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Chemical Composition And Feed Floatation Of Adansonia Digitata Meal Diet

GARBA T. H.[1], BUKAR M. A[2], VETSARY, P[3], NGATI FILIBUS[4]
[1]*Federal College of Fisheries and Marine Technology, Lagos, Nigeria*
[2]*College of Agriculture Gujba, Yobe State, Nigeria*
[3]*Department of fisheries, Modibbo Adama University Yola*
[4]*Federal University of Agriculture, Mubi, Adamawa State*

Abstract- ***An increase in the competitive use of soybean meal necessitates a need for another alternative plant protein. Based on this, Adansonia digitata "(Baobab) leaf meal was investigated for its phytochemicals, proximate compositions, floatation efficiency, and its effect on Clarias gariepinus, growth, feed utilization, hematological profile and cost-benefit for 84 days. 40% crude protein diets were formulated, and soybean meal was substituted for Baobab leaf meal at 0%, 10%, 20%, 30% and 40%, which were fed to 150 Clarias gariepinus fingerlings of average weight (0.71±0.05) and length (4.96±0.18) which were stocked at 10 fingerlings per tank. The results showed that diet T5 had the best floatation efficiency indices compared to other diets. Diet T5 had the highest mean weight gain (10.82±1.36g/fish), which is significantly different (p< 0.05) from the T1, T2, T3 and T4. There were significant differences (p< 0.05) in feed utilization between the groups and those fed 40% baobab meal. The cost of feeding the fish ranged from N293.84 to N397.31, which was reduced with an increase in the inclusions of Adansonia digitata leaf meal diets. As the inclusion level increases, the Profit index net profit benefit-cost ratio increases while the incidence of cost decreases. All these were significantly different (p≤0.05). Based on the results from this study, the Baobab leaf meal could be used to substitute for plant protein in the diet of Clarias gariepinus to 40% inclusion levels for aquaculture sustainability.***

I. MATERIALS METHODS

Experimental location

The experiment was conducted in the wet laboratory of the Department of Fisheries, Modibbo Adama University of Technology. The experimental set-up consisted of fifteen (15) glass tanks (60x30x95cm) in dimension. The glass tanks served as an aquatic environment for the experimental fish fingerlings and were covered with a net to prevent them from jumping out and predators from entering the glass tanks. The glass tanks were cleaned, disinfected with table salt and allowed to dry for 24 hours, after which water was supplied to two-thirds of the size of the tank, aerated with an electric aerator and covered with a net of mesh size 3mm. The experiment lasted for 12 weeks.

Experimental Design and Set-up

A completely randomized design was used for this experiment. Five experimental diets that have different inclusion levels were arranged serially in triplicate which formed the fifteen experimental units

Experimental Fish

The clarias gariepinus fingerlings were purchased from the Modibbo Adama University of Technology fish hatchery farm. The fish were acclimatized for three days in fifteen glass tanks measuring 60×30×95cm, and they were fed with the experimental diets.

Experimental Feed Preparation and Formulation

The ingredients that were used to formulate the experimental diet included Baobab Leaf Meal (BBLM), Soybeans, fish meal, maize and fixed feed ingredients (vitamin and mineral Premix, Lysine and methionine, salt and palm oil) were purchased from Jimeta main markets, Jimeta, Yola, Adamawa state. The feed ingredients were separately processed and milled to a fine powder using a hammer miller. The milled ingredients were kept in an airtight plastic container until it was required for use. Five experimental diets were formulated; the control diet (CTR) was without the baobab leaf meal, while the baobab leaf meal was used to substitute soybean meal in the other four experimental diets (T1, T2, T3, T4, and T5) at 0%, 10%, 20%, 30% and 40% inclusion levels respectively. (Table 1).

The feed ingredients were thoroughly mixed with hot water at a temperature of 100Ċ into a homogenized paste. The paste was pelletized (2mm) with a pelletizing machine.

Transportation of Fish Fingerlings

One hundred and fifty (150) *Clarias gariepinus* fingerlings of average weight (0.71±0.05) and length (4.96±0.18) were obtained from the Department of Fisheries Research Farm, Modibbo Adama University of Technology, Yola and transported to the laboratory in 50 L water storage can. They were held in glass tanks for one week for acclimatization and fed the experimental diet.

Processing of Baobab Leaf Meal (BBLM)

Baobab (*Adansonia digitata*) leaves were procured from Jimeta's main market in Jimeta, Yola. The leaves were washed with tap water to remove the dust so as to avoid contamination of the Baobab leaf meal. After that, the Baobab leaf meal was sun-dried before grinding into powder using a domestic hammer mill machine. The powdered BBLM was kept in an airtight plastic container at room temperature until it was required for use.

II. LABORATORY PROCEDURES

Phytochemical Screening of Baobab (Adansonia digitata)

Qualitative analysis

The presence of saponins, tannins, flavonoids, glycoside, steroids, anthraquinone and alkaloids was determined according to the method defined by Congesta *et al.* (2005.

Quantitative analysis

Total alkaloids, flavonoids, saponins, Tannins, Total Phenols, Cardiac Glycosides and Steroids were determined using the method described by Krishnaiah *et al*. (2009)

Proximate Analysis of Feed Sample

Determination of moisture

The moisture content of the samples was determined by weighing the samples and oven dried at 80^{o}C for 24 hours. The loss in weight gave the moisture content of the original sample.

$$\text{Moisture (\%)} = \frac{\text{Loss in Weight due to drying}}{\text{Weight of Sample Taken}} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

W_1 = Weight of crucible
W_2 = Weight of crucible + sample
W_3 = Weight of crucible + sample after drying

3.8.2 Determination of crude lipid

The crude lipid was determined by the continuous solvent extraction method in a Soxhlet apparatus, as described by James (1995).

3.8.3 Determination of crude fibre

The crude fiber was determined by the Weende method described by both Pearson (1976) and James (1995).

3.8.4 Determination of protein

The protein content of the samples was determined by the Kjeldhal method reported by James (1995). The total nitrogen was determined and multiplied by the factor 6.25 to obtain the protein concentration or content.

3.8.5 Determination of carbohydrate

The carbohydrate content of the test samples was determined by estimation using the arithmetical difference method described by Pearson (1976) and James (1995). The carbohydrate content was calculated and expressed as the nitrogen-free extract.

3.8.6 Determination of ash

The ash content of the samples was determined by the method described by James (1995).

III. FEED PELLET FLOATABILITY AND WATER STABILITY TEST.

Ten (10) pellets of each experimental feed were placed gently on the surface of the water in a glass tank for 30 minutes, and floatability was recorded

after every 5-minute interval. A water stability test was also conducted using 10 pellets (2 mm) diameter tied in a nylon sieve material of (0.1 mm mesh). They were carefully tied with a twine to avoid breakage. Ten (10) for each treatment were fixed in a glass tank and allowed to remain for time intervals ranging from 10 minutes to 50 minutes, with removal after every 10 minutes. At the end of every test, one of the samples for each replicate was lifted slowly with the aid of the twine and allowed to drain for 3 minutes, after which the contents were put on flat boards and oven-dried at 105°c for 24 hours to obtain the whole pellet at the start of the test. The following water stability (ws) indicated were calculated using the equation below:

i. Weight Gain (g): This was computed from the difference between the initial and final weight measured using a sensitive balance.

Weight gain (g) = $W_f - W_i$

ii. Sinking time rate (S.T.R): A calibrated stopwatch was used for the timing and recorded in seconds.

iii. Volume of water absorbed: The volume of water absorbed was calculated in relation to the density of water (1 g/cm³).

Volume of water absorbed = Mass (g) × density of water (g/cm³)

iv. Relative absorption rate =

$$\frac{W_f - W_i}{W_i} \times 100$$

v. Absorption efficiency rate (cm³/sec) =

$$\frac{\text{Volume of water absorbed}}{\text{Time taken}}$$

vi. Sinking time index (sec⁻¹) =

$$\frac{1}{\text{Time taken}}$$

vii. Water stability (%) =

$$\frac{\text{Final sample weight of pellet (g)} \times \text{LDM}}{\text{Initial sample weight of pellet (g)} \times \text{IDM}} \times 100$$

Where Wf = Final sample weight, Wi = Initial sample weight, IDM = Initial sample dry matter, and LDM = Final sample matter (Fagbenro and Jauncey, 1995).

Statistical Analysis

All the data were subjected to descriptive statistics, analysis of variance, correlation and line graph representation. The mean values were compared at a 5% significant level using the Duncan Multiple Range Test (Duncan, 1955). The statistical package of SPSS 16.0 for the windows 2007 was used for the statistical analysis.

IV. RESULT

Chemical Composition of *Adansonia digitata* Meal.

Table 2 presents the chemical composition of *Adansonia digitata* (baobab) meal diet. The dry matter value was in decreasing order from 92.68%, 92.61%, 92.50%, 92.33%, and 92.42%, respectively, for T1 (0%) control, T2 (10%), T3 (20%), T4 (30%) and T5 (40%) with an increased level of baobab leaf meal. The highest value of 40.40% crude protein was recorded in the control diet, T1 (0%), while the lowest crude protein of 39.66% was recorded in T4 (30%). The values of crude fiber ranged from 3.10% to 5.99% in increasing order of 0% > 10% > 20% > 30% and 40%, but crude lipid increased with the level of inclusion of baobab from T1(0%) to T3 (20%) and had a decreasing trend from 7.75% to 7.56% from T4 (30%) to T5 (40%). The ash values ranged from 9.35 to 10.39 %, with T4 (30%) having the lowest value of 9.08% and Nitrogen Free Extract (NFE) having a range of 28.7% (T5) to 33.52% (T4).

Qualitative and Quantitative Analysis of Adansonia digitata

The results of the qualitative phytochemical screening of *A. digitata* indicated the presence of total phenols, saponins, tannins, flavonoids, steroids, anthraquinones, quinones, cardiac glycosides, and alkaloids (Table 3). The quantitative phytochemical analysis showed flavonoids to be highest in milligram per gram (mg/g) of 0.357, followed by total phenols (0.210 mg/g), saponins (0.100 mg/g), alkaloids (0.043 mg/g), tannins (0.033 mg/g), cardiac glycosides (0.025 mg/g) and steroids (0.001 mg/g) respectively (Table 4).

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Feed Pellets Floatation and Water Stability

Results obtained for the floatability of the experimental diets formulated with varying levels of Baobab meal showed that after 30 minutes of exposure to water, the control diet (T1) had a sinking time rate of 2.00, T2 (4.00), T3 (3.00), T4 (8.00), and T5 (6.00). And the sinking time index ranged from 0.140 (T3) to 0.257 (T1) (Table 5). Furthermore, feed T2, T3, T4 and T5 showed a decrease in their floating ability compared to the control feed (T1). Diet T4 had the maximum sinking time of 8 seconds, followed by T5 (6 seconds), T2 (4 seconds), T3 (3 seconds) and control diet T1 (2 seconds). Results obtained for the water stability of the experimental diets (Table 4) formulated with varying levels of baobab showed that feed T4 had the highest values of 85.33% and the least value was from T1 with 60.33% These are significantly different ($p<0.05$) to each other.

Table 1: Ingredients Compositions (g/100g) of Experimental Diets

Ingredients	T1 (control)	T2	T3	T4	T5
Inclusion levels	0%	25%	50%	75%	100%
Fish meal	29.41	29.41	29.41	29.41	29.41
Soybean	29.41	22.06	14.71	7.35	0.00
Boabab meal	0.00	7.35	14.71	22.06	29.41
Maize meal	34.68	34.68	34.68	34.68	34.68
Starch	2.0	2.0	2.0	2.0	2.0
Calcium diphosphate	1.0	1.0	1.0	1.0	1.0
Vitamin and mineral Premix	0.5	0.5	0.5	0.5	0.5
Palm oil	0.5	0.5	0.5	0.5	0.5
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin C	0.5	0.5	0.5	0.5	0.5
Salt	1.5	1.5	1.5	1.5	1.5
Total	100.00	100.00	100.00	100.00	100.00
Calculated crude protein	40.00	40.00	40.00	40.00	40.00
Cost of feed production (N/kg)	367.31	319.70	330.15	263.84	264.70

Table 1.Proximate Compositions of Experimental Diets

Experimental Diets	Proximate Compositions (%)							Estimated Metabolizable Energy KJ/Kg
	Moisture	Dry matter	Crude protein	Crude fibre	Crude Lipid	Ash	Nitrogen Free Extract	
T1	7.32±0.14	92.68±0.14	40.40±0.33	3.1±1.24	6.8±0.51	9.35±0.51	33.03±1.99	13368.83±0.14
T2	7.39±0.14	92.61±0.14	40.17±0.33	3.35±1.24	7.65±0.51	9.41±0.51	32.03±1.99	13461.02±0.14
T3	7.5±0.14	92.5±0.14	39.69±0.33	4.36±1.24	8.21±0.51	9.85±0.51	30.39±1.99	13338.13±0.33

T4	7.67± 0.14	92.33± 0.14	39.66±0. 33	5.32±1 .24	7.75±0. 51	9.08±0 .51	33.52±1.99	13161.50±1.24
T5	7.58± 0.14	92.42± 0.14	39.78±0. 33	5.99±1 .24	7.56±0. 51	10.39± 0.51	28.7±1.99	12873.44

Table 2.Qualitative Phytochemical Screening of Adansonia digitata Leaf

S/No.	Phytochemical	Aqueous Extract	Methanolic Extract
1	Flavonoids	+	+
2	Triterpenes	-	-
3	Tannins	+	+
4	Resins	-	+
5	Coumarins		+
6	Steroids	+	+
7	Anthraquinones	+	+
8	Quinones	+	+
9	Saponins	+	+
10	Total Phenols	+	+
11	Alkaloids	+	+
12	Cardiac Glycosides	+	+
13	Terpenoids	-	-
14	Chalcones	-	-

Keys: + : presence
: Absence

Table 4: Quantitative Phytochemical Screening of *Adansonia digitata* (Baobab)

S/No.	Phytochemical	Concentration (mg/g) Mean Concentration (Mean±SD)			
1	Flavonoids	0.360	0.390	0.320	0.35
2	Tannins	0.033	0.035	0.030	0.03
3	Cardiac Glycosides	0.021	0.030	0.025	0.02
4	Saponins	0.110	0.090	0.100	0.10
5	Total Phenols	0.220	0.210	0.200	0.21
6	Alkaloids	0.040	0.048	0.040	0.04
7	Steroids	0.001	0.000	0.001	0.00

Table 3.*Adansonia digitata* Leaf Meal diets Pellets Floatation and Water Stability

Indices	T1	T2	T3	T4	T5	S.E
Weight before suspension (g)	15±0.00	15±0.00	15±0.00	15±0.00	15±0.00	15.00±0.00
Weight after suspension (g)	$22.7±1.32^{a}$	$20.80±1.32^{b}$	$19.20±1.32^{c}$	$19.70±1.32^{c}$	$20.20±1.32^{bc}$	20.52±1.32
Weight gain (g)	$7.70±1.36^{a}$	$5.80±1.36^{b}$	$4.20±1.36^{c}$	$4.70±1.36^{c}$	$5.20±1.36^{bc}$	5.52±1.36
Sinking time rate (sec)	2.00^{b}	4.00^{b}	3.00^{b}	8.00^{a}	6.00^{a}	4.60±2.41
Volume of water absorbed (cm^3)	$7.70±2.41^{a}$	$5.80±2.41^{b}$	$4.20±2.41^{c}$	$4.70±2.41^{c}$	$5.20±2.41^{bc}$	5.52±1.36
Relative absorption rate (%)	51.33^{a}	38.67^{b}	28.00^{c}	31.33^{bc}	34.67^{b}	36.80±9.04
Absorption Efficiency Rate	0.257^{a}	0.193^{b}	0.140^{c}	0.157^{c}	0.173^{bc}	0.18±0.05
Water stability (%)	60.33^{c}	68.67^{c}	78.03^{b}	85.33^{a}	80.67^{ab}	74.60±10.03
Sinking time index (min-*1*)	$0.500±0.15^{a}$	$0.250±0.15^{c}$	$0.333±0.15^{b}$	$0.125±0.15^{d}$	$0.167±0.15^{d}$	0.28±0.15

The mean of data on the same row with different superscripts are significantly different ($p \leq 0.05$

V. DISCUSSION

Feed Pellets Floatation and Water Stability

The research findings of this study showed that feed formulated with baobab meal (BLM) exhibited water stability, which decreased with the increase in inclusion level except for diet D5. This result is corroborated by the result of Momoh *et al*. (2016). The diet, however, had better floatation than the result recorded by (Adeparusi and Famurewa, 2011) when 40% CP diets were produced, possibly as a result of the inclusion of yeast in the experimental diet. This shows a positive trend of higher percentage stability with a higher percentage of cassava inclusion. Effiong *et al*., 2009, reported a water stability of 82.81% for fish feed formulated using

cassava starch as a binder after one hour of exposure to water. This is, however, lower than the 151.33% being reported in this research. This can be attributed to differences in the choice of treatment; while this research included maize and starch, duckweed was used in the research of (Effiong *et al*., 2009), hence accounting for the difference in water stability value.

The control feed (T1 – 0%) formulated with no baobab leaf meal (BLM) inclusion had the highest water stability. In fish feed formulation, water stability, floatability and nutrient leaching rate are the main issues. Although the feed will sink and disintegrate, it is lower compared to the time taken for the fishes to consume the feed that is disintegrating, but it is lower compared to the time taken for the fishes to consume the feed that is 10-15 minutes (Masser and Warts, 1992). The difference could be attributed to the difference in the ingredients used in formulating the experimental diets.

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