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SHORT COMMUNICATION

SUITABILITY OF YAM FLOUR FOR ON-FARM FLOATING FEED PRODUCTION

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ABSTRACT

Fish feed is a critical component in aquaculture, accounting for 60-80% of operational costs, particularly for small-scale farmers in Nigeria. This study explored the incorporation of yam flour as a replacement for wheat flour in the production of on-farm floating fish feeds. Five feeds were formulated and compounded at 30 % and 40 % crude proteins at varying replacement levels of wheat flour with yam flour designated as feed 1 (25 %YF/75 %WF), feed 2 (50 %YF/50 %WF), feed 3 (75 %YF/25 %WF), feed 4 (100 %YF), and feed 5 (100 %WF.). Ten pellets were randomly selected and tested for buoyancy for 60 minutes. The data obtained were analysed using descriptive statistics, with a bar chart. The results showed that the combination of 25% yam flour and 75% wheat flour gave 100% flotation for 60 minutes. This combination is recommended for on-farm floating feed production.

Keywords: Replacement, pellet, buoyancy

INTRODUCTION

Extruded fish feed has many vital uses in the aquaculture sector, including its high physical and nutritional value (Sørensen, 2012). Complete fish feed diets must contain nutrients; the main nutrients are protein, starch, fat, and crude fibre. Among nutrients, starch provides energy for fish and also serves as a floater to facilitate the expansion of the feed (Sørensen *et al.,* 2010). Fish is regarded as an excellent source of dietary protein, vitamins, fats and minerals that are important to the human diet for the maintenance of good health, it is also responsible for about 55 % of protein intake sources in worldwide (FAO, 2022), fish is a viable source of income and food to a large populace in developing nations such as Nigeria (Abiodun, 2003). The majority of fish farmers in Nigeria are small-holder semi-intensive (Adekola, 2001). As the aquaculture sector continues to grow, demand for formulated feeds and protein is increasing (Hua *et al.,* 2019). High-quality feeds are too expensive; they also accounted for 60-80% of production costs (Fu, 2005; Sá *et al.,* 2007; Orire and Sadiku, 2014). To achieve the maximum yield of fish, feed requires appropriate ingredients and processing techniques (Tiamiyu and Solomon, 2012). Different qualities of fish feed, including pellet shape, size, water-absorption quality, density, softness or stability, and floating time, may affect feed quality. Yam flour has the important features of gelatinization and non-crystallization (Colonna *et al*., 1984; Gomez and Aguilera, 1984; Chevanan *et al.,* 2007). They act as a binder, playing an important role in both floating and sinking fish feed (Orire *et al.*, 2010; Solomon *et al.*, 2011). The minimum requirements of yam flour for sinking and floating feed are 18% to 22% and 5% to 11%, respectively (Riaz, 1997). Pellets absorb water, becoming soft, but must maintain their shape for 2 hours until the fish consumes them.

Therefore, this research was carried out to assess the suitability of yam flour for on-farm floating feed production, and to investigate the replacement level of wheat flour with yam flour that produces the best feed buoyancy.

MATERIALS AND METHODS

Experimental Materials

The materials used in this experiment include fish meal, wheat flour, baker's yeast, yam flour, a plastic spoon, bowls, warm water, a sensitive weighing scale, and hand-pelleting machines.

Experimental Site

The research was carried out at the Department of Water Resources, Aquaculture and Fisheries Technology Laboratory, located at the School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State.

Source of Feed Stuffs

Yam tubers, wheat flour, vegetable oil, and baker's yeast were purchased from Kure Ultra-Modern market, Minna, Niger State, while fish meal was purchased from the fish meal store in Minna.

Processing of Yam Flour

Two kg of tubers of the variety *Discorea rotundata* (white yam) were washed with portable water, peeled, washed, cut into smaller chips (150g), and parboiled at 50 °C. The parboiled samples were soaked in portable water for 12 h and then dried under the sun for 5 days. The dried yam chips were milled into flour, sieved using 0.25 0.25-micrometer sieve, and were subjected to analysis (Orire *et al*., 2010)

Proximate Analysis

Proximate analysis for crude protein, moisture, lipids, and ash content was carried out for both ingredients and pelleted feeds according to the AOAC (1980) method in the Water Resources Aquaculture and Fisheries Technology Laboratory (Table 1).

Feed Preparation and formulation.

The Pearson Square method was used to formulate eight feeds containing 30% and 40% crude protein (Salihu and Orire, 2020). They were compounded by the addition of a proportion part mix of yam flour, wheat flour, fish meal, and baker's yeast at 5% for all the feeds. Yam flour was used

to replace wheat flour at 0%, 25%, 50%, 75% and 100% for 30% and 40% crude protein feeds (Tables 2 and 3).

Warm water at 60°C was added to the feedstuffs to produce a semi-solid dough, which was then pelleted using a pelleting machine. The sun-dried pellets were kept in a sealed plastic container for later buoyancy analysis (Adekunle *et al*., 2014).

Feed Buoyancy Test

The floating ability of pellets was evaluated for 1 hour. Five pellets were randomly selected, placed in a 250ml beaker with 150ml of fresh water, and the degree of floatation was recorded every 5 minutes for 1 hour (Orire *et al*., 2012).

Statistical Analysis

The results were subjected to descriptive statistics using a bar chart to determine significant differences among the mean treatments.

Table 1: Proximate Compositions of the Feed Ingredients

Feed Stuffs	Crude Protein (%)	Moisture (%)	Ash (%)	Crude Lipid (%)
Fish meal	59.06	5.99	7.88	16.15
Wheat flour	14.44	7.33	1.45	3.19
Yam Flour	4.38	3.95	1.10	2.60
Yeast	40.69	3.33	2.10	0.60
Palm Oil	12.25	8.98	1.45	2.10

Table 2: Formulated Feeds at 30% Crude Protein Level Containing Varying Replacement of Wheat Flour with Yam Flour

Feedstuff (%)	Feed 1 (100WF)	Feed 2 (25%YF 75%WF)	Feed 3 (50%YF 50%WF)	Feed 4 (75%YM 25%WF)	Feed 5 (100%YF)
Fishmeal	56.62	56.62	56.62	56.62	56.62
Wheat flour	33.38	24.54	16.69	8.84	0.00
Yeast	5.00	5.00	5.00	5.00	5.00
Yam flour	0.00	8.84	16.69	24.54	33.38
Vitamin-mineral premix	5.00	5.00	5.00	5.00	5.00
Total	100	100	100	100	100

Table 3: Formulated Feeds at 40% Crude Protein Level at Varying Replacement Levels of Wheat Flour with Yam Flour

Feedstuff (%)	Feed1 (100WF)	Feed2 (25%YF 75%WF)	Feed3 (50%YF 50%WF)	Feed4 (75%YM 25%WF)	Feed5 (100%YF)
Fishmeal	38.43	38.43	38.43	38.43	38.43
Wheat flour	51.57	41.92	24.28	9.65	0.00
Yeast	5.00	5.00	5.00	5.00	5.00
Yam flour	0.00	9.65	27.28	41.92	51.57
Vitamin-mineral premix	5.00	5.00	5.00	5.00	5.00
Total	100	100	100	100	100

RESULTS

Figure 1 indicates the floatability test for 30% crude protein feeds with varying replacement levels of wheat flour with yam flour. As shown in Figure 1, 100% wheat-flour-based feed and 25% WF/75% WF feed both achieved 100% floatability for 60 minutes. Feed with 75%YF/25%WF had an 80% floatation rate for 60 minutes, while the 50%YF/50%WF replacement level exhibited 50% floatability for 60 minutes. The 100% YF-based feed gave a 20% floatation percentage for 35 minutes.

Figure 2: indicates the floatability test for 40% crude protein feeds at varying replacement of wheat flour with yam flour. The feed containing 25%YF/75%WF maintained 80% floatability for 60 minutes, while 50%YF/50%WF maintained 40% floatability for 60 minutes. Moreover, at 75%YF/25%WF, the performance dropped to 20% for 60 minutes. However, 100% WF-based pellets gave 100% floatability for over 60 minutes.

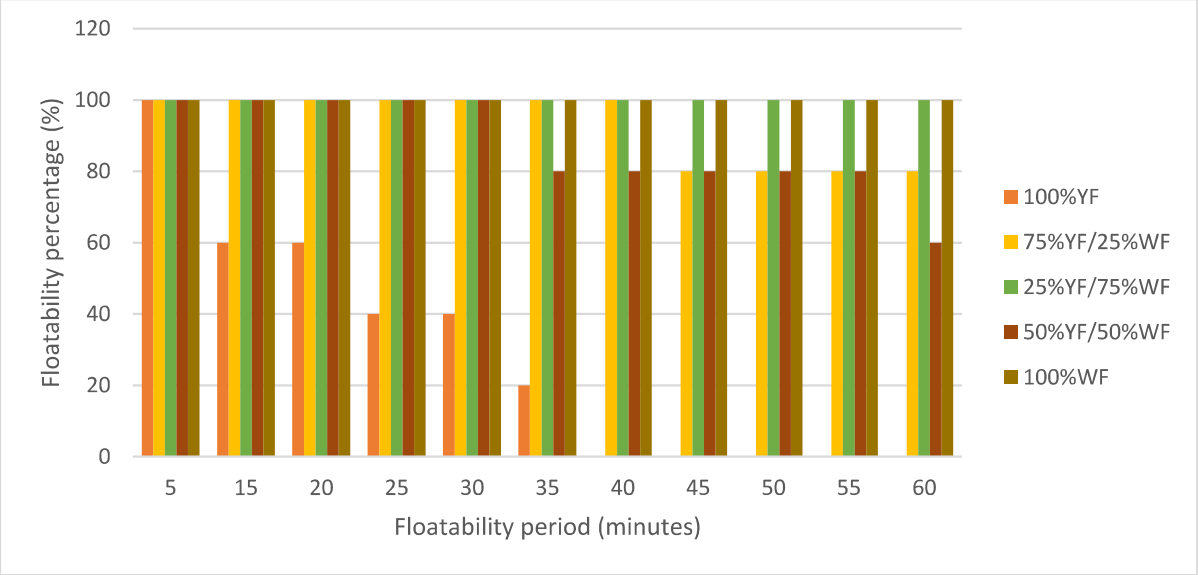

Figure 1: Floatability Performance for 30% Crude Protein Feed at Varying Replacement Level of Wheat Flour with Yam Flour

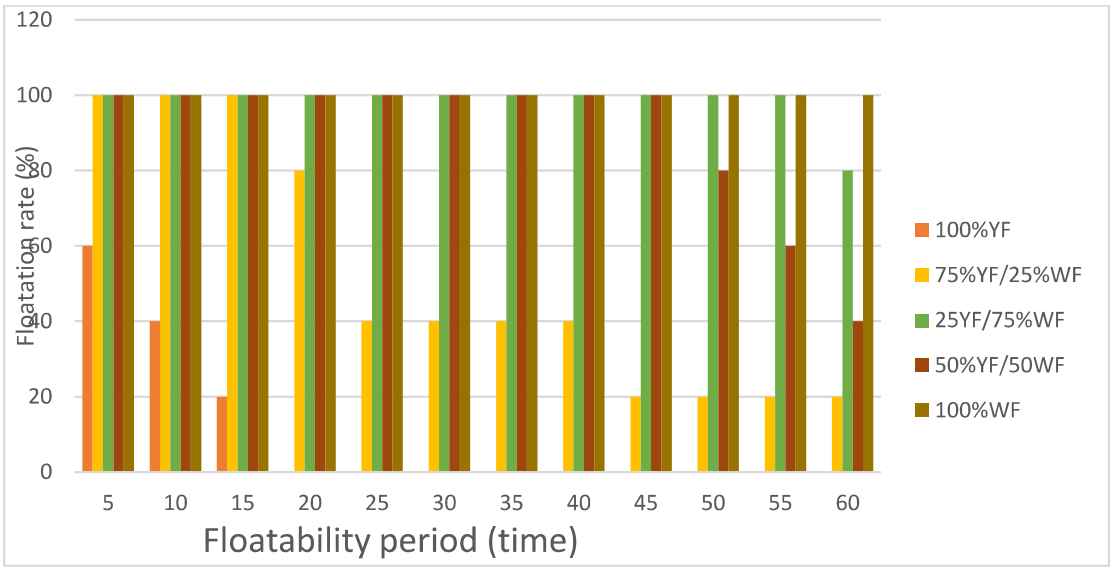

Figure 2: Floatability Performance for 40% Crude Protein Feed at Varying Replacement Level of Wheat Flour with Yam Flour

DISCUSSION

The results of the experiment showed that floatability tests for 30% and 40% crude protein feeds, at varying replacement levels of yam and wheat flour, are promising for on-farm floating feed. Pellets containing a high percentage of yam flour had lower floatation percentages than wheat-based feeds. Wheat flour has moderate to high buoyancy due to its gluten content (Akintoye *et al.,* 2020). This property holds the ingredients together, thereby contributing to pellet buoyancy. The 25% YF/75% WF feed gave the best flotation for 30% and 40% crude protein feeds. The pellets maintained 100% floatability for 60 minutes with 30% crude protein and for 55 minutes with 40% crude protein; however, the decrease i.12n floatation rate observed with 40% crude protein could be due to a higher protein density. This agrees with the work of Salihu and Orire (2020), who reported high floatability with feed of a lower crude protein level. For the 50% YF/50 WF feed, flotation performance declined gradually to 100% across all treatments, irrespective of oil protein level. The 75% YF/25% WF also indicates a reduced flotation percentage of up to 20%. Yam flour-based floating feed at 100% inclusion level performed poorly despite being a starchy product, but its non-glutinous nature could be responsible for poor floatation. The feed

absorbed water quickly and sank faster during the buoyancy test. The high water-absorption capacity of yam flour can cause the pellets to become waterlogged and sink more rapidly. The 100 % floatability was maintained in 100 % wheat-based diets throughout the study periods, and the 30% and 40% crude protein diets were attributed to the pellets' water stability. This finding is consistent with the report by Fashina *et al.* (2019), which found that better feed stability was achieved with gelatinized wheat binders. Thus, combining yam flour at 25% and 75% with wheat flour achieves a high feed floatability. Higher inclusion of yam flour, up to 75%, can cause the feed to absorb water quickly and sink.

CONCLUSION

The yam flour on its own may not contribute significantly to the production of buoyant feed unless it is combined with wheat flour at a 25 % replacement level.

RECOMMENDATION

It is therefore recommended that the yam-to-wheat-flour ratio be optimized at a ratio 25 %:75 % beyond which there will be reduced pellet floatation.

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