Floating and Stability Effect on Fish Feed Pellets Using Different Concentration of Baobab Leaf Meal (*Adansonia digitata*)

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Original Research Article

ABSTRACT

The objective of this study was to evaluate the floating and stability of fish feed pellets formulated with different concentration of Baobab (*Adansonia digitata*) leaf meal (BLM). Five isonitrogenous fish feed (35% CP) with varying inclusion levels of Baobab leaf meal (0% BLM, 4% BLM, 8% BLM, 12% BLM and 16% BLM designated as D_1, D_2, D_3, D_4 and D_5 respectively was used. Ten (10) pellets of each experimental feed were placed in plastic beaker (55 x 25 x 30 cm) for 50 minutes. Feed pellet floatability and stability were recorded every five minutes. Results showed that feed pellet floatability increased significantly (P<0.05) with increase in BLM concentration. Highest feed pellet floatability (41.66 ± 2.88 minutes) was recorded in D_5 (16 % BLM) and least (0.00 ± 0.00

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minutes) in D_1 (0% BLM) which sank down immediately. Similarly, feed pellet stability increased significantly ($P<0.05$) with increase in BLM concentration. Highest pellet stability (42.66 ± 1.17 minutes) was recorded for D_5 (16 % BLM) and least (18.54 ± 2.10 minutes) in D_1 (0% BLM). Based on these findings, it is concluded that 16% BLM inclusion level in fish feed has led to a high pellet floatability and stability. Therefore, Baobab leaf meal (BLM) which is relatively cheap, toxic free, easy to process and available specifically in Northern part of Nigeria is recommended for floating feed formulation.

Keywords: Water Stability; Floatability; Baobab Leaf Meal (BLM); Fish Feed Pellets; Adansonia digitata

1. INTRODUCTION

In Nigeria, fish farming is increasingly becoming very lucrative because Nigeria is one of the largest fish consumers in the world. For optimal health, fast growth and sustainable production of farmed fish, a balanced feed with a good physical characteristic such as pellet stability and floatability is required. Fish nutrition is therefore critical to sustainable aquaculture production as it represents about 60 – 80 % of the total production cost [1]. According to lim and Cuzon, [2], aquafeed can either be pelleted or extruded with particles of high durability to withstand handling, transportation stress. High quality aquafeed should be highly stable in water to minimize disintegration and loss of nutrients upon exposure to water. Floating feed is very suitable for pelagic or surface feeders because fish quickly get access to the feed and do not expend much energy in swimming to the bottom to source for food [3]. Impaired growth has been documented on feeding fish with non-floating and unstable feed due to disintegration and sinking of feed into mud or pond bottom restricting utilization by the target fish [4]. Such disintegration may lead to bacterial build up which is capable of causing diseases to the fish. Use of stable and floating feed will help in complete utilization by the fish and minimum wastage which will help in a more profitable and sustainable aquaculture production [5], [6]. Moreover, floating fish feed will enable the farmer to observe how much and how active their fish are responding to feed [7]. Baobab is a deciduous tree with a lifespan of hundreds to thousands of years [8]. Baobab spends only 4 months of the year in leaf with the fresh young leaves containing nutrients such as protein (4 %), vitamin a and c [9]. The fruit pulp has a very high content of vitamin c which is almost ten (10) times that of oranges [11].

Please arrange serially ref [10]

Baobab leaf is an excellent source of iron, calcium, potassium, manganese, molybdenum, magnesium, zinc and phosphorus. Energy value varies from 1180-1900kj/100g of which 80% is metabolized energy. The leaves are rich in pro-vitamins A and C. In terms of protein content, baobab leaves are rich in 5 out of the 8 essential amino acids [10]. In Nigeria, baobab is specifically available in the northern part of the country. Generally, baobab is comprised of eight (8) species with large, spectacular and nocturnal flowers [12]. *Adansonia digitata* is a baobab species that is indigenous to drier part of Africa while *Adansonia gibbosa* is restricted to the North-Western Australia. The remaining six (6) species are endemic to madagascar [13]. *A. Digitata* which grows in the arid and semi-arid region of Africa is commonly known as monkey bread which is derived from the fact that monkeys eat baobab fruit. In fish culture, one of the major factors that negatively influence growth and good health of fish is quality of feed with regards to nutrient profile and physical characteristics. Since commercial feed is highly expensive and sometimes, its availability and supply is inconsistent especially in rural areas where most fish farms are located, most farmers are presently formulating local feed using locally available ingredients [14]. The major challenges most of these fish farmers are facing is the sinking and poor stability of these locally formulated feed, which results in leaching of nutrients into the water, disintegration of feed, water pollution and growth of harmful bacteria which may predispose fish to diseases. This may result in poor growth performance of fish and reduced profitability [14]. Therefore, the objective of the study is to evaluate the effect of baobab leaf meal (*A. Digitata*) on the floatability and stability of fish feed pellets formulated with locally available raw materials.

2. METHODS

2.1 Study Area

The study was carried out in Fish Nutrition Laboratory of the department of fisheries, University of Maiduguri, Borno state, Nigeria. It is geographically located at latitude11.80°n and.longitude 13.19°e and it is situated at elevation 325 meters above sea level.

2.2 Collection and Processing of Baobab Leaves (*A. Digitata*)

Fresh baobab leaves (*A. Digitata*) were collected from the Botanical garden of the University of Maiduguri, and identified by a Botanist from University of Maiduguri. The leaves were soaked in water for 24 hours in other to eliminate anti-nutritional factors. Thereafter, the leaves were sundried before grounded into powder using the hammer miller and kept in an airtight container until required.

2.3 Formulation of Experimental Diets

Five isonitrogenous fish feed (35% cp) with varying inclusion levels of baobab leaf meal (0% blm, 4% blm, 8% blm, 12% blm and 16% blm designated as d_1, d_2, d_3, d_4 and d_5 respectively was used (Table 1). The experimental diets were formulated according to pearson square methods.

2.4 Feed Pellet Floatability and Water Stability Test

Ten (10) pellets of each experimental feed were placed gently on the surface of water in a plastic basin of size 55 x 25cm for 50 minutes and floatability was recorded after every 5 minutes interval. Water stability test was conducted using 10 pellets (2mm) diameter tied in a nylon sieve material of (0.1mm mesh). They were carefully tied with a twine to avoid breakage. Ten (10) for each treatment were fixed in a plastic basin of size 55 x 25cm and allowed to remain for time interval 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 (lim and cuzon, 1994). The water stability (ws) was calculated using the equation below;

Water stability (mins) = weight of retained whole pellets/ initial weight of pellets x time taken.

2.5 Proximate Composition of Experimental Diets

Proximate composition of each experimental diet was analyzed according to the methods of AOAC [15]. Protein and lipid were determined by the micro kjeldahl and soxhlet extraction of samples.

2.6 Statistical Analysis

Data obtained from the experiment were subjected to one way analysis of variance (ANOVA) with the aid of statistix version 8.0 and means separation between the treatments was done using LSD at 0.05 % confidence level ($p= 0.05$).

3. RESULTS AND DISCUSSION

The proximate composition (Table 2) of the experimental diets formulated with varying levels of baobab leaf meal (BLM) showed that the highest crude protein (32.80%), crude fibre (19.66%), crude fat (8.10%), crude ash (2.33%) and NFE (35.95%), were obtained in d_5 (16 % BLM), while the lowest crude protein (29.47%), crude fibre (13.33), crude fat (6.55%) and the highest moisture content (10.56%) were analyzed from d_1 (control). D_3 (8 % BLM) had the highest dry matter of 97.30 % and the lowest crude ash of (1.66 %). There was no significant difference ($p>0.05$) between the proximate compositions of the diets with varying inclusion levels of baobab leaf meal (BLM) because the diets are isonitrogenous and the crude protein is the same.

Results obtained for the floatability of the experimental diets (Table 3) formulated with varying levels of Baobab leaf meal (BLM) showed that after 50 minutes of exposure to water, the control diet did not float at all recording a mean floating time of 0.00 ± 0.00 minutes. Furthermore, feed D_2, D_3, D_4 and D_5 showed a significant ($p<0.05$) improvement in their floating ability compared to the control feed (D_1). D_5 had the maximum floatation period of 41.66 ± 2.88 minutes, followed by D_4 (25.00 ± 0.00 minutes), D_3 (10.00 ± 5.00 minutes) and D_2 (8.33 ± 2.88 minutes). Results obtained for the stability of the experimental diets (Table 3) formulated with varying levels of baobab leaf meal (BLM) showed that feed formulated with blm had a significantly higher ($p<0.05$) stability compared to the control

Table 1. Percentage composition of experimental diets

Ingredients	Experimental diets				
	D_1	D_2	D_3	D_4	D_5
Wheat bran	55.36	55.36	55.36	55.36	55.36
Fish meal	21.67	21.67	21.67	21.67	21.67
Soya bean	21.67	21.67	21.67	21.67	21.67
Premix	0.30	0.30	0.30	0.30	0.30
Vitamin c	0.05	0.05	0.05	0.05	0.05
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.35	0.35	0.35	0.35	0.35
Lysine	0.30	0.30	0.30	0.30	0.30
Baobab leave	0	4	8	12	16

Table 2. Proximate composition of the experimental diets

Indices	D_1 (0 % blm)	d_2 (4 % blm)	d_3 (8 % blm)	d_4 (12 % blm)	d_5 (16 % blm)
Crude protein	29.47 ± 0.55^b	31.7 ± 0.32^{ab}	32.05 ± 1.05^a	31.44 ± 0.45^{ab}	32.80 ± 1.11^a
Fat	6.55 ± 7.66^c	7.52 ± 1.00^b	7.77 ± 0.57^b	8.01 ± 2.48^a	8.10 ± 2.50^a
Fibre	13.33 ± 2.51^c	16.00 ± 1.0^{bc}	16.00 ± 1.0^{bc}	17.00 ± 2.30^{ab}	9.66 ± 1.15^a
Ash	2.00 ± 0.00^a	2.33 ± 0.57^a	1.66 ± 0.57^a	2.00 ± 0.00^a	2.33 ± 0.57^a
Dry matter	89.43 ± 7.66^a	97.23 ± 0.64^a	97.30 ± 0.43^a	94.31 ± 1.59^a	95.80 ± 2.95^a
Moisture	10.56 ± 7.66^a	2.76 ± 0.64^a	2.70 ± 0.43^a	5.60 ± 1.51^a	4.28 ± 0.95^a
Nfe	38.09±0.043	39.62±0.094	39.8±0.193	35.95±0.225	32.83±0.316

**means with the same superscript are not significantly different (p>0.05)*

Table 3. Pellets characteristics of experimental diets formulated with baobab leaf meal (BLM)

Pellet characteristics	D_1 (0%blm)	D_2 (4%blm)	D_3 (8%blm)	D_4 (12%blm)	D_5 (16%blm)
Initial weight of pellets (g)	1.42 ± 0.08^c	2.69 ± 0.06^b	3.12 ± 0.20^a	3.01 ± 0.80^{ab}	3.40 ± 0.15^a
Weight of retained whole pellets (g)	0.53 ± 0.08^d	1.76 ± 0.08^c	2.20 ± 0.20^{bc}	2.36 ± 0.23^b	2.90 ± 0.05^a
Stability (mins)	18.54 ± 2.10^c	32.76 ± 1.05^b	35.23 ± 2.42^b	39.12 ± 2.94^{ab}	42.66 ± 1.17^a
Floatability (mins)	0.00 ± 0.00^d	8.33 ± 2.88^c	10.00 ± 5.00^c	25.00 ± 0.00^b	41.66 ± 2.88^a
Floatability rate (%)	0.00 ± 0.00^d	16.66 ± 2.88^c	20.00 ± 5.00^c	50 ± 0.00^b	83.32 ± 2.88^a

**means with the same superscript are not significantly different (p>0.05)*

feed (D_1). After 50 minutes of exposure to water, feed D_5 had the highest water stability of 42.66 ± 1.17 minutes whereas feed D_1 had the lowest water stability of 18.54 ± 2.10 minutes. Feed D_2 had water stability of 32.76 ± 1.05 minutes, D_3 (35.23 ± 2.42 minutes) and D_4 (39.12±2.94).

Findings of this study showed that feed formulated with baobab leaf meal (BLM) exhibited floating ability which increased with the increase in inclusion level. The control feed (D_1 – 0% BLM) formulated with no baobab leaf meal (BLM) inclusion had no floating ability while D_5 (16 % BLM) had the highest floating ability and water stability. In fish feed formulation, water stability, floatability and nutrient leaching rate are the main issues. Although the feed will sink and disintegrate but it is lower compared to the time taken for the fishes to consume the feed that is disintegrate but it is lower compared to the time taken for the fishes to consume the feed that is 10-15 minutes [1]. The implication of findings obtained in this study is that feeding fish with feed d_5 (16 % BLM) will not result in loss of feed pellet and nutrients due to sinking into mud or pond bottom which may decay leading to water pollution and bacterial growth which may cause diseases. The different inclusion level of baobab (*A. Digitata*) leaf added to the feed, contributed to the floatability and the stability of the fish feed after exposure for 50 minutes. According to solomon *et al.,* [16], wheat grain starch (WGS) recorded 50 % floatation at 50 minutes exposure to water. This is however lower than results obtained for feed D_5 (16% BLM) with a floatability rate of 83.32 % but similar to floatability rate of 50% obtained for feed D_4 (8% BLM) after exposure to water for 50 minutes. The difference could be attributed to the difference in the ingredients used in formulating the experimental diets. This implies that the inclusion of baobab leaf meal (BLM) in fish feed will result in a better floatability compared to wheat grain starch (WGS). The floatability characteristics observed in baobab leaf meal (BLM) could be due to the presence of high glutein protein in baobab leaf meal (BLM) compared to wheat grain starch (WGS). [17] reported a water stability as high as 82.81 % in fish feed formulated with cassava starch as a binder after 50 minutes exposure to water. This is however lower than the 83.32 % reported for feed D_5 (16 % BLM) in the present study. [18] reported a floatation period of 40% when crushed water melon shell was added at 15% in a fish diet, this is however lower than 50% obtained from this study at 12% inclusion of (BML). Findings of this study indicates that baobab leaf meal (BLM) has proven to aid feed buoyancy and stability when included in the right form and percentage. When feed sinks, there is a serious nutrient loss due to leaching of the essential vitamins like vitamin A, D, E, K of fat soluble status and about one third of the free plus protein bound amino acid. Extruded floating feed cost is quite a disadvantage over a dried and moist pellet [19]. And as such, floating feed is a management tool as it enables the farmer to observe the feeding activity of their fishes [20]. Though feed (D_1 – 0% BLM) and (D_2 – 4% BLM) exhibited low buoyancy, the two feeds can still be utilized by benthic feeders like catfish [21].

The result from this study showed that ingredients used in fish feed formulation influenced the pellet characteristics. The natural binding quality of the ingredient used in feed formulation could be utilized to their fullest capacity instead of adding non-nutritive agents. Therefore, to formulate floating local feed, careful selection of feedstuff or ingredients is a necessity to enhance the buoyancy of feed since some feedstuffs have positive buoyancy characteristics.

4. CONCLUSION

The use of baobab leaf meal (BLM) as a binder and floatability agent in local feed formulation has yielded a very positive result in the present study. Baobab leaf meal (BLM) is relatively cheap, toxic free and available specifically in the northern part of Nigeria. Baobab leaf meal (BLM) is easy to process and its usage in floating feed formulation is cheap compared to the cost of importing extruded floating feed from the western nation. However, there is a need to perform an in-vitro experiment with fish.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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