximate composition using AOAC methods (1995). To obtain fish fillets, each fish was cut along its full length. Fish fillet from each treatment were blended into a smooth paste in a 3.8 L kitchen-type blender (Warning Products, New Hartford, CT) which was thoroughly cleaned and dried between samples. Triplicate determination was made for each treatment.

Feeding regime

Juvenile fish were stocked seven in each container (40L capacity) where they were fed for 60 days on diets containing various levels of inclusion of boiled baobab seeds meal with varying crude protein levels in triplicates. Fishes were fed to satiation daily at 7:00 hours and 18:00 hours.

Fish in each tank were individually weighed at the beginning (W1) and at the end (W2) of the feeding experiment. Dead fish were removed and recorded daily. Mortality during the experiment was 8%. Unconsumed feed and excreta were siphoned out daily (one hour after feeding) after which water level was topped to maintain the same water level. Stocking/Feeding Regime:

All fish were starved for 24 hours prior to the commencement of the experiment. The feeding trail was carried out in five transparent plastic tanks of 40L capacity with water depth of 0.40m. The tanks were placed on wooden table with a height of 1.4m. Experimental fish (juvenile *C. gariepinus*) were randomly distributed into five treatment groups and each group had 10 replicates. The feeding trial was carried out in a 40L transparent plastic tank. The fish were fed to satiation for 60 days daily in the morning (6.00am) and in the evening (18.00pm). All fishes were subjected to a 12:12 light and dark cycle using a natural day and night regime.

Water Management

There was 50% exchange of water in all the tanks daily. Raw borehole water was used for the study. Water was temporally stored in 500L plastic containers from where it was transferred into the experimental tanks every morning.

Measurement of Weight

Before stocking and before the feeding trial each experimental fish was weighed (W1) and after the feeding trial (W2). Increase in body weight the difference in final body weight (W2) and initial body weight (W2) in grams was used as the major indicator for growth.

Computation of Data

Mean weight gain (g) was estimated as, mean final weight – mean initial weight. Mean Daily weight gain (MDWG) was calculated as W2-W1/T2-T1, Specific growth rate was calculated as Specific Growth Rate = (LogW2 - LogW1) × 100 / T2 - T1, where W2 and W1 = final and initial weight respectively; T2 and T1 = final and initial time (Zaid and Sogbesan, 2010). The mean, standard deviation and analysis of variance (ANOVA) were computed using Statistical Package for Social Sciences (SPSS) version 15. Means were separated using Duncan Multiple Range Test and significance was judged at $p<0.05$.

RESULT AND DISCUSSION

Table 2: Proximate Composition of Baobab Seed and Fruit

Composition	Seed (%)	Fruits (%)
Moisture	4.3±0.1	10.4 ±0.4
Protein	18.4±0.5	3.2 ±0.1
Fat	12.2±0.1	0.3±0.0
Ash	3.8±0.1	4.5±0.2
Crude fiber	16.2±0.9	5.4±0.3
Carbohydrate	49±1.7	76.2±1.0
Metabolizable Energy	363.8±9.7	320.3±4.4

Table 3: Proximate composition of experimental diet of *C. gariepinus* at varying replacement levels of boiled baobab seed meal.

Constituents	D1 0%BBSM	D2 25%BBSM	D3 50%BBSM	D4 75%BBSM	D5 100%BBSM
Moisture	9.44^{ab}±0.41	9.05^{b} ± 0.06	10.18^{a}±0.01	10.13^{a}±1.01	9.39^{ab}±0.38
Protein	41.13^{a}±1.63	40.25^{a}±1.59	42.88^{a}±1.66	40.38^{a}±1.65	42.00^{a}±0.38
Ash	10.50^{a}±1.39	12.00^{a}±2.00	11.0^{a}±1.73	11.80^{a}±0.90	10.00^{a}±1.73
Crude fiber	1.90^{a}±0.00	1.91^{a}±0.00	2.39^{a}±0.76	2.00^{a}±1.00	1.50^{a}±0.10
Fat (ether extract)	9.00^{b}±0.86	10.97^{a}±1.17	8.95^{b}±0.79	6.97^{c}±1.01	9.98^{a}b±0.67
Carbohydrate	28.07^{ab}±1.00	25.82^{ab}±2.54	25.05^{b}±2.61	29.34^{a}±0.67	27.13^{ab}±1.73
NFE	37.47±1.01	34.87±1.14	34.78±0.98	38.85±0.99	36.52±1.08

Value are mean ± standard deviation of triplicate samples abc means ± SD with similar superscripts in the same column are not significant different (p>0.05).

The result of the proximate composition of fruits and boiled baobab seeds are presented in Table 2. The moisture content of baobab seeds was 4.3±0.1%, crude protein 18.40±0.5%, cruder fiber 16.20±0.9%, either extracts 12.20±0.1%, and ash 3.80%. The moisture level in baobab fruit was 10.4 ±0.4%, protein 3.2±0.1%, fat 0.3±0.0%, ash 4.5±0.2% and crude fiber 5.4±0.3%. Moisture content in fruits was generally higher than in seeds. Protein levels in seeds of baobab in this study are not in accord with Nkafamiya *et al.,* (2007) who reported protein levels of 21.75±0.12 g/100g. However, the crude protein of the seeds of baobab were compared favourably with that published by Ezeagu, (2005). However, the amount of protein recorded in this study is considered to be moderate Aduku, (1993) and Ezeagu, (2005) qualifies the boiled baobab seeds as commendable protein supplement in fish feed formulations. Similarly, ash, fat and carbohydrate contents of baobab seed in this study agree with literature reports of the same seed (Aduku, 1993; Ezeagu, 2005; Nkafamiya *et al.,* 2007).

Composition of feed ingredient and experimental diets

The proximate composition of experimental diets is presented in Table 3. The result revealed diets were generally iso-nitrogenous. The protein content ranged from 40.38±1.65 to 42.88±1.66% were not significantly different (p>0.05) and conform to the recommendation of optimum dietary protein of the fish (Luquet, 1991). The results also show that there was a significant difference (p>0.05) in moisture, fat and carbohydrates of the experimental diets.

Growth performance of *C. gariepinus*

The growth performance of *C. gariepinus* fed on various experimental diets was evaluated in terms of body weight gain (g), mean daily body weight gain (g) and specific growth rate is presented in Table 4.

Table 4: Effect of replacement of Boiled Baobab seeds (BBMS) as protein source in *C. gariepinus* diet.

Parameters	D1 0%BBSM	D2 25%BBSM	D3 50%BBSM	D4 75%BBSM	D5 100%BBSM	SEM
Mean Initial body weight (g)	101.03^{a}	101.67^{a}	102.11^{a}	101.67^{a}	101.03^{a}	43.12
Mean Final body weight (g)	1002.11^{a}	803.35^{b}	651.65^{c}	483.16^{d}	354.88^{e}	34.76
Mean Body weight gain (g)	901.22^{a}	700.69^{b}	550.19^{b}	380.94^{c}	250.39^{d}	22.8
Mean Daily weight gain (MDWG)	15.4^{a}	11.67^{b}	10.76^{b}	6.33^{c}	4.17^{c}	17.9
Specific Growth rate (SGR) (%)	3.62^{a}	3.55^{a}	3.08^{b}	2.59^{c}	2.09^{d}	11.6

Value are mean ± standard deviation of triplicate samples abc means ± SD with similar superscripts in the same column are not significant different (p>0.05).

Tables 5: Proximate Composition of *C. gariepinus* Fed Diets with various Level of Boiled Baobad Seed Meal.

Constituents	D1 0%BBSM	D2 25%BBSM	D3 50%BBSM	D4 75%BBSM	D5 100%BBSM
Moisture	$73.77^{a}±1.96$	$74.21^{a}±9.65$	$70.21^{c}±2.65$	$73.77^{a}±5.39$	$71.67^{b}±1.96$
Protein	$19.29^{c}±0.01$	$17.50^{d}±0.50$	$21.88^{a}±0.11$	$21.00^{a}±1.00$	$20.13^{b}±0.03$
Crude fiber	$2.70^{ab}±0.30$	$2.90^{a}±0.17$	$2.39^{bc}±0.09$	$1.93^{a}±0.12$	$2.00^{cd}±0.30$
Ash	$1.00^{a}±0.00$	$1.00^{a}±0.00$	$1.20^{a}±0.09$	$1.15^{a}±0.12$	$1.20^{a}±0.10$
Fat (ether extract)	$1.05^{ab}±0.30$	$2.90^{a}±0.17$	$1.36^{cd}±0.24$	$1.72^{cd}±0.24$	$2.88^{a}±0.42$
Carbohydrate	$2.19^{a}±0.03$	$2.29^{a}±0.49$	$2.45^{a}±0.49$	$2.13^{a}±0.84$	$2.12^{a}±0.25$

Value are mean ± standard deviation of triplicate samples abc means ± SD with similar superscripts in the same column are not significant different (p>0.05).

Experimental fish utilized the five (5) different diets at varying levels that solicited significant differences in some parameters and did not in some others. The Table shows that there was a significant difference (p>0.05) in the mean final body weight of *C. gariepinus* fed with different levels of BBSM.

The results indicated that there were significant differences (p>0.05) in mean body weight gains of fish groups fed Diet D1 (0% BBSM) and the other diets. This group of fishes had significantly higher (p>0.05) mean body weight gain. Mean body weight gain of fish fed Diets D2 and D3 were not significantly different (p>0.05). Fish fed on Diets D2 and D3 had significantly higher mean body weight gain when compared with those fed with diet D4 and D5. Legumes have been variously used as a protein source in the diet of fish (Olvera *et al.,* 1988; Viola, *et al.,* 1988; De-Silva and Gunasekera, 1989; Hughes, 1991). The specific growth rate of C. gariepinus fingerlings fed Diet 1 (0% BBSM) is not significantly different (p>0.05) from those fed with 25% BBSM but significantly different from the remaining diets. Differences in SGR of *C. gariepinis* between feeds significantly declined (p>0.05) as the level of substitution of boiled baobab seed meal progressed. However, such significant declines in mean daily weight gain occurred only beyond 25% substitution. Gomes *et al.,* (1995) had similarly observed that the inclusion of plant protein made from rapeseed and field peas had no effect at up to 15% replacement of the protein but at 45% inclusion, growth performance of rainbow trout was significantly lower than the control diet.

Proximate analyses of fish fillets fed with the experimental diets

The result of fillet composition of *C. gariepinis* fed with the experimental diets is presented in Table 5 and it revealed a significant difference (P<0.05) in fillet concentrations of moisture, protein, crude fiber and ether extract while there were no significant differences in the concentrations of ash and carbohydrates.

As presented in this table, fillets of *C. gariepinus* fed diets containing 0% BBSM, 25% BBSM and 100% BBSM had significantly higher (p<0.05) moisture contents compared to other diets. Protein content in the diets containing 50% BBSM ($21.88^{a}±0.11\%$) and 75% BBSM ($21.00^{a}±1.00\%$) were significantly higher than for other test diets. Ether extract levels in fish fillets fed diet 0% BBSM was significantly lower (P<0.05) than the other treatment groups (Table 5).

CONCLUSION

In this study, boiled baobab seed meals were incorporated at various levels into the diet of juvenile *C. gariepinus*. Analyses of the seeds of *A. digidata* indicate that the proximate composition is comparable with those of plant protein sources. The diets so formulated were nutritionally acceptable and biologically available to juvenile *C. gariepinus* under laboratory conditions. The protein, fat, crude fibre and moisture values of the diets used for this study could satisfy the growth requirements of *C. gariepinus* at this stage of its development and are comparable to the quality of other feed ingredients particularly seeds. A similar result was obtained when Tilapia (Oreochromis niloticus) fingerlings and juvenile *C. gariepinus* were fed on different grains (Solomon 2007; Zaid and Sogbesan, 2010). Using the mean daily weight gain and specific growth rate as indicators of feed utilization, a 25% inclusion level is most desirable for juvenile *C. gariepinus.*

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