Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online) DOI: 10.7176/JBAH
Vol.9, No.18, 2019
www.iiste.org

Effects of Fish Feed Carbohydrate Sources on the Floatation and Water Stability of Fish Feed Pellets

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Abstract

Three feeds were formulated to carry out a study on the floatation test and water stability tests of fish pellets. The feeds were formulated using different sources of carbohydrate (Maize, Guinea corn and Wheat). After 30 minutes of exposure to water, Guinea corn maintained 90% of floating pellets while the other two sources had 80% floating pellets respectively. There were significant differences in the percentage number of pellets floating between 0 and 30 minutes ($P<0.05$). There were also significant differences in the water stability of the pellets, between 10 and 30 minutes. Wheat had the highest water stability of 87.8% while Maize had 75.4% water stability and Guinea corn had the lowest percentage of 71.6% but after 50 minutes Maize had the highest percentage of 61.8% and Guinea corn had the lowest percentage of 52.4%.

Keywords: Carbohydrate sources, Floating ability and Water stability.
DOI: 10.7176/JBAH/9-18-06
Publication date:September 30th 2019

1. Introduction

Fish farming is the most common form of aquaculture. It involves raising fish commercially in tanks, ponds or ocean enclosures, usually for food. Aquaculture involves cultivating freshwater and marine water population under controlled conditions, and can be contrasted with commercial fishing, which is the harvesting of wild fish (Tsevis *et al.*, 1992). Fish feed consists of natural food and artificial (supplementary) feeds. When fish have balanced diet to eat, they grow fast and stay healthy. In natural water and well-fertilized ponds microscopic plants (phytoplankton), microscopic animals (zooplankton), detritus and insect larvae are example of natural feeds (Robinson, 2006). These sources of feed are not adequate for commercial production of table fish. Artificial feed supplements are given in form of pellets which can be sinking or of floating types. Fish feed cost is a major factor militating against expansion of fish culture in Nigeria in that it accounts for about 60-80% of management costs (Olomola, 1990). The floating feeds being produced locally are too small to meet the farmers' need. Extruded floating feed cost is significantly more expensive than locally produced dried and sinking pellets (Lovell, 1988). The greatest proportion of the floating feeds in Nigerian markets is imported from United States of America and other western countries (Falayi, 2009). Adesina (2012) affirmed that Nigeria spent N117.7 billion annually on importation of fish feeds. There is a dire need to develop locally a technology to produce floating fish pellets at a comparative lower cost than the imported ones. This will reduce our dependence on importation of fish feeds and save the country her foreign exchange (Adesina, 2012). The objective of the study is to produce a floating fish pellet with three different sources of carbohydrate from local raw materials and test the pellets produce for their floating abilities and water stabilities.

2. Materials and Methods

The raw materials used for this research work were guinea corn, wheat, maize, cassava starch and soya bean meal, which were purchased from Wazo market in Ogbomoso, The feed ingredients that constitute the feed formulation are groundnut cake, wheat offal, calcium phosphate, fish meal, vitamin premix, methionine, lysine and fish oil. They were bought from Adom Agro-Allied (Nig) Ltd, Ahoyaya in Ogbomoso, Nigeria.

2.1 Feed formulation

The method shown in Fig.1 was used in formulating the fish pellets. These selected feed ingredients were as shown in Table 1.

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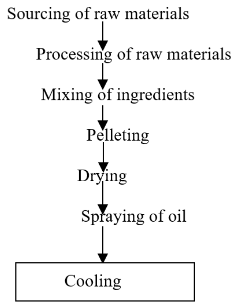

Figure1. Flow chat of feed pellet production

A cyclone hammer mill was used in grinding the raw-materials. Each ingredient was sieved to 0.1 mm after milling. Electronic weighing balance was used to measure various quantities of the ingredients. These ingredients were first thoroughly mixed dried by a wooden spatula in a plastic bowl, before adding water. The volume of water that was added was 180 cm^3 per 300g dried mash. Volume of water was chosen based on previous pre-experimental experience. Good pelleting could not be achieved when the water content was more than 180 cm^3. The feed was further stirred thoroughly to form a wet feed mash.

Table 1. Feed Composition Adopted for this Research

Composition	Percentage, %
CHO sources (maize, wheat and guinea corn)	20
Fish meal	20
Soya meal	20
GNC	20
Wheat offal	10
Starch	10
Vitamin premix	0.5
Salt	0.5
Methionine	0.2
Lysine	0.2

The wet feed mash was conveyed into the pelleting machine through the hopper. The mechanical screw action and the friction created, blended, sheared and cooked the mash, leading to a rise in temperature due to increased pressure in the barrel. High temperature of operation in the presence of water promotes gelatinization of starch (Anderson, 2012). At the end of the barrel, the mixture was forced through a die at high pressure. Because of the difference between the pressure inside and outside of the barrel, the material expanded, and pellet was formed according to the mode of the die plate. Drying was done immediately after pelleting, using a small electronic oven dryer which had four heating elements, two at the top and two at the bottom with temperature ranging from 100°C-250°C.The oven had a temperature regulator and a timing switch with a power rating of 1380W and a voltage of 230V/50Hz.

The pellets were oven dried at a temperature of 120°C for 120 min to remove the moisture present in the feed. Drying enhances the durability of the feed for proper storage of the pellet.

2.2 Floatation tests

Floating tests were carried out by selecting 10 pellets per sample randomly from three sources of carbohydrates been used to produce the pellets. These pellets were dropped in a 250 cm^3 glass beaker filled with water of about 150 cm^3 .The total observation time was for 30 mins and the time of floatation was recorded at intervals of 5 min. At the end of each observation time the number of pellets that were floating was recorded. The process was replicated five times for each treatment and the mean number of the floating pellets was recorded. The mean numbers of floating pellets were expressed as been done by Solomon *et al* (2011).

$$\% \text{ of floating pellets} = \frac{\text{number of floating pellets}}{\text{Initial number of pellets}} \times 100 \quad (1)$$

2.3 Water stability test

The water stability test was determined over a period of 50 min by wet durability test as described by keri *et al.* (2013). Five grammes of pellet from each treatment were weighed. The selected 5g of each sample were dropped into a nylon sieve material of 0.1 mm. This nylon sieve with the pellets were then immersed into the glass beaker of a 250 cm^3 filled with water to a level of 150 cm^3.

The immersion time ranges from 10-50 min with removal of each sample after every 10 min (Keri *et al.*, 2013). At the end of every test time, the nylon sieve was slowly removed from the beaker and allowed to drain for

3 min. The wet pellets were oven dried at 105ºC for 30 min followed by further drying at 65ºC to a constant weight, then cooled in a desiccator (Keri *et al*., 2013). The water stability was calculated using the following equation:

$$\% \text{ of water stability} = \frac{\text{weight of retained whole pellets}}{\text{intital weight of pellets}} \times 100 \qquad (2)$$

All data were analyzed using Analysis of Variance (ANOVA).

3. Results and Discussions

Table 2 shows the floatation abilities of the three types of pellets. The pellets from the three different carbohydrates sources exhibited 100% floatation till 5min. At the end of the 5th minute pellets made of maize had 80% floatation till the 30th minute. The pellets from guinea corn maintained 100% floatation till 20th minute and 90% after 20th minute till 30th minute. The pellets made of wheat had 100% floatation till 10th minute. After the 10th minute till 20th minute the floatation dropped to 90% and further dropped to 80% after 20th minute till 30th minute.

Also Table 3 reveals that at 5% confidence interval the three carbohydrate sources are significantly different in their floating abilities of the pellets produced from them. Also, the floatation percentages at different time intervals are significantly different at 5% confidence interval.

It can be deduced/adduced from the above that the highest floating pellets was with pellets produced from guinea corn followed by those of wheat and the pellets from maize had the least. The initial superiority of Guinea corn over the other sources in term of floating ability can be attributed to more gluten protein in guinea corn than wheat and corn has no gluten protein which according to Magnus, 1982 and Ponte and Reed 1982 reported that proteins become stiffened during dough preparation hence contributing to the firm springing consistency in bread.

However, experience from the use of imported fish floating pellets showed that all the pellets from the three sources of carbohydrate performed well with their time and percentage floatation.

Table 2- Floatation tests of pellet made using three sources of carbohydrates.

Treatments	% of floating pellet						
Time(min)	0	5	10	15	20	25	30
Maize	100	100	80	80	80	80	80
Guinea corn	100	100	100	100	100	90	90
Wheat	100	100	100	90	90	80	80

Table 3. AVOVA table for % of floating pellet

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	457.1429	2	228.5714	8	0.006196	3.885294
Columns	857.1429	6	142.8571	5	0.008704	2.99612
Error	342.8571	12	28.57143			
Total	1657.143	20				

Table 4 shows the water stability test of the three types of pellets. After the 10th minute pellets made of maize had 78.2% water stability and at the 30th minute it went down to 75.4%, the water stability further dropped to 61.8% after the 50th minute. The pellets from guinea corn had 76.2% water stability at 10th minute and 71.6% after 30th minute, at the end of the 50th minute 52.4% water stability was recorded. The pellets made of wheat had 99% water stability at the 10th minute. After the 30th minute the water stability dropped to 87.8% and further dropped to 55.6% at the end of the 50th minute.

Table 4- Water stability test using three sources of carbohydrates.

Treatments	% of water stability of pellet				
Time(min)	10	20	30	40	50
Maize	78.2	77.6	75.4	67.0	61.8
Guinea corn	76.2	74.2	71.6	56.8	52.4
Wheat	99.0	97.6	87.8	58.2	55.6

Also Table 5 reveals that at 5% confidence interval the three carbohydrate sources are not significantly different in their water stability of the pellets produced from them but the water stability percentage at different time intervals are significantly different at 5% confidence interval.

It can be deduced/adduced from the above that between 10- 30 minutes wheat as the highest percentage of water stability and guinea corn had the lowest. Results also show that after 50 min maize had the highest water stability while guinea corn has the lowest. However, the declining rate of water stability of feed produced using wheat grain as observed in this work is further supported by (Hashim *et al.,*1992) who reported the use of four local seaweeds and carrageenan as binding agents in pelleted diets for snakehead (*Channa striatus*) using five isonitrogenous diets with 5% of each binding agent plus 5% wheat flour. They reported that the carrageenan-based diet had the best water stability whereas the control diet which contained only wheat flour was the least stable after 60 min.

Table 5 ANOVA table for water stability of pellet

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	451.8453	2	225.9227	4.135304	0.058445	4.45897
Columns	2046.843	4	511.7107	9.366386	0.004118	3.837853
Error	437.0613	8	54.63267			
Total	2935.749	14				

Results obtained from the water stability also shows that a water stability as high as 99.0% was recorded using cassava starch as a binding agent. However Effiong *et al.* (2009) reported a water stability as high as 82.81% for fish feed formulated using cassava starch as binder after one hour of exposure to water which is lower than the 99.0% being reported in this present study. This can be attributed to differences in treatment. They used duckweed in addition to the binders hence accounting for the difference in water stability. Apart from the nature of binder used, the water stability of feed pellets depends upon the nature of ingredients constituting the feed. Feeds having water soluble and rough ingredients disintegrate faster (Meyers and Zei-Eldin, 1972) and require higher amount of binder.

5. Conclusion

Fish feed formulation in Nigeria are gaining more and more grounds especially among the rural areas, there is room for increasing aqua cultural production through better farm management, genetics, tested techniques and innovations. But meeting the ever increasing demand for fish feed in Nigeria through aquaculture will have to come from the use of locally production and make it affordable to all famers. Locally available ingredient will reduce the cost of production. The use of binding agent is very important in fish formulation to promote higher stability of pellet. Among the three sources of carbohydrate used in this study Guinea corn is most suitable to use in feed formulation because it possesses higher floating ability and it is readily cheap.

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