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THE PRODUCTION OF FLOATING FISH FEED USING MELON SHELL AS A FLOATING AGENT

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ABSTRACT
A total of sixteen (16) feeds were formulated, containing different percentage inclusion levels of melon shell. The melon shell was subjected to three (3) different treatments; ground, crushed and uncrushed. Diet 1 had 0 percent melon shell inclusion. Diets 2, 3, 4, 5 and 6 had 5%, 10%, 15%, 20% and 25% melon shell inclusions in ground form respectively. While Diets 7, 8, 9, 10 and 11 had 5%, 10%, 15%, 20% and 25% melon shell inclusions in crushed form respectively and Diets 12, 13, 14, 15 and 16 had 5%, 10%, 15%, 20% and 25% melon shell inclusions in uncrushed form respectively. The diets were all subjected to floating trials and their percentage floatation over time showed significant differences ($P<0.05$). Diets 7, 8 and 11 had the highest percentage floatation over time at 40%, 30.3% and 40% floatation assessed over 60 minutes respectively. Therefore, melon shell in crushed form at appropriate inclusion levels will produce floating feed for aquatic organisms.

KEY WORDS: Floating feed, melon shell, aquatic organism.

INTRODUCTION

Fish feed production is an important factor to be considered in both subsistence and commercial fish farming as it has consequences on both growth efficiency and feed wastage (Tsevis *et al.*, 2000). During the last decade, there has been a marked increase in the use of extruded diets for feeding fish. Extruded feed have superior water stability, better floating properties ease in digestion, growth, water protection, zero water pollution, optimized labour usage and zero wastage of raw materials (Amalraaj, 2010) and a higher energy than sinking pelleted feed (Hilton *et al.*, 1981; Johnson and Wandsvick, 1991). While sinking pelleted feeds lead to wastage of raw materials and water pollution. Impaired growth is also noticed during the use of non-floating feeds or raw materials since high feed conversion ratio is involved (Johnson and Wandsvick, 1991). Despite desirable traits of floating and water-stable characteristics of extruded/expanded feeds as well as the fact that it enables one to observe feeding activity and thus avoid overfeeding, it may be of inferior nutritive quality if overheating is employed during the manufacturing process (Cheftel, 1986). Dry and moist feeds may be similar in some ways, though moist feeds contain a high level of raw fish or slaughterhouse offal and by-products, which give the final product high moisture level. In most practical circumstances, the important factor for selecting feed for fish culture is not whether it is moist or dry feed, rather its nutritive value, because most feed formulations employed today can support reasonable growth without causing any physiological impairment or heavy mortality. Most of the aqua-feeds have been developed via extrusion process involving expansion of the feeds to achieve water stability or buoyancy in water with the use of extruder machines like Cooker Extruder, Insta Pro 600 Extruder (Kearns, 1989). Extruded feed is buoyant and almost hydrophobic as such leaching is low compared to sinking feeds (Falayi, 2008). The nutrients are retained within the periods of floating thereby enabling fish to consume whole extruded ration (Kearns, 1989). It is very suitable for pelagic or surface feeders in the sense that the fish quickly access the feed and do not expend much energy in going to the bottom to source for food (Balarin and Haller, 1982).The production of feed using these machines is usually expensive as the machines are not cost-friendly. Adikwu (2000) reported that to meet the demand of fish farmers at both commercial and subsistence level, the use of readily affordable pelleting machines in the developing of floating feeds becomes necessary, since feed floatation can be achieved via inclusion of floaters in feeds. Though the use of extruded floating feed is safer, because feed ingredients can be pasteurized or sterilized during feed extraction operation, thus aiding digestibility of feeds and reducing adverse effects of some feed material on the health of aquatic animals (Amalraaj, 2010), yet extruder machines are quite expensive to purchase. Therefore the production of floating feeds using readily affordable floating agents to attain feed bouyancy becomes paramount. Floating feed is a management tool in that farmers can see how much and how actively the fish eat, seeing the fish is almost a necessity when the ponds are harvested and restocked periodically without draining and the farmer has precise knowledge about the mass of fish in the pond (Mgbenka and Lovell, 1984, Falayi *et al.*, 2004). Melon (*Colocynthis citrullus L.*) is a widely cultivated and consumed as oil seed crop in west Africa. The seeds contain about 53% oil, 28% protein and some other important mineral nutrients (Oyolu, 1977; Abaelu *et al.* 1979). They are consumed in 'egusi soup', melon ball snacks and ogiri, (a fermented condiment) (Oyenuga, 1968; Odunfa, 1981). Melon seeds contain a fairly high amount of unsaturated fatty acid, linoleic acid (Girgis and Said, 1968) suggesting a possible hypocholesterolic effect (lowering of blood cholesterol). The oil extracted from the seeds is used for edible purposes (Ajibola *et al.*, 1990). The shell of melon is usually considered as agricultural waste. The shell is light brown in colour and light in weight like a flake, hence usually floats when placed in water. This experiment therefore, seeks to establish the ability of melon shell to aid feed buoyancy, achievement of which would nonetheless support sustainable aquaculture production.

MATERIALS AND METHODS

The materials used include hand pelleting machine, a bowl for mixing/compounding of feedstuffs, tap-water, distilled water and a bowel for floating trial, 450 mm x 8 mm foil (cellophane) paper, weighing Balance (Metler Citizen 400) , spatula, test tubes, flasks and pipettes, digestion Rack, Furnace, Oven, Burner, Markham's Distillation Apparatus, Soxhlet Solvent Extractor and Chemicals (catalysts and reagents).

Experimental procedure / Methods:

The experiment was carried out in the Water Resources, Aquaculture and Fisheries Technology Laboratory of Federal University of Technology Minna, Bosso Campus. The feedstuffs used were purchased from both Minna market and New Bussa market. These include: fishmeal, soybean, maize, vitamin premix and melon shell. The maize and Soybean (toasted) were ground or milled separately. While the melon shell was subjected to three treatments; ground, crushed and uncrushed. The feedstuffs were then variously analysed for their crude protein content (Table 1). Afterwards, Pearson square method of feed formulation was used for the sixteen (16) diets formulation, having a target crude protein level of 35% for each of the diets (Tables 2 and 3). The feedstuffs were mixed thoroughly with little quantity of water, about 71.24cm^3 (0.07124litres) to form consistent dough for each diet. The dough formed for each of the diet was pelleted and sun-dried. The analysis of the proximate chemical composition which include; crude protein, lipid, crude fibre, ash content and moisture content of the sixteen diets were carried out according to AOAC (2000). The floating duration for the diets were assessed using a stop watch. Floating trials for the diets were carried out using a bowel with 3200cm^3 (3.2litres) volume of water. These were done after the moisture content of each of the diet was assessed. Furthermore, for each of the sixteen (16) diets, 10 pellets were taken and used for the analysis to ascertain the total number of pellets that remained afloat over a period of 60 minutes. The buoyancy test for the pellets was repeated in triplicate from which percentage mean floatation was determined.

Experimental diets

Sixteen (16) feeds were prepared for the experiment, which include: Diet 1 (With 0% Melon Shell) the control diet. Diet 2 (5% Melon Shell – Ground), Diet 3 (10% Melon Shell – Ground), Diet 4 (15% Melon Shell – Ground), Diet 5 (20% Melon Shell – Ground), Diet 6 (25% Melon Shell – Ground), Diet 7(5% Melon Shell – Crushed), Diet 8 (10% Melon Shell – Crushed), Diet 9 (15% Melon Shell – Crushed), Diet 10 (20% Melon Shell – Crushed), Diet 11 (25% Melon Shell – Crushed), Diet 12 (5% Melon Shell – Uncrushed), Diet 13 (10% Melon Shell – Uncrushed), Diet 14 (15% Melon Shell – Uncrushed), Diet 15 (20% Melon Shell – Uncrushed), and Diet 16 (25% Melon Shell – Uncrushed).

TABLE 1: Crude protein proximate analysis of feedstuffs

NO.	Feedstuffs	% Crude protein
1	Fishmeal (FM)	60.38
2	Maize Meal (MM)	10.15
3	Soybean Meal (SM)	42.70
4	Melon Shell (MS)	13.83
5	Vitamin Premix	-

Statistical analysis

The results for the floating trials for the diets were subjected to one way analysis of variance (ANOVA) test to determined the significant levels using Minitab 14 release statistical software package and the figure was drawn with the aid of Microsoft excel 2\window 2007.

RESULTS

Table 4 shows the percentage mean floatation of pelleted feeds assessed over 60 minutes for each of the diets (D1-D16). The control diet (D 1) with no melon shell inclusion did not float at all as all pellets sank within 5minutes. Diets 2, 3 4, 5 and 6 and Diets 12, 13, 14, 15 and 16 also exhibited zero buoyancy with no significance difference ($P>0.05$) among the diets. Furthermore, diets 7, 8 and 11 showed significant improvement in their floating ability. The diets also indicated significant difference ($P<0.05$) among the diets as they exhibited floatation at 40%, 30.3% and 40% over 60 minutes respectively (Table 5, Figure 1). Similarly diet 9 and 10 had 6.6% and 3.3% floatation respectively assessed over 60minutes with significant difference ($P<0.05$) (Table 5).

DISCUSSION

From the results melon shell exhibited floating ability at appropriate inclusion level and form. The control diet D1, with no melon shell inclusion had no floating ability Diets 2, 3 4, 5 and 6 and Diets 12, 13, 14, 15 and 16 were similarly sank despite inclusion of melon shell. The inability of these diets to float could be attributed to the nature of melon shell inclusion in the diets. The melon shell in the diets were ground and crushed, this would have compromised their buoyancy ability. It was also noticed during pelleting that most of the pellets were malformed and some have their melon shell held back as they could not come out of the die. A few pellets that came out of the pelleting dice hole had little or no melon shell in them. As most of the shell pieces were held back in the pelleting machine. The result was different for diet2 7,8,9, 10 and 11 where melon shell was included in crushed form which demonstrated floatation at different rate. This ability can be traced to the presence of melon shell occupying significant part of the diets thereby creation voids that resorted in their floatation at 40%, 30.3% and 40% irrespectively which is a function of feed processing methodology (Adekola, 2001). Floating feed minimizes nutrient loss (Tsevis *et al.*, 2000) however, extruded feed may impact negatively on the feed, extrusion can cause protein denaturation, texture alteration and partial dehydration (Adekola, 2001). Thus the use of local agricultural wastes such as duck weed, honey comb and baker's yeast with floating ability become imperative (Culley *et al.*, 1981) as they are likely to retain nutrients supposedly lost by extrusion technology (Cockrel *et al.* 1976). From this experiment, melon shell has proven to aid feed buoyancy when included in right form and percentage.

TABLE 2: formulated diets (d1-d8) and their proximate composition

Feedstuffs	Diets (D1 – D8)							
	D1 (0% MS) Control	D2 (5% MS) Ground	D3 (10% MS) Ground	D4 (15% MS) Ground	D5 (20% MS) Ground	D6 (25% MS) Ground	D7 (5% MS) Crushed	D8 (10%MS) Crushed
Fishmeal (FM)	28.52	26.27	24.10	22.02	20.01	18.09	26.27	24.10
Maize meal (MM)	37.96	37.46	36.80	35.97	34.99	33.82	37.46	36.80
Soybean Meal (SM)	28.52	26.27	24.10	22.01	20.00	18.09	26.27	24.10
Melon Shell (MS)	0.00	5.00	10.00	15.00	20.00	25.00	5.00	10.00
Vitamin Premix	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Proximate composition	Calculated crude protein = 35%							
% Crude protein (CP)	35.0	34.1	33.8	34.5	34.2	34.8	33.7	33.6
% lipid	18.0	17.0	17.0	18.0	18.0	19.0	19.0	19.0
% crude fiber (CF)	2.2	3.2	3.4	3.6	3.8	4.0	4.0	6.2
% Ash	11.5	11.5	11.5	12.0	12.5	12.0	11.5	10.0
% moisture	8.0	10.2	9.6	10.4	11.0	10.4	9.2	10.8

TABLE 3: Formulated diets (d9-d16) and their proximate composition

Feedstuffs	DIETS (D9 – D16)							
	D9 (15% MS) Crushed	D10 (20% MS) Crushed	D11 (25% MS) Crushed	D12 (5% MS) Uncrushed	D13 (10% MS) Uncrushed	D14 (15% MS) Uncrushed	D20 (20% MS) Uncrushed	D16 (25%MS) Uncrushed
Fishmeal (FM)	22.02	20.01	18.09	26.27	24.10	22.02	20.01	18.09
Maize meal (MM)	35.97	34.99	33.82	37.46	36.80	35.97	34.99	33.82
Soybean Meal (SM)	22.01	20.00	18.09	26.27	24.10	22.01	20.00	18.09
Melon Shell (MS)	15.00	20.00	25.00	5.00	10.00	15.00	20.00	25.00
Vitamin Premix	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Proximate composition	**Calculated crude protein = 35%**							
% Crude protein (CP)	34.2	34.8	33.6	33.7	34.0	34.9	35.0	34.6
% Lipid	19.0	21.0	23.0	18.0	18.0	18.0	19.0	19.0
% crude fibre(CF)	7.8	9.6	10.8	2.4	2.6	2.8	3.0	3.2
% Ash	12.5	13.5	13.5	15.0	13.0	14.0	13.5	15.0
% Moisture	8.8	9.4	8.4	10.4	11.0	9.4	10.2	10.4

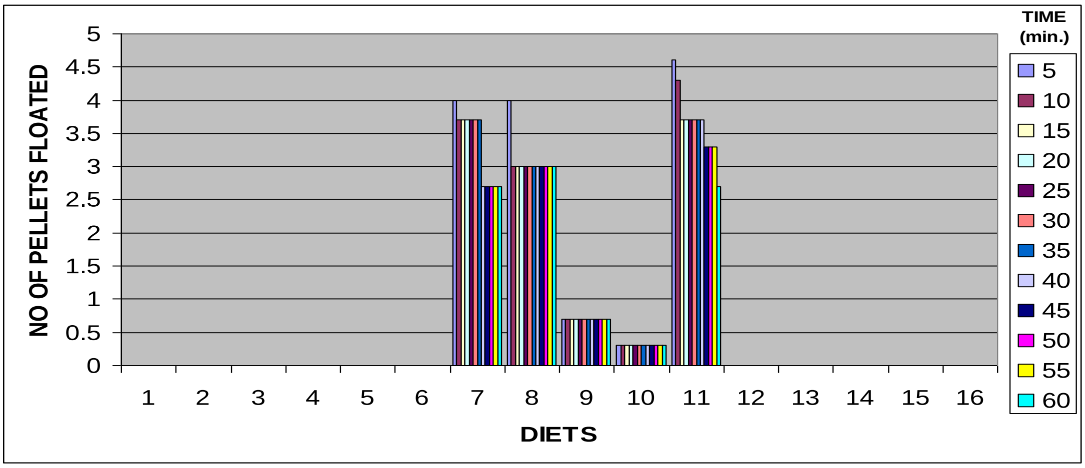
TABLE 5: Percentage floatation of pelleted feeds assessed over time

DIETS	5 TO 60 MINUTES	ST.DEV. (±)
D1(0% MS – Control)	0.00 ± 0.00^{c}	0.61
D2 (5% MS – Ground)	0.00 ± 0.00^{c}	0.61
D3(10% MS – Ground)	0.00 ± 0.00^{c}	0.61
D4(15% MS – Ground)	0.00 ± 0.00^{c}	0.61
D5(20% MS – Ground)	0.00 ± 0.00^{c}	0.61
D6(25% MS – Ground)	0.00 ± 0.00^{c}	0.61
D7(5% MS – Crushed)	4.00 ± 1.00^{a}	0.61
D8(10% MS – Crushed)	3.33 ± 1.52^{b}	0.61
D9(15% MS – Crushed)	0.66 ± 1.15^{c}	0.61
D10(20% MS – Crushed)	0.33 ± 0.57^{c}	0.61
D11(25% MS – Crushed)	4.00 ± 1.00^{a}	0.61
D12(5% MS – Uncrushed)	0.00 ± 0.00^{c}	0.61
D13(10% MS – Uncrushed)	0.00 ± 0.00^{c}	0.61
D14(15% MS – Uncrushed)	0.00 ± 0.00^{c}	0.61

D15(20% MS – Uncrushed)	0.00 ±0.00 ^{c}	0.61
D16(25% MS – Uncrushed)	0.00 ±0.00 ^{c}	0.61

Figures with the same superscripts in the time range column are not significantly different (P>0.05).

Figure 1: Mean percentage floatation of pelleted feeds assessed over time (60min)



CONCLUSION

From the experiment, inclusion of melon shell in crushed form at 5,10 and 25% inclusion levels gave floating feed with 40%, 30.3% and 40% floating rate over 60 minutes. When melon shell was included in ground and uncrushed forms there was no floatation at all. However, feeding trial has to be conducted to evaluate the growth performance of fish fed melon shell based diets as energy source.

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TABLE 4: Mean percentage floatation of pelleted feeds assessed over 60 minutes

DIETS	TIME (MINUTES)																							
	5		**10**		**15**		**20**		**25**		**30**		**35**		**40**		**45**		**50**		**55**		**60**	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
D1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D4	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D5	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D6	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D7	4.0	40	3.7	37	3.7	37	3.7	37	3.7	37	3.7	37	3.7	37	2.7	27	2.7	27	2.7	27	2.7	27	2.7	27
D8	4.0	40	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30	3.0	30
D9	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7	0.7	7
D10	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3	0.3	3
D11	4.6	46	4.3	43	3.7	37	3.7	37	3.7	37	3.7	37	3.7	37	3.7	37	3.3	33	3.3	33	3.3	33	2.7	27
D12	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D13	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D14	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D15	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D16	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0