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PRODUCTION OF FLOATING PELLETS USING APPROPRIATE METHODS

BY

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ABSTRACT

The study investigated into the use of floating materials like candle wax, yeast and baking powder to achieve pellet buoyancy. Ten diets were formulated with incorporation of floating agents; Diet I-YBCT- (yeast-baking powder in cold water -toasted), Diet II-YBCU- (yeast-baking powder in cold water -untoasted) Diet III -YBWT(yeast-baking powder in warm water –toasted), Diet IV-YBWU- (yeast-baking powder in warm water –untoasted), Diet V-WIT- (candle wax incorporated toasted), Diet VI-WIU- (candle wax incorporated untoasted), Diet VI-WCT- (candle wax coated –toasted), Diet VII-WCU- (candle wax coated untoasted), Diet IX-WBYT- (wax-baking powder-yeast toasted), Diet X –WBYU- (wax-baking powder-yeast untoasted). There were significant differences ($P< 0.05$) in water stability between the diets of IX and X. While for Diets I – VIII there were no significant differences. On the effect of toasting on the diets Diet X exhibited highest water stability (85 minutes) than Diet IX (60 minutes). Moreover, Diets I, III, V and VII exhibited significant difference for the first 10 minutes of buoyancy test while Diets II, IV, VI and VIII exhibited zero buoyancy $P>0.05$).
Therefore, diets containing Yeast, Wax, Baking Powder and toasted and untoasted demonstrated best water stability long enough for consumption of fish and will thence guarantee good water quality management and cost effectiveness.

Key words: Buoyancy, Yeast, Baking powder, Wax, Toasted, Untoasted.

INTRODUCTION

Nutrition is a process of furnishing cells inside animal with the appropriate chemical needed for optimum functioning of the numerous metabolic reactions involves in maintenance, growth, work and reproduction (Eyo, 1991).

Aquaculture production either semi-intensive or intensive involves input of supplementary complete feed and this account for up to 40% and 60% of production costs respectively (Fagbenro *et al.*, 2003). The competing need of agricultural produce and by-product between man, livestock and fish in feed formulation and production has led to high cost of feed ingredients (Oregun and Ayinla, 2001). The hard earned palletized fish feed are prone to leaching and immediate sinking and disintegrating to the bottom of pond at feeding, this is a loss in aquaculture input management (Falayi, 2000; Falayi *et al.*, 2003).

The imported floating pellet is highly expensive. This has made Nigerian a buyer of expanded floating pellet fish feed at high cost from the United States of American (U.S.A.) and other European countries. Therefore, it is imperative that emphasis should be laid on the technology of developing buoyant (floating) fish feeds of good quality using appropriate methods.

MATERIALS AND METHODS

Diet Formulation

Square method was employed in calculating the energy and protein levels. Five different diets were formulated using the same crude protein (35% CP) as shown in Table I. All the ingredients were measured and labeled separately to avoid accidental mixing. The feed stuffs used were: soybean meal (44%CP), maize meal (9% CP), yeast (72.35 % CP), fish meal (66.7% CP), baking powder (N_2aCo_3) and candle wax. Yeast, baking powder and candle wax were meant to serve as floating agent while yeast serves as both protein source as well as a floating agent in the fifth diet.

Diet Preparation

Ten different diets were prepared as follows;

Diet I and II: The ingredients used for these diets were soybean meal, fish meal, maize meal and vitamin premix. Yeast and baking powder were used as floating agents. Each of the ingredients was measured using sensitive electronic weighing balance (MP 300 Citizen) and was thoroughly mixed until homogeneity was achieved. 400ml of cold water was added followed by thorough stirring to facilitate even distribution of heat until good dough was achieved. The dough was then covered and put in the sun for about 30 minutes for the activation of the yeast and baking powder. Then it was pelleted using 4mm die pelleting machine and oven dried at 60° C for 24 hours. Diet I was toasted using pop corn toasting machine to further activate the rising capacity of yeast and baking powder while diet II of the same ingredients was not toasted.

Diet III & IV: The composition and preparation of the diets were exactly the same with that of Diets I & II above. The difference however has to do with the mixing of dough with warm water. The dough was then covered and put under the sun for 30 minutes for the enhancement of yeast-baking powder activity. The dough was then pelleted and oven dried for 60° C for 24 hours.

Diet V & VI: The composition comprises soybean meal, fish meal, maize meal, vitamin premix and candle wax. The wax was melted into liquid form and then incorporated into the diet. The ingredients were thoroughly mixed to ensure homogeneity. Warm water was used in making the dough and was then pelleted using 4mm die pelleting machine. It was then oven-dried at 60 ° C for 24 hours. Diet V was then toasted while Diet Vi was not toasted.

Diet VII & VIII: The diets comprise soybean meal, fish meal, vitamin premix and maize meal. After thorough mixing of the ingredients, warm water was used in making the dough and pelleted using 4mm die pelleting machine. The diets were then oven dried at 60° C for 24 hours. The dried pellets were thereafter soaked in liquid wax as coat and allowed to solidify. Diet VII was then subjected to toasting while Diet VIII was not.

Diet IX & X: This consist of fish meal, yeast, maize, candle wax, baking powder, and vitamin premix. Candle wax was melted before incorporation into the mixture. Warm water was added to the ingredients to make the dough and then pelleted using 4mm die pelleting machine. The pellets were oven-dried at 60° C for 24 hours. Diet IX was then toasted while Diet X was not.

Table 1 Formulated diets and their percentage composition.

Feed stuff	Percentage composition (g)				
	Diet I & II	Diet III & IV	Diet V &VI	Diet VII & VIII	Diet IX & X
Soybeans meal (SBM)	24.10	24.10	28.90	22.46	0.00
Fish meal (FM)	24.10	24.10	28.90	22.46	22.46
Maize meal (mm)	39.30	39.30	34.71	42.58	42.58
Yeast	5.00	5.00	0.00	0.00	22.46
Vitamin premix	2.50	2.50	2.50	5.00	2.50
Baking powder	5.00	5.00	0.00	0.00	5.00
Candle wax	0.00	0.00	5.00	0.00	5.00
Total	**100**	**100**	**100.01**	**100.01**	**100**

Key:
Diet I: yeast, baking powder and cold water toasted (YBCT).
Diet II: yeast, baking powder and cold water untoasted (YBCU).
Diet III: yeast, baking powder and warm water toasted (YBWT).
Diet IV: yeast, baking powder and warm water untoasted (YBWU).
Diet V: candle wax incorporated toasted (WIT)
Diet VI: candle wax incorporated untoasted (WIU)
Diet VII: candle wax coated toasted (WCT).
Diet VIII: candle wax coated untoasted (WCU).
Diet IX: wax, baking powder and yeast toasted (WBYT).
Diet X: wax, baking powder and yeast untoasted (WBYU).

Pellet Toasting

500g pellet was measured from each of the five diets using sensitive electronic weighing balance (MP 300 Citizen). Each diet was fed into popcorn machine. The efficiency of the machine was satisfactory to generate heat and toast the pellet within a period of 8 minutes 45 seconds. The toasted pellet was taken to the shade to cool for 30 minutes and then package in air-tight polyethylene material.

RESULTS AND DISCUSSION

The experiment conducted for attainment of buoyancy of aquatic feed using appropriate methods showed remarkable results. Ten (10) different diets of varied nutritional composition and floating agents were measured for buoyancy at five (5) minutes interval for 1 25 minutes (85 minutes) and the result obtained showed significant differences ($P<0.05$) in the time recorded for a toasted diet of the composition wax, baking powder and yeast (WBY). WBY showed significant difference ($P<0.05$) in the floatation time for a period of 85 minutes (figure 1). However, there were significant differences ($P<0.05$) in the floatation in the following period 0-10 minutes, 15-25 minutes and 35-85 minutes respectively. For the toasted diet with wax incorporation (WI) and yeast baking powder warm water (YBW) significant difference ($P<0.05$) was observed in the first 10 minutes while for the rest of the time there were no significant difference ($P>0.05$). For the yeast baking powder cold (YBC) and wax coated (WC) diets, there were significant difference ($P<0.05$) in the time of flotation for the first 15 minutes and for the

rest of the time, there were no significant difference ($P>0.05$) as shown in Table 2 and figure 1 respectively

The effect of toasting on diets also indicated significant difference ($P<0.05$) between diets WBY toasted and untoasted. However, there were no significant difference ($P>0.05$) among the diets WI, YBC, YBW and WC both toasted and untoasted (Table 3; figures 1 and 2). On the effect of toasting on feed buoyancy, there was significant difference ($P<0.05$) between toasted and untoasted diets of WBY while for the rest of the diets WI, YBC, YBW and WC there were no significant difference ($P>0.05$) observed (Table 4).

Table 2: Floatation period for Toasted and Untoasted Diets

	Toasted diets					Untoasted diets				
Floating duration (sec)	Diet I	Diet III	Diet V	Diet VII	Diet IX	Diet II	Diet IV	Diet VI	Diet VIII	Diet X
5	9.33^{a}	1.00^{a}	0.33^{a}	0.67^{a}	0.67^{a}	7.67^{a}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
10	9.33^{a}	0.33^{b}	0.00^{b}	0.33^{ab}	0.00^{b}	6.00^{b}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
15	8.33^{ab}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	5.67^{b}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
20	8.00^{ab}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	3.67^{c}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
25	8.00^{ab}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	3.67^{c}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
30	7.33^{b}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	3.67^{c}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
35	7.50^{b}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	3.33^{c}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
40	7.50^{b}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	3.50^{c}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
45	7.50^{b}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	1.33^{d}	0.00^{a}	0.00^{a}	0.00^{a}	0.00a
50	7.50^{b}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	1.00^{d}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
55	7.50^{b}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.33e	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
60	7.00^{bc}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.33^{e}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
65	6.00^{c}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.00e	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
70	3.33^{d}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{e}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
75	1.67^{de}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{e}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
80	0.67^{e}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{e}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}
85	0.00^{f}	0.00^{c}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{e}	0.00a	0.00^{a}	0.00^{a}	0.00^{a}

Data in the same row carrying different superscripts are significantly different from each other ($P<0.05$).

Table 3: Effect of toasting on diets

Treatments	Toasted	Untoasted
Wax baking powder yeast (WBY)	6.11^{a}	2.34^{b}
Wax incorporated (WI)	0.00^{a}	0.00^{a}
Yeast baking powder cold water (YBC)	0.00^{a}	0.00^{a}
Yeast baking powder warm water (YBW)	0.00^{a}	0.00^{a}
Wax coated (WC)	0.00^{a}	0.00^{a}

Data in the same row carrying different superscripts are significantly different from each other ($P<0.05$).

Keys: Wax baking powder yeast (WBY), Wax incorporated (WI), Yeast baking powder cold water (YBC), Yeast baking powder warm water (YBW), and Wax coated (WC)

Table 4: Effect of toasting on feed buoyancy

diets	Toasted	Untoasted
(WBY)	6.070^{a}	2.340^{b}
(WI)	0.078^{c}	0.154^{c}
(YBC)	0.020^{c}	0.000^{c}
YBW	0.059^{c}	0.000^{c}
WC	0.039^{c}	0.000^{c}

Data on the same row carrying different superscripts are significantly different from each other ($P<0.05$).

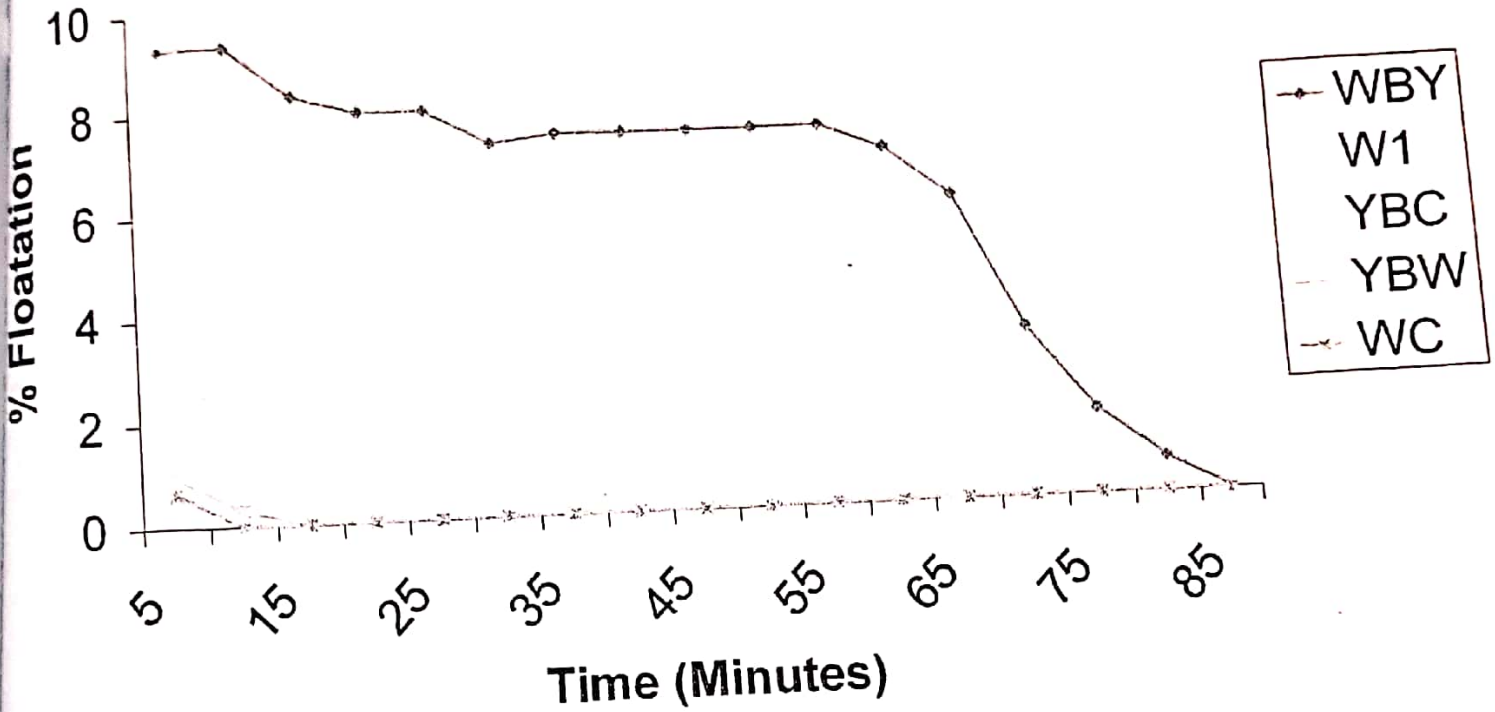

Fig.1:Floating time of pellets of toased diets containing wax, baking power and yeast.

Key:
WBY = Wax baking powder yeast
WI= Wax incorporation
YBC= Yeast baking powder cold

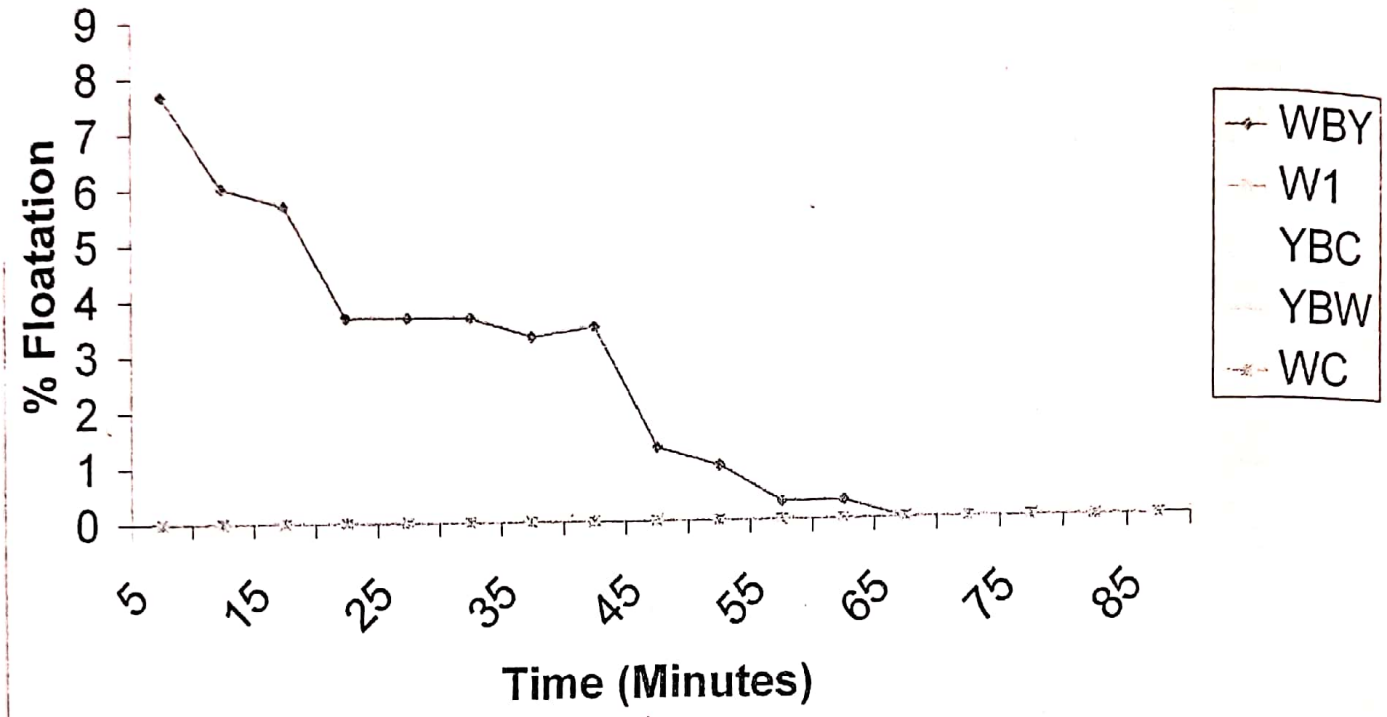

Fig.2: Floating time of pellets of untoasted diets contaning wax, baking powder and yeast.

YBW=Yeast baking powder warm
WC= Wax coated.

From the result obtained diets containing wax, baking powder and yeast (WBY) toasted and untoasted displayed highest degree of buoyancy. However, diet WBY performed better than WBY untoasted. However, diet WBY toasted performed better than WBY untoasted. The difference in buoyancy performance can be attributed to toasting effect. In addition to this is the high level of inclusion (25%) of yeast *(Saccharomyces cerevisiae)* in the diets which during fermentation increased the gas content of the pellets thereby causing it to float. This is similar to technology in the baking industry (Ponted and Reed, 1982; Magnus, 1982; Cheftel, 1986; Oda and Ouchi, 1989). The carbon dioxide ($C0_2$) gas produced from baking powder and yeast were trapped in the diets and made the diet afloat as well as maintaining its stability for those early minutes of immersion trials (Giullo, 1995; Falayi, 2001). The sinking rate of pellet is also depended on it density (Boting, 1991). According to De Silva and Anderson (1995), lipid enhances water stability of pellets and thus preventing pellet sinking. Furthermore, diets I, II, III and IV even although containing yeast, baking powder and wax for toasted and untoasted, performed poorly. The poor performance could be attributed to the low level of inclusion of the

floating agents especially the yeast whose level of inclusion was 5%. Toasting of the diets also enhanced the buoyancy rate as evidenced in the result of diet I, III, V and VII as against diets of similar compositions; Diets II, IV, VI and VIII which exhibited zero degree of buoyancy. Attainment of floating pellets using the appropriate method will save cost and energy expended when searching for sinking pellet (Adekola, 2001; Eyo, 2001). There will be minimum leaching which ensures good water stability (Viola and Zohar, 1986; Fagbenro and Jauncey, 1985; Meyers, 1993; Falayi, 2001;Falayi *et al*, 2003 and Falayi *et al.* 2004)

CONCLUSION AND RECOMMENDATION

Floating pellets can be made on-farm using appropriate methods by incorporating into the feed stuffs floating agents such as yeast (*Saccharomyces cerevisiae),* candle wax and baking powder (Sodium bicarbonate). However, to achieve a significant level of buoyancy, the level of inclusion of yeast should be reasonably high since it is a unicellular organism which is rich in amino acid and thus capable of replacing to a reasonable levels other protein sources. Availability of the local floating agents to achieve this objective makes them better alternatives to expensive foreign pellets and as such would go a long way to cut down production cost in aquaculture while in the same vein, saving the nation's foreign exchange.

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