

Original Research Article

THE EFFECT OF VARYING INCLUSION LEVELS OF BAOBAB (*Adansonia digitata*) LEAF MEAL ON THE FLOATABILITY AND STABILITY OF FISH FEED PELLETS

ABSTRACT

To assess the effect of varying inclusion levels of Baobab (*Adansonia digitata*) leaf meal on the floatability and stability of locally formulated fish feed pellets. Five isonitrogenous fish feed (35% CP) with five different inclusion levels of Baobab leaf meal (BLM) including 0.0% (control), 4 %, 8 %, 12 % and 16% labelled D₁, D₂, D₃, D₄ and D₅ were formulated respectively. The study was carried out in Fish Nutrition Laboratory of the Department of Fisheries, University of Maiduguri. Between June to August 2015. 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. Floatability and stability were recorded at different time intervals. After 50 minutes period of exposure to water, results showed that floatability of the experimental feed increased significantly ($P<0.05$) with increase in (BLM) inclusion level with Feed D₅ recording the highest floatability time of 41.66 ± 2.88 minutes and Feed D₁ (Control) sank immediately with 0.00 ± 0.00 minutes of floatability. Similarly, stability of the experimental feed in water also increased significantly ($P<0.05$) with increase in (BLM) inclusion level with Feed D₅ recording the highest water stability time of 42.66 ± 1.17 minutes and Feed D₁ (Control) recorded the least water stability time of 18.54 ± 2.10 minutes. Based on findings of this study, the inclusion of (BLM) at 16 % level has the potential to enhance fish feed floatability and stability. (BLM) is relatively cheap, toxic free and available specifically in the Northern part of Nigeria. (BLM) is easy to process and its usage in formulating local floating feed is cheap compared to the cost of importing extruded floating feed from the Western nation.

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

1. INTRODUCTION

Fish farming is increasingly becoming very lucrative in Nigeria 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 which is also rich in nutrients required by fish has to be fed. 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 and be of good water stability to minimize disintegration and loss of nutrients upon

29 exposure to water. Floating feeds is very suitable for pelagic or surface feeders because
30 fish quickly get access to the feed and do not expend much energy in swimming to the
31 bottom to source for feed [3]. Impaired growth has been documented on feeding fish with
32 non-floating and unstable feeds due to disintegration and sinking of feed into mud or pond
33 bottom restricting utilization by the target fish [4]. Such disintegration may lead to bacterial
34 build up which is capable of causing diseases to the fish. Use of stable and floating feed will
35 help in complete utilization by the fish and minimum wastage which will help in a more
36 profitable and sustainable aquaculture production [5] [6]. Moreover, floating fish feed will
37 enable the farmer to observe how much and how actively their fish are responding to feeding
38 [7]. Baobab is deciduous tree which has a lifespan of hundreds to thousands of years [8].
39 According to Huges and Philippe [9], Baobab spends only 4 months of the year in leaf with
40 the fresh young leaves containing nutrients such as protein (4 %), vitamin A and C [10]. The
41 fruit pulp has a very high content of vitamin C which is almost ten (10) times that of oranges
42 [11]. Baobab leaf is also an excellent source of iron, calcium, potassium, Manganese,
43 Molybdenum, magnesium, zinc and phosphorus [10]. In Nigeria, Baobab is specifically
44 available in the Northern part of the country. Baobab is generally comprised of eight (8)
45 species with large, spectacular and nocturnal flowers [12]. *Adansonia digitata* is a Baobab
46 species that is indigenous to drier part of Africa. *Adansonia gibbosa* is another Baobab
47 species that is restricted to the North-Western Australia and the remaining six (6) species
48 are endemic to Madagascar [13]. *A. digitata* which grows in the arid and semi-arid region of
49 Africa is commonly known as monkey bread which is derived from the fact that monkeys eat
50 Baobab fruit. One of the major challenges fish farmers are facing is the sinking and poor
51 stability of locally formulated feed which results in leaching of nutrients into the water,
52 disintegration of feed, water pollution and growth of harmful bacteria which may cause
53 diseases. This may result in poor growth performance of fish and reduced profitability
54 [14]. Therefore, the objective of the study is to evaluate the effect of Baobab leaf meal (*A.*
55 *digitata*) on the floatability and stability of fish feed pellets formulated with locally available
56 raw materials.

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58 **2. MATERIAL AND METHODS**

59 **2.1 STUDY AREA:** the study was carried out in fish nutrition laboratory of the Department of
60 Fisheries, University of Maiduguri, Borno State, Nigeria. It is located 11.85 latitude and 13.16
61 longitude and it is situated at elevation 325 meters above sea level. It occupies a total
62 landmass of 50,778sq km (Ministry of land and survey Maiduguri, 2008).

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65 **2.2 Composition and formulation of experimental feed**

66 The experimental feed (Table 1) is composed of Baobab leaf meal (BLM), soybeans meal,
67 fishmeal, wheat bran, vitamin premix, methionine, sodium chloride, calcium, lysine, vitamin

68 C, and water. Fresh Baobab leaves (*A. digitata*) were collected from the Botanical garden of
 69 the University of Maiduguri, and identified by a Botanist from University of Maiduguri. The
 70 leaves were soaked in water for 24 hours in order to eliminate anti-nutritional factors.
 71 Thereafter, the leaves were sundried before grounded into powder using the hammer miller
 72 and kept in an airtight container until required. Five isonitrogenous diets (35 % CP) labeled
 73 D₁, D₂, D₃, D₄ and D₅ were formulated using Pearson square method with five varying levels
 74 of Baobab leaf meal (BLM). The varying levels included 0 % (control), 4 %, 8 %, 12 % and
 75 16 %.

76 **Table 1: Percentage composition of experimental diets**

Ingredients	Experimental diets				
	D ₁ (0 % BLM)	D ₂ (4 % BLM)	D ₃ (8 % BLM)	D (12 % BLM)	D ₅ (16 % BLM)
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
Total	100	100	100	100	100

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81 **Figure 1:** Baobab (*Adansonia digitata*) tree from the University of Maiduguri botanical
82 garden.

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84 **2.3 Floatability Experiment**

85 Ten (10) pellets of each experimental feed were placed gently on the surface of water in a
86 plastic basin of size 55 x 25cm for 50 minutes and floatability was recorded after every 5
87 minutes interval.

88 **2.4 Stability Test**

89 Water stability test was conducted using 10 pellets (2mm) diameter tied in a nylon sieve
90 material of (0.1mm mesh). They were carefully tied with a twine to avoid breakage Ten (10)
91 for each treatment were fixed in a plastic basin of size 55 x 25cm and allowed to remain for
92 time interval ranging from 10 minutes to 50 minutes with removal after every 10 minutes. At
93 the end of every test, one of the samples for each replicate was lifted slowly with the aid of
94 the twine and allowed to drain for 3 minutes after which the contents were put on flat boards
95 and oven-dried at 105°C for 24 hours to obtain the whole pellet at the start of the test (Lim
96 and Cuzon, 1994). The water stability (WS) was calculated using the equation below;

97 Water Stability (mins) = weight of retained whole pellets/ initial weight of pellets x time taken

98 **2.5 Proximate Analysis of the Experimental Diets**

99 The proximate composition of each experimental diet was analyzed according to the
100 methods of AOAC [15]. Protein and lipid were determined by the micro Kjeldahl and Soxhlet
101 extraction of samples.

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106 **2.6 Data analysis**

107 Data obtained from the experiment were subjected to One Way Analysis of Variance
108 (ANOVA) with the aid of Statistix version 8.0. Means separation between the treatments was
109 done using LSD at 0.05 % confidence level ($P= 0.05$).

110 **3. RESULTS AND DISCUSSION**

111 **3.1 Proximate Composition of the Experimental Diets**

112 The proximate composition (Table 2) of the experimental diets formulated with varying levels
113 of Baobab leaf meal (BLM) showed that the highest crude protein (32.80%), crude fibre
114 (19.66%), crude fat (8.10%), crude ash (2.33%) and NFE (35.95%), was obtained in D₅ (16
115 % BLM), while the lowest crude protein (29.47%), crude fibre (13.33), crude fat (6.55%) and
116 the highest moisture content (10.56%) was analyzed from D₁ (control). D₃ (8 % BLM) had
117 the highest dry matter of 97.30 % and the lowest crude ash of (1.66 %). **There was no**
118 **significant difference ($P>0.05$) between the proximate compositions of the diets with varying**
119 **inclusion levels of Baobab leaf meal (BLM).**

120 **3.2 Floatability of the Experimental Diets**

121 Results obtained for the floatability of the experimental diets (Table 3) formulated with
122 varying levels of Baobab leaf meal (BLM) showed that after 50 minutes of exposure to water,
123 the control diet did not float at all recording a mean floating time of 0.00 ± 0.00 minutes.
124 Furthermore, feed D₂, D₃, D₄ and D₅ showed a significant ($P<0.05$) improvement in their
125 floating ability compared to the control feed (D₁). D₅ had the maximum floatation period of
126 41.66 ± 2.88 minutes, followed by D₄ (25.00 ± 0.00 minutes), D₃ (10.00 ± 5.00 minutes) and
127 D₂ (8.33 ± 2.88 minutes).

128 **3.3 Stability of the Experimental Diets**

129 Results obtained for the stability of the experimental diets (Table 3) formulated with varying
130 levels of Baobab leaf meal (BLM) showed that feed formulated with BLM had a significantly
131 higher ($P<0.05$) stability compared to the control feed (D₁). After 50 minutes of exposure to
132 water, feed D₅ had the highest water stability of 42.66 ± 1.17 minutes whereas feed D₁ had
133 the lowest water stability of 18.54 ± 2.10 minutes. Feed D₂ had water stability of 32.76 ± 1.05
134 minutes, D₃ (35.23 ± 2.42 minutes) and D₄ (39.12 ± 2.94).

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142 **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

143 *Means with the same superscript are not significantly different ($P>0.05$)144 **Table 3: Pellets characteristics of experimental diets formulated with Baobab leaf**
145 **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

146 *Means with the same superscript are not significantly different ($P>0.05$)

147 Findings of this study showed that feed formulated with Baobab leaf meal (BLM)
 148 exhibited floating ability which increased with the increase in inclusion level. The control feed
 149 (D₁ – 0% BLM) formulated with no Baobab leaf meal (BLM) inclusion had no floating ability
 150 while D₅ (16 % BLM) had the highest floating ability and water stability. In fish feed
 151 formulation, water stability, floatability and nutrient leaching rate are the main issues.
 152 Although the feed will sink and disintegrate but it is lower compared to the time taken for the
 153 fishes to consume the feed that is 10-15 minutes [1]. The implication of findings obtained in
 154 this study is that feeding fish with feed D₅ (16 % BLM) will not result in loss of feed pellet and
 155 nutrients due to sinking into mud or pond bottom which may decay leading to water pollution
 156 and bacterial growth which may cause diseases. The different inclusion level of Baobab (*A.*
 157 *digitata*) leaf added to the feed, contributed to the floatability and the stability of the fish feed

158 after exposure for 50 minutes. According to Solomon *et al.*, [16], wheat grain starch (WGS)
159 recorded 50 % floatation at 50 minutes exposure to water. This is however lower than results
160 obtained for Feed D₅ (16% BLM) with a floatability rate of 83.32 % but similar to floatability
161 rate of 50% obtained for Feed D₄ (8% BLM) after exposure to water for 50 minutes. The
162 difference could be attributed to the difference in the ingredients used in formulating the
163 experimental diets. This implies that the inclusion of Baobab leaf meal (BLM) in fish feed will
164 result in a better floatability compared to wheat grain starch (WGS). The floatability
165 characteristics observed in Baobab leaf meal (BLM) could be due to the presence of high
166 gluten protein in Baobab leaf meal (BLM) compared to wheat grain starch (WGS). [17]
167 reported a water stability as high as 82.81 % in fish feed formulated with cassava starch as a
168 binder after 50 minutes exposure to water. This is however lower than the 83.32 % reported
169 for Feed D₅ (16 % BLM) in the present study. Findings of this study indicates that Baobab
170 leaf meal (BLM) has proven to aid feed buoyancy and stability when included in the right
171 form and percentage. When feed sinks, there is a serious nutrient loss due to leaching of the
172 essential vitamins like Vitamin A, D, E, K of fat soluble status and about one third of the free
173 plus protein bound amino acid. Extruded floating feed cost is quite a disadvantage over a
174 dried and moist pellet [18]. And as such, floating feed is a management tool as it enables the
175 farmer to observe the feeding activity of their fishes [19]. Though feed (D₁ – 0% BLM) and
176 (D₂ – 4% BLM) exhibited low buoyancy, the two feeds can still be utilized by benthic feeders
177 like Catfish [20]. The result from this study showed that ingredients used in fish feed
178 formulation influenced the pellet characteristics. The natural binding quality of the ingredient
179 used in feed formulation could be utilized to their fullest capacity instead of adding non-
180 nutritive agents. Therefore, to formulate floating local feed, careful selection of feedstuff or
181 ingredients is a necessity to enhance the buoyancy of feed since some feedstuffs have
182 positive buoyancy characteristics.

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184 **4. CONCLUSION**

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186 The use of Baobab leaf meal (BLM) as a binder and floatability agent in local feed formulation
187 has yielded a very positive result in the present study. Baobab leaf meal (BLM) is relatively
188 cheap, toxic free and available specifically in the Northern part of Nigeria. Baobab leaf meal
189 (BLM) is easy to process and its usage in floating feed formulation is cheap compared to the
190 cost of importing extruded floating feed from the Western nation.

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