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Prototypic use of albino rats for biological evaluation of the potential of processed baobab seed as feedstuff in African catfish diet

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***Target Audience:** Fish nutritionist, Animal nutritionist, Feed producers*

Abstract

Processed baobab seed meals were investigated as possible protein source in fish feed with prototypic use of albino rats. Baobab seeds were subjected to six processing methods: autoclaving (0.15MPa for 30 mins), toasting (150^{0}C for 30 mins) and soaking (72 hours) in water, liquor, alkali and pulp. The seeds were used to formulate eight isonitrogenous (10%CP) diets including six test diets, a basal and a standard diet for weaning albino rats. The biological values of rats fed test diets (99.43%-99.91%) were significantly the same (p>0.05) as those fed casein (99.89%). The true digestibility values of rats fed test diets were also significantly the same (p>0.05) as those fed casein (99.82%) except those fed soaked in liquor baobab seed (98.54%s). There was increase in mean weight gained of the rats fed soaked in alkali baobab seed meal, 2.03±3.62g while rats fed other test diets showed decrease in weight gained. Soaked in alkali baobab seed meal have a good potential of been used as a protein source in fish feed.

Keywords: Baobab, Rat, Fishfeed, Processing

Description of Problem

One of the major hindrances to the development of fish aquaculture industry in Africa is the lack of locally produced high-quality fish feed (1). Fish feed is a single most expensive factor in any aquaculture production business and consume about 60% of the production cost in intensive fish culture system (2). Fishmeal is the major protein source in aquaculture feeds. The global supply of fishmeal is not growing and fishmeal must be used more sparingly to improve profitability and sustainability of aquaculture (3). Plant proteins are widely recognised as an important source of affordable protein (4). Soybean meal has high protein content of one of the best protein among plant protein feedstuffs used in fish feeds (5). However, wider use of soyabean meal for fish feed is limited by its high cost compared to other plant protein sources and competing use in other animal feed industries. Hence, research focus should be directed on looking for other cheap, alternative plant protein sources.

One of such plants that have potential of being inexpensive, locally available and nutritionally dense is Baobab (*Adansonia digitata*) (6). Baobab, which grows naturally as a wild tree (7), belong to the family Bombacaceae and is the most widespread of the *Adansonia* species in the African continent. It is found mostly in hot, dry savannah of sub-Saharan Africa and called "kukah" by many ethnic groups in Nigeria (8).

It was reported (9) that *Adansonia digitata* L. kernel is rich in energy, protein and mineral content and also has a potential usefulness as a food protein source in tropical and subtropical regions. Biological value and net protein utilization may be considered as good measures of protein quality (10). A complete evaluation of the dietary protein

includes measurement of the biological value and the digestibility. The biological evaluation of protein quality is usually carried out using rats (11). Hence, this study aims at investigating the potential of differently processed baobab seed meal for utilisation as protein source in the fish feed with the prototypic use of albino rats.

Materials and Methods

Processing of baobab seeds:

Mature baobab fruits were collected from the vicinity of the University of Ibadan, Oyo State, Nigeria. Baobab seeds were removed from the baobab pods, sorted, washed and dried to attain a constant weight. The seeds were milled and sieved to obtain raw baobab seed meal (RBSM). The remaining baobab seed meals were processed as follows:

Toasting: Portion of the dried baobab seeds were placed in a tray and put in an oven until the temperature reaches 150^0 C for 30 minutes (12). Its meal was designated as toasted baobab seed meal, TBSM.

Autoclaving: Some dried baobab seeds were autoclaved at 0.15 MPa for 30 minutes, and dried in an oven at a temperature of 70^oC for 3 hours (modified method of 13). Its meal was designated as autoclaved baobab seed meal, ABSM.

Soaking in maize liquor: Part of the washed and dried seeds was soaked in maize liquor for 72 hours, washed, sundried and roasted at 70 ^{0}C for 30 minutes (modified method of 14). This was designated as soaked in liquor baobab seed meal, SLBM.

Soaking in water: Dried seeds were soaked in water (1:3 kg/litres) for 72 hours, sundried and roasted at 70 ^{0}C for 30 min (modified method of 14). Its meal was designated as soaked in water baobab seed meal, SWBM.

Soaked in alkali: Part of the dried seeds were soaked in alkali medium (5% wood ash) at 1kg:3litres seeds to water for 72 hours, sundried and roasted at 70 ^{0}C for 30 minutes. The meal was designated as soaked in alkali baobab seed meal, SABM.

Soaking in pulp: Another part of the seeds were soaked in water with the pulp (1:3 kg/litres) for 72 hours to dissolve the pulp as suggested by (14), sundried and roasted at 70 ^{0}C for 30 min, dried seeds. Its meal was designated as soaked in pulp baobab seed meal, SPBM.

Experimental procedure for rat study:

The experiment was carried out in the Rat unit of the Department of Animal Science, Faculty of Agriculture, University of Ibadan, for 15 days. 50 weanling male albino rats of weights range of between 22-30 g were obtained from the Rat Unit of the Department of Veterinary Physiology and Pharmacology of the University of Ibadan. Three rats were sacrificed before the commencement of the experiment for proximate composition. Five rats on weight equalization basis were randomly allotted to each experimental diet. The rats were housed in well ventilated individual houses with provision for urine, faecal collection and unrestricted access to water and feed.

The raw and processed baobab seed meals were hammer-milled, sieved, finely grinded, re-sieved and incorporated into the rat feed. The experimental diets were formulated according to (15) adapted to contain 10% of protein for casein (table 1). The experimental feed and water were supplied *ad- libitum*. A good hygienic environment was maintained throughout the experimental period, daily feed intakes and weight gain were recorded. The food residues were collected, dried and weighed. The faeces were collected, oven-dried at 60^oC (16) and stored in plastic containers in a dessicator until analysis. A drop of dilute H_2SO_4 was added to urine samples to prevent any loss of nitrogen.

Data were collected daily on mortality, feed intake, and weight gain. At the end of the 15 days of experiment, three rats were sacrificed from each treatment units for proximate composition. True digestibility (T\D) and biological value were computed from total feed intake, total faeces and urine voided, as well as the nitrogen determination.

Table 1: Composition of purified and experimental dietsfor rats

Ingredients (%)	ST	NFD	RBSM	TBSM	SPBM	ABSM	SLBM	SWBM	SABM
Casein	10.00	-	-	-	-	-	-	-	-
Corn starch	71.50	81.50	38.30	37.70	40.60	43.70	44.20	40.70	44.20
Baobab seed meal	-	-	43.20	43.80	40.90	37.80	37.30	40.80	37.30
Non nutritive cellulose	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Soya oil	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Sucrose	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Vitamin premix	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Dicalcium phosphate	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Table salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Calcium carbonate	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Calculated composition	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Crude protein	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

ST: Standard diet for rat using casein NFD: Nitrogen free diet RBSM: Raw baobab seed meal ABSM: Autoclaved baobab seed mealTSBM: Toasted baobab seed meal SWBM: Soaked in water baobab seed meal. SLBM: Soaked in liquor baobab seed meal.SPBM: Soaked in pulp baobab seed meal.SABM: Soaked in alkali baobab seed meal

Table 2: Nutritional indices of rats fed differently processed baobab seed meal

Indices	STD	NFD	RBSM	TBSM	SPBM	ABSM	SLBM	SWBM	SABM
MWG (g)	5.60	-14.26	-3.40	-4.02	-1.16	-5.70	-3.68	-1.20	2.03
	$\pm$0.35^{c}	$\pm$5.87^{a}	$\pm$3.76^{b}	$\pm$4.75^{b}	$\pm$2.33^{b}	$\pm$5.12^{b}	$\pm$4.34^{b}	$\pm$3.79^{b}	$\pm$3.62^{b}
TD (%)	99.82^{ab}	100^{b}	99.31^{ab}	98.91^{ab}	98.87^{ab}	98.92^{ab}	98.54^{a}	98.77^{ab}	98.71^{ab}
BV (%)	99.89	100	99.91	99.97	99.92	99.84	99.43	99.75	99.60

Values with different superscripts are significantly different ($p \leq 0.05$) TD:TrueDigestibiliity BV- Biological Value STD- Standard Diets NFD- Nitrogen Free Diet RSBM-Raw Baobab Seed Meal TBSM- Toasted Baobab Seed Meal SPBM- Soakeded in Pulp Baobab Seed Meal ABSM- Autoclaved Baobab Seed Meal SLBM- Soaked In Liquor Baobab Seed Meal SWBM- Fermented In Water Baobab Seed Meal SABM- Fermented In Alkali Baobab Seed Meal

Statistical analysis

Collected data were subjected to one-way analysis of variance (ANOVA) (17). Means that were significantly ($P < 0.05$) different were separated using the Duncan's Multiple Range Test.

Results and Discussion

True digestibility (TD) values of the experimental rats fed all the test diets were not significantly different ($p > 0.05$) except those feds oaked in maize liquor baobab seed meal which has a T/D value of 98.54%. The highest T/D, 99.31%was recorded in rats fed raw baobab seed meal. The true digestibility values recorded in this study were greater than those recorded by (16) and (18). This might be as a result of difference in the processing methods employed.

The biological values (BV) for the experimental diet ranged from 99.43% to 99.97%. The BV values of all the experimental rats were not significantly different ($p > 0.05$). The BV of rats fed casein were not significantly different ($p > 0.05$) from those fed processed baobab seed meals. Soaked in maize liquor baobab seed meal recorded the lowest BV, 99.43%. Biological value measures the proportion of absorbed nitrogen, which is retained and presumably utilised for protein synthesis and therefore reflects true protein quality (9). This indicates that the raw and processed baobab seed meals have good protein quality. Biological value is the currently much used method for assessing protein quality (19).

The best mean weight gained, 5.60$\pm$0.35g, was obtained in rats fed the

standard diet. This was followed by those fed with soaked in alkali baobab seed meal with a mean weight gain of 2.03±3.62g (Table 1). Apart from the mean weight gained by rats fed soaked in alkali baobab seed meal, the MWG by all the rats fed processed baobab seed meal were negative, signifying drops in weight. This is not in agreement with the findings of (16) who reported increase in weight gained by rats fed raw baobab seed meal compared to processed baobab seed meal. Weight gain and specific growth rate are usually considered as the most important measurement of productivity of diets (20). This indicates that meals processed by first soaking the seeds in an alkali medium performed best among the methods that were used to process baobab seed meal in this study.

Conclusion and Applications

1. Raw, toasted, autoclaved, soaked in pulp, water, alkali and liquor baobab seed meal have good protein quality and are highly digestible.
2. Soaked in liquor recorded the lowest biological and digestibility values.
3. Soaking in alkali is the best method of processing baobab seed compared to other aforementioned methods because it increased the mean weight gain.

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