Comparative Analysis of Sinking Time Index and Water Stability of Different Inclusion Level of Cassava Flour and Brewer Yeast in a Test Diet

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Abstract: The ability of fish feed to maintain its nutritional content for considerable period of time in pond water has become an important aspect of aquaculture. Several feed binder, mostly starch with other ingredient capable of creating air trap within the pellet of formulated feed has been used to improve the integrity of fish feed in water. The presence of the above characteristics in cassava flour and brewer yeast inform their selection for this experiment. This research, therefore, compares the effect of different percentage inclusion of cassava flour and brewer yeast on fish feed stability and sinking time index of a test diet. Pearson square method was used to formulate a 40% crude protein diet using fish meal, soyabean meal, groundnut cake, rice bran, maize and brewer dry grain. Cassava and yeast were included at 5, 10, 15, 20 and 25% level and represented as C1, C2, C3, C4, C5 for cassava and Y5, Y4, Y3, Y2 and Y1 for yeast, respectively. The treatments were represented as C1Y5, C2Y4, C3Y3, C4Y2, C5Y1. Floatation tests and water stability test were conducted to determine floatation and the level of disintegration of the test diet per time, respectively. All data were analyzed using Analysis of Variance (ANOVA) followed by Fisher's Least Square Difference (LSD) at 5% level of significance. The result of the experiment revealed significant different across the floatability of the test diet. The diet (C1Y5) had the best floating time index while the diet (C5Y1) had the least floatability performance. Water Stability shows diet (C5Y1) gave the best water stability percentage while (C1Y5) gave the least water stability percentage. The result of the experiment shows that brewer yeast is a very good floating agent and can support floatation of feed in water for more than 25 min, while cassava flour has shown itself as a capable candidate for prolonging the stability of aqua feed in water. Further research can be conducted in the direction that will determine the percentage inclusion of a floating agent and a binder for maximum result of floatation and water stability determination.

Key words: Fish feed, feed binder, aquaculture, treatments, characteristics, experiment

INTRODUCTION

The success of fish farming business depends largely on the provision of low cost and good quality fish feed that can guarantee optimum feed conversion ratio. Presently, aquaculture production still frequently experiences low feed conversion efficiency which is mostly linked to feed wastage (Devenport, 2003). In a bid to produce good quality feed that will give the best feed conversion efficiency and reduce wastage, scientist have resolved to the production of feed with high nutritional value (Barrows *et al.*, 2008) and maximum water stability and digestibility (Hansen and Storebakken, 2007; Booth *et al.*, 2000; Bahurmiz and Ng, 2007) through the use of starch to bind nutrient components of feed together. Starch is an important component of fish feed, it serves the purpose of binding the ingredients in order to form a durable, floating and water stablepellet (Obi *et al.*, 2011). In Nigeria, floating feed is in greater demand than sinking pellets, this is because it offers the opportunity for the farmer to observe feeding activityand satiation point of

fish thereby discouraging overfeeding and feed wastage. Floating feed also exhibits superior characteristics such as greater water stability, digestibility, water protection, zero water pollution and zero wastage of raw materials (Almaraaj, 2015).

Unfortunately, only calculatedchoice of ingredient combination and starch component's will give the desired result of floatation and binding quality of the feed (Strahm and Plattner, 2001). Therefore, it is important tocombine ingredients that will give low bulk density and high buoyancy pelleted feed (Obi *et al.*, 2011). In order to produce feed with these characteristics, it will require the inclusion of good quality feed binder which is normally starchy feed material like cassava tuber starch, maize flour starch ormillet flour starch among others (Solomon *et al.*, 2011) in combination with other feed materials that have the characteristics of trapping air within pellet of the formulated feed such as yeast, duckweed, honeycomb and melon shell (Obi *et al.*, 2011). The presence of the above characteristics in cassava flour and brewer's dry grain as reported by Solomon *et al.*

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(2011) inform their selection for this experiment. This research, therefore, compares the effect of different percentage inclusion of cassava flour and brewer yeast on fish feed stability and sinking time index.

MATERIALS AND METHODS

Source and processing of feed materials: The feed materials used for the experiment (cassava flour, fish meal, maize, yeast, groundnut cake, soyabean meal, rice bran and brewer dry grain) were all sourced from a reputable feed milling industry at Akobo, Ibadan. All the feedstuffs were given appropriate processing and handling care to improve their digestibility and remove anti-nutritional factor. Soyabean, groundnut cake and fish meal will be processed as described by Solomon *et al.* (2011) while yellow maize, rice branand brewer yeast were prepared following the description of Gbadamosi *et al.* (2006). Dried cassava tuber was ground to powder after processing and sieved with a 0.2 mm sieved before use in the formulation of the diet.

Feed formulation: Pearson square method was used to formulate a 40% crude protein diet using fish meal (25%), soyabean meal (15%) and groundnut cake (10%) as the protein ingredient in the mixture, while rice bran (8%), maize (10%) and brewer dry grain (7%) was included in the diet. Cassava and yeast were each included at 0, 5, 10, 15, 20 and 25% level and represented as C1, C2, C3, C4, C5 for cassava and Y5, Y4, Y3, Y2 and Y1 for yeast, respectively. The treatments were represented as C1Y5, C2Y4, C3Y3, C4Y2, C5Y1.

Production of pellet: All ingredients to be used were severally milled until a fine particle of 0.5 mm size was achieved. This is necessary in order to ensure a homogenous particle size for proper mixing and binding of the diets (Houlihan *et al.*, 2008; Jauncey *et al.*, 2007). The milled ingredients were weight-out using Tree KRS 502 scale 500×0.01 g precision in respect to the percentage of composition in the formulation earlier calculated as shown in Table 1. Other additives including

salt, lysine, methionine and premixes were also added after which they were mixed together using a mini mixer until a homogenous blend was obtained (Table 2). Hot water was used to prepare the ingredients into consistent dough and the pellets were produced using 4 mm die holes on an extruding machine yearmega model DGP 120.

Experimental set up

Floatation or buoyancy test: Glass aquaria of dimensions 54×30×27 cm were filled up to ¾ of its capacity (32805 cm^3) with tap water in the Fisheries and Aquaculture Laboratory of the University of Ibadan, Nigeria. Floatation or buoyancy tests were carried out using glass aquaria triplicates for each treatment, hence, a total of 15 glass aquaria were used for the study. Twenty pellets of each diet bound with different level of cassava and yeast as floater were dropped into the aquarium and observed for 25 min at 5 min interval. At the end of every observation (timing was made by a stop-watch), the number of pellets that were afloat were recorded accordingly. The mean numbers of the floating pellets were expressed as in Eq. 1:

$$\text{Pellets afloat } (\%) = \frac{\text{Final No. of pellets afloat}}{\text{Initial No. of pellets afloat}} \times 100 \quad (1)$$

Water stability test: Water stability of each diet was measured for a period of 20, 40 and 60 min. This was done by placing 10 pellets of each replicate into a nylon sieve materials of 1 mm mesh size, tied with a string and inserted into an aquarium containing pond water. At the end of every test time, one of the samples for each

Table 1: Gross composition of diet

Feed materials			Values (%)		
Fishmeal	25	25	25	25	25
Soyabean meal	15	15	15	15	15
Groundnut cake	10	10	10	10	10
Rice bran	8	8	8	8	8
Maize	10	10	10	10	10
BDG	7	7	7	7	7
Cassava	5	10	15	20	25
Yeast	25	20	15	10	5
Total	100	100	100	100	100

Table 2: Proximate composition of ingredient

Ingredient	M	CP	CL	CF	Ash	NFE	ME
Rice bran	1.5	12.19	1.0	11.4	2.0	72.30	2921
Cassava flour	0.8	10.58	0.6	13.1	1.0	70.32	2985
Soyabean meal	1.5	44.60	7.0	6.5	6.0	33.40	2798
Brewer's dry grain	2.5	21.88	4.5	15.3	2.5	55.82	2507
Maize	9.5	10.34	4.0	6.5	3.0	76.16	3554
Fish meal	3.5	68.50	10.2	2.5	8.0	10.9	2860
Groundnut cake	1.0	42.90	2.5	1.2	8.0	32.8	2864
Yeast	7.0	45.20	1.0	2.7	4.2	46.9	2842

CP = Crude Protein (%), CL = Crude Lipid (%), NFE (%), ME (kcal/kg)

replicate was lifted slowly with the aid of the twine and allowed to drain for 3 min after which the contents were put on flat boards and sun-dried and weighed to obtain dry matter weight. The weight obtained here was the left over from the original weight after immersion due to disintegration for each test period, i.e., weight of whole pellets. The water stability was calculated as the percentage of the weight of retained (whole) pellets against the initial total sample dry weight as expressed in Eq. 2:

$$\text{Water stability}(\%) = \frac{\text{Weight of retained whole pellets}}{\text{Initial total weight of pellets}} \times 100$$

$$(2)$$

Data analysis: All data were analyzed using Analysis of Variance (ANOVA) followed by Fisher's Least Square Difference (LSD) at 5% level of significance.

RESULTS AND DISCUSSION

Proximate composition: The proximate composition of the test diet shows that the treatment C1Y5 and C5Y1 has the highest and lowest percentage of crude protein, respectively with the crude protein decreasing across the treatment with decreasing percentage inclusion of yeast and increasing percentage inclusion of cassava flour. This attribute can be directly linked to higher crude protein in yeast as compared to cassava flour; this is as tarried with the findings of (Eyo, 2005). Crude fibre also shows slight significance among the treatments with no significance between C1Y5 and C2Y4 (Table 3).

Floatation result: The result shows significant different across the floatability of the test diet. The diet (C1Y5) had the best floating time index while the diet (C5Y1) had the least floatability performance. Generally, floatability decreases progressively from C1Y5 to C5Y1. This is directly proportional to the decrease in percentage

inclusion of yeast and increase in percentage inclusion of cassava flour in the test diet. This results is similar to the result recorded by Momoh *et al.* (2016) and Falayi and Sadiku. 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.

Water stability result: Water stability shows significant difference across the test diet with a mild difference at 20 min. A sharp difference was recorded at 40 min period. Generally, diet (C5Y1) gave the best water stability percentage while (C1Y5) gave the least water stability percentage. This shows a positive trend of higher percentage stability with higher percentage cassava inclusion. The results on Table 4 and 5 also suggest that there might be a negative correlation between water absorption and water stability of the pellets-diets with the least water absorption were seen to have the greatest water stability and vice versa. Although, water stability reduced for all the diets after 60 min, the general trend was still maintained.

Effiong *et al.* (2009), reported a water stability of 82.81% for fish feed formulated using cassava starch as binder after 1 h of exposure to water. This is however, higher than the 65.75% being reported in this research. This can be attributed to differences in the choice of treatment while this research included yeast; duckweed was used in the research of Effiong *et al.* (2009), hence, accounting for the difference in water stability value.

Table 3: Proximate composition of diet

Variables	C1Y5	C2Y4	C3Y3	C4YY2	C5Y1
Moisture (%)	4.4	4.6	4.7	4.6	4.8
Crude protein	43.0	41.2	39.9	39.1	38.6
Crude fibre	7.3	7.3	7.7	7.8	7.9
Ether extract	7.2	6.7	6.6	6.4	6.2
*NFE	38.1	40.2	41.1	42.2	42.7

*Determined by subtraction from 100% of other parameters

Table 4: Floatation result (%)

Minutes	C1Y5	C2Y4	C3Y3	C4YY2	C5Y1
5	93.75±1.79[a]	81.45±1.09[b]	67.5±1.12[c]	56.55±1.69[d]	49.75±1.09[e]
10	82.31±1.67[a]	67.45±2.14[b]	54.12±1.34[c]	37.14±1.34[d]	25.42±2.40[e]
15	45.63±2.27[a]	24.31±1.67[b]	15.56±3.33[c]	0.00[f]	0.00[f]
20	34.63±3.25[a]	0.00[f]	0.00[f]	0.00[f]	0.00[f]
25	22.34±2.24[a]	0.00[f]	0.00[f]	0.00[f]	0.00[f]

Means with same letter along the row are not significantly different according to Duncan multiple range test (p = 0.05)

Table 5: Water stability (%)

Minutes	C1Y5	C2Y4	C3Y3	C4Y2	C5Y1
20	78.75±3.45[a]	82.75±2.33[b]	87.5±1.64[c]	92.75±3.69[d]	96.75±1.59[e]
40	54.75±2.14[a]	61.75±1.60[b]	66.61±1.57[c]	79.45±2.23[d]	85.87±1.38[e]
60	24.75±1.79[a]	33.75±1.09[b]	42.5±1.12[c]	49.75±3.69[d]	65.75±1.09[e]

Means with same letter along the row are not significantly different according to Duncan multiple range test (p = 0.05)

CONCLUSION

The results of the experiment shows that brewer yeast is a very good floating agent and can support floatation of feed in water for more than 25 min. The result further indicates that cassava flour has shown itself as a capable candidate for prolonging the stability of aquaculture feed in water. Also, starch and brewer yeast also have beneficial nutritional advantage to the fish and are affordable. In summary, the different ingredients used and their percentage inclusion gives the resulting physical properties of the pellet. The quantity of starch used and inclusion of other materials that can create an air trap in the pellet will suggest the durability of the pellet, this is because starch gelatinizes and acts as a binding agent, the more starch present, the better the quality of the pellet.

RECOMMENDATION

Further research can be conducted in the direction that will determine the percentage inclusion of a floating agent and a binder for maximum result of floatation and water stability determination.

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