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Floating and Growth-Promoting Potential of Melon Peel-Based Diets for *Clarias gariepinus* (Burchell, 1822) Fingerlings at Varying Inclusion Levels

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ABSTRACT

Background and Objective: Farmers rely on costly extruded feeds to ensure prolonged floatation and nutrient stability in water. Effective binding agents are needed to enhance buoyancy and sustain feed availability for fish. Melon seed peels may serve as a natural alternative to improve floating capacity. This study evaluates the effect of Melon seed peel-based diets on feed buoyancy and the growth performance of *Clarias gariepinus* fingerlings to develop cost-effective floating fish feed. **Materials and Methods:** One hundred and twenty catfish fingerlings of initial mean weight and length at 3.07+0.10 g and 6.01+1.03 cm were purchased, acclimated, and distributed randomly to the treatments. The research was designed using a Complete Randomized Design (CRD). The diets were formulated using Pearson's square methods. The ingredients used were yellow maize, soya bean, fish meal, fish premix, palm oil, salt, and Melon seed peel as the floating agent at 25, 50, 75, and multi-feed 0% as control diets of melon peels respectively. Experimental data were analyzed using one-way ANOVA in SPSS (version 20), and treatment mean differences ($p<0.05$) were separated by Duncan's multiple range test. **Results:** The result showed that diets formulated at 50 and 75% inclusions of Melon seed peels gave the highest floatation at 16.67 min for 40 min and 16.67 min for 60 min. While the 25% inclusion of Melon seed peels diet had the best growth performance at mean weight gain, specific growth rate, and food conversion ratio (5.26±1.26, 0.57±0.11%, and 1.07±0.11 g), respectively. **Conclusion:** The highest values among the growth and floatation parameters measured, showed the peel had an increasing positive effect on the growth performance while floatation increased as the inclusion level of the melon peels increased in the diets. Therefore, 25-50% inclusion level is recommended for fish farmers.

KEYWORDS

Floating capacity, growth performance, *Clarias gariepinus*, Melon seed peels, food conversion ratio

INTRODUCTION

Aquaculture diets are produced in wet pellets or dry pellets and extruded; these should have particles of high durability that can withstand handling and transportation and also be of good water stability to

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reduce disintegration and loss of nutrients upon exposure to water[1]. Farm-made fish feed requires high-quality binding agents that would have the ability to stabilize feed in water and enhance prolonged feed floatation time when the floater is trapped or coated within the nutrients[2]. When a water-stable pellet is achieved, there will be a wholesome acceptance and utilization by the fish. Also, there should be minimum wastage which shall be of immense benefit to aquaculture practices in terms of nutrient utilization as compared with the broadcast method. Water stability of feeds can be enhanced by the use of binders and many varieties of natural, modified, or synthetic products that have been tested with varying attributes of success [1]. Plant melon (*Citrullus colocynthis*) is generally drought tolerant, intolerant to wet and poorly drained soils, and frost-sensitive. Familiar members of this family are bitter apple, gourd, cucumber, melon, and pumpkin[3].

Valuable cucurbit plants are widely distributed in desert areas and have medicinal and nutritional values[4,5]. The melon plant is also commonly grown in Nigeria by peasant and commercial farmers. The seed kernel is used in the preparation of a relished soup called "Egusi". Besides the medicinal uses, the fruit is also employed as food for animals and humans[6].

Agricultural wastes such as husk, shells, backs, residues, peels, etc. are wastes produced at agricultural premises as a result of agricultural value addition. Such wastes can be effectively utilized as feed ingredients for fish and animal feeds[7]. The seed peels are light brown in color and lightweight; like a flake hence usually float when placed in water. It is important that interest should be geared towards the technology of producing buoyant (floating) fish feeds without deleterious effects on the quality of compounded diets. Such feed must be very buoyant and float in water for a long period before it sinks[8]. Sadiku and Jauncey[6] observed the same in mean weight gain and daily feed intake for *C. gariepinus* fed with floating and sinking feeds. Sadou *et al.*[4] showed significantly higher weight increase and specific growth rate for *C. gariepinus* fed with coppens (floating feed) than those fed with local feed (sinking). Another study of Hilton *et al.*[7] reported similar mean weight gain for *C. gariepinus* fed on floating and sinking feeds while Ekanem *et al.*[8] and Sadou *et al.*[4] observed high growth performance for *C. gariepinus* fed on sinking and floating diets. The feed conversion efficiency of *C. gariepinus* was the same as the two diets during the study period.

Similarly, Sadiku and Jauncey[6] observed that feed conversion efficiency in the same fish species was not affected significantly by the forms of the feeds used. These discrepancies call for more studies in *C. gariepinus* to unveil the underlying causes. Most unconventional feed ingredients are either crop residues or agro-industrial by-products. Crop residues are high in fiber, low in nitrogen, and low in digestibility; these include cereal and legume straws and stalks[9,10]. The fact that fish feed accounts for at least 50-60% of the total cost of production, has motivated the research for cheap and locally available or improved feed ingredients that are unsuitable for direct human consumption but can serve as alternative energy for fish to reduce the cost of production without compromising feed quality[11]. This has necessitated the move to find agricultural wastes that can provide energy and enhance growth as well reduce cost of feed production to fish farmers. Therefore, the research investigated the floating and growth-enhancing capacity of melon peel-based diets for *Clarias gareipinus* (Buchell1882) fingerlings fed different inclusion levels.

MATERIALS AND METHODS

Study area and duration: The experiment was carried out in the Nutritional Laboratory, Department of Fisheries and Aquaculture, Ebonyi State University, Abakaliki, Nigeria, from January to March, 2023.

Research protocol: The experimental fish was collected from Thy Grace Aqua-Tech Farm Abakaliki and was acclimated for 2 weeks. The 5000 g dried Melon seed peels were collected from the rural women who process Melon seeds for commercial purposes (EGUSI) in Abakaliki Local Government Area of Ebonyi

State. The husks were milled into powder form using a locally made miller machine (unbranded) and then sun-dried at 35°C for 5 hrs. The trial diets were formulated by mixing the ground melon peels with other feed ingredients purchased and processed from Meat Market a section of Abakpa Main Market Abakaliki, Ebonyi State at different inclusion levels. The experimental diets were formulated to contain 42% crude protein, 6.12% ash, and 4.8% moisture, the protein of the experimental diets was made almost similar to that of the commercial diet, to make proper comparisons. Therefore, Diet I (25% msp), Diet 2 (50% msp), Diet 3 (75% msp), and control diet a commercial diet (multi-feed). After the acclimation, the experimental fish was measured and weighed to get the initial weight and length. Thereafter they were distributed to different treatments of five and the control. The 120 experimental fish was fed melon peel diets at 5% body weight twice daily. During the period of the experiment the following parameters were monitored and calculated to determine the growth performance; initial mean weight, mean final weight, mean weight gain, specific growth rate, feed intake, food conversion ratio, protein intake, and survival rate. Floatation tests were carried out using bowls triplicates for each treatment; hence a total of 12 bowls was used for the study. Bowls of 10 L were filled up to 7 L. Each of the pellets including the control diet had 0.7 g, after the measurement, four pellets were dropped in each treatment and observed for 60 min at 10 min intervals. At the end of every observation, the timing was monitored by a stopwatch; the pellets that were afloat were recorded accordingly.

Statistical analysis: Data collected from the experiment were subjected to One-way Analysis of Variance (ANOVA) using Statistical Package for Social Science (SPSS) version 20 and the mean differences at ($p<0.05$) among treatments were separated using the Duncan's multiple range test.

RESULTS

Production of nutritionally certified formulated diets for semi-intensive culture should have standard sustainable prospects for the rearing of African catfish (*Clarias gariepinus*) in developing countries. Table 1 shows proximate composition (%) of experimental diets. The moisture content had a value of 4.23±0.041% the highest at 50% inclusion of Melon seed peels, T_4 recorded the least value of ash at 4.90±0.23% where crude protein recorded a value of 39.44±0.17 as the highest but there is no significant different ($p<0.05$) from the control diet. Table 2 shows the ingredients composition of the diets containing Melon seed peels at different inclusions. The results indicate a progressive increase in MSP inclusion from 0% in the control (D1) to 18.22% in D4, replacing yellow maize, which decreased correspondingly from 24.30 to 6.08%. The proportions of GNC, SBM, fish meal, premix, bone meal, oil, and salt remained constant across all dietary treatments. This suggests that MSP was incorporated at increasing levels by reducing yellow maize while maintaining other ingredient compositions.

Table 3 shows the percentage of pellets afloat, after each time of observation. After 10 min, the control diet and Diet 3 had the highest percentage (100%) while Diet 1 had the least (83.33%). After 40 min of exposure to water, the control diet maintained 100% pellets afloat while Diet 1 had the least. There was no significant difference in the percentage number of pellets afloat between 10 and 40 min of exposure to water ($p<0.05$). Diet 4 and control diet exhibited the highest floatation while Diet 2 had the least floatation. All experimental diets except the control failed to stand the dissolving effect of water after 40 to 60 min as no pellets were left afloat. The growth response of *Clarias gariepinus* fingerlings fed varying levels of inclusions of Melon seed peel diets are shown in Table 4. The results obtained from the growth response of fish-fed Melon seed peel diets indicated that, fish fed 25% Melon seed peel replacement gained 5.26 g, while fish fed 75% Melon seed peel diet had 2.21 g. The values obtained for the fish-fed control diet to 75% Melon seed peel diet were not significantly different ($p<0.05$). The fish fed 25% Melon seed peel diet had the highest value of 0.57% for the specific growth rate (SGR%) and the lowest value of 0.29% for fish fed 75% Melon seed peel diet and the values recorded for all the treatments were not significantly different ($p<0.05$). There was no significant difference ($p<0.05$) in the feed conversion ratio (FCR) in the fish-fed control diet and 25% Melon seed peel diets but there was a

Table 1: Proximate composition (%) of experimental diets (Mean±SE)

Proximate composition (%)	T_1 (control)	T_2 (25%)	T_3 (50%)	T_4 (75%)
MC	3.81±0.01^{b}	3.56±0.02^{d}	4.23±0.04^{a}	3.67±0.03^{c}
DM	95.19±0.01^{d}	95.44±0.02^{b}	94.77±0.04^{e}	95.33±0.03^{c}
Ash	5.54±0.33^{a}	5.27±0.17^{ab}	5.19±0.00^{ab}	4.90±0.23^{b}
C. fat	6.18±0.0^{d}	7.34±0.00^{b}	7.34±0.01^{b}	6.82±0.01^{c}
EE	2.18±0.00^{c}	3.34±0.12^{b}	3.30±0.03^{b}	4.17±0.09^{a}
CP	39.23±O.27^{a}	38.93±0.46^{a}	39.44±0.17^{a}	38.96±0.25^{a}
CHO	43.06±0.53^{b}	41.56±0.44^{c}	40.50±0.16^{c}	41.47±0.23^{c}

Figures on the same row having the same superscript are not significantly different ($p<0.05$), MC: Moisture content, DM: Dry matter, C. fat: Crude fat, EE: Ester extract, CP: Crude protein, CHO: Carbohydrate, T2: Diet 1 (25% msp), T3: Diet 2 (50% msp) and T4: Diet 3 (75% msp)

Table 2: Ingredients composition of diets containing Melon seed peel

Ingredient	D_1 (control)	D_2 (25%)	D_3 (50%)	D_4 (75%)
MSP	00.00	06.08	12.15	18.22
Yellow maize	24.30	18.22	12.15	06.08
GNC	19.30	19.30	19.30	19.30
SBM	19.70	19.70	19.70	19.70
Fish meal	29.10	29.10	29.10	29.10
Premix	00.30	00.30	00.30	00.30
Bone meal	00.30	00.30	00.30	00.30
Oil	05.00	05.00	05.00	05.00
Salt	02.00	02.00	02.00	02.00

MSP: Melon seed peel, GNC: Groundnut cake, SBM: Soya bean meal, T_2: Diet 1 (25% msp), T_3: Diet 2 (50% msp) and T_4: Diet 3 (75% msp)

Table 3: Floating time of the diets

Diets/time	10 min	20 min	30 min	40 min	50 min	60 min
D_1 contrl (MF)	100	100	100	100	100	91.67
D_2 (25%)	83.33	50.00	25.00	00.00	00.00	00.00
D_3 (50%)	91.67	75.00	41.67	16.67	00.00	00.00
D_4 (75%)	100	83.33	66.67	58.33	41.67	16.67

MF: Multi feed, T_2: Diet 1 (25% msp), T_3: Diet 2 (50% msp) and T_4: Diet 3 (75% msp)

Table 4: Growth performance of experimental fish (Mean ±SE)

Parameters	T_1 (control)	T_2 (25%)	T_3 (50%)	T_4 (75%)
Initial weight (g)	4.76±0.15^{a}	4.68±0.02^{a}	4.51±0.26^{a}	4.88±19^{a}
Mean final weight (g)	9.48±0.83^{a}	9.94±1.26^{a}	7.80±0.68^{a}	7.10±0.34^{a}
Mean weight gained (g)	4.72±0.98^{a}	5.26±1.26^{a}	3.29±0.29^{a}	2.21±0.27^{a}
Mean daily weight gained (g)	0.08±0.2^{a}	0.09±0.02^{a}	0.06±0.02^{a}	0.04±0.00^{a}
Specific growth rate (%day)	0.52±0.93^{a}	0.57±0.11^{a}	0.42±0.11^{a}	0.29±0.03^{a}
Feed intake (g)	5.13±0.83^{a}	5.41±1.09^{a}	4.42±0.30^{a}	4.24±0.40^{a}
Feed conversion ratio	1.12±0.10^{b}	1.07±0.11^{b}	1.58±0.43^{ab}	1.93±0.08^{a}
Protein intake (g)	2.05±0.33^{a}	2.17±0.44^{a}	1.77±0.12^{a}	1.69±0.16^{a}
Protein efficiency ratio	2.28±0.24^{ab}	2.40±0.28^{a}	1.84±0.50^{ab}	1.30±0.51^{b}
Survival rate (SR)	85.00	82.00	80.00	75.00

Figures on the same row having the same superscript are not significantly different ($p<0.05$), T_2: Diet I (25% msp), T_3: Diet 2 (50% msp) and T_4: Diet 3 (75% msp)

significant difference ($p<0.05$) when compared with the fish fed the diets containing 50, and 75% Melon seed peels diet. The highest value of 2.40 recorded for protein efficiency ratio (PER) was recorded in a fish-fed diet containing 25% Melon seed peel and the lowest value of 1.30 was recorded in a fish-fed diet containing 75% Melon seed peel. The values recorded for the control and 50% Melon seed peel diet were not significantly different ($p<0.05$). Survival rate (SR) was highest in fish fed with 0% Melon seed peel-based diet.

DISCUSSION

Feed is invariably an important component of intensive food fish production, as it has been shown to influence the growth rate, body composition, and health status of cultured fish, as well as the economic

viability of the operation[12]. Nigeria does not meet these criteria, which explains why farmers prefer to use floating feeds rather than sinking pellets. Besides, floating feeds allow farmers to view fish while feeding, while over-eating and wastage can be easily avoided[13]. However, these perceived advantages have not been translated into profits in many farms as the cost of feeding fish with floating feeds often leads to higher production costs. This makes farmers sometimes assume that all floating feeds produce the same growth effects on fish and are thus misled about the efficiency of these feeds. The consequences may be grievous, leading to irreparable loss to the farmers. It is added that the highest floating pellets were with pellets produced from T_4 (75%) followed by those of T_3 (50%) and the pellets from T_2 (25%) had the least.

The initial superiority of multi-feed over the experimental diets in terms of buoyancy in the water can be attributed to the extrusion of the pellets. However, experience from the use of imported fish floating pellets showed that all the pellets from the three sources of carbohydrates performed well with their time and percentage floatation. It can be adduced from the above that between 10-30 min Melon seed peel at the highest percentage inclusion had better floatation and lower percentage inclusion had the lowest. Results also show that after 50 min Melon seed peel diets 75% inclusion had the highest water floatation while at 25% inclusion had the lowest. However, the decline of floating pellets of feed produced at 75% inclusion of Melon seed peels as observed in this work is supported by Hashim and Saat[13] who reported the use of four local seaweeds and carrageenan as binding agents in pellet diets for snakehead (*Channa striatus*) of five iso-nitrogenous 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. Growth performance, the result showed that Diet 2 had the highest mean weight gain and feed intake and was in conformity with the work of Ajani *et al.*[14] that reported the same in mean weight gain and feed intake for *C. gariepinus* fed on floating feeds. The same way in food conversion ratio, protein efficiency, and specific growth rate but the survival rate was better in the control diet than the fish-fed diet two but differed from the previous findings of Mustapha *et al.*[12] and Hashim and Saat[13], reported higher growth performance for *C. gariepinus* fed with sinking and floating diets. The feed conversion efficiency of *C. gariepinus* was similar between the two diets during the study period. Similarly, found feed conversion efficiency in the same fish species had no significant effect by the forms of the feeds used.

CONCLUSION

The need for reducing feed costs in fish production has led to the adoption of alternative feed resources that are cheaper and of low dietary importance to man. In a bid to search for alternative and cheaper energy in the aquaculture sector, this research was conducted to determine the effect of Melon seed peel on the floating capacity and growth performance of *Clarias gariepinus* fingerlings. Diets 1 and 2 having the highest values among the parameters measured, showed the peel had an increasing positive effect on the growth. The floatation increased as the inclusion level of the melon peels increased in the diets. Therefore, 25% inclusion level is recommended for fish farmers.

SIGNIFICANCE STATEMENT

The need for reducing feed costs in fish production has led to the adoption of alternative feed resources that are cheaper and of low dietary importance to man. Other energy sources like (Maize) in fish feed have been in alarming competition with human and livestock consumption. Therefore, it was deemed necessary to find waste (Melon seed peels) as an alternative energy source that can be included in fish feed which can enhance buoyancy, acceptability, and growth optimally to fish. The results of the research indicated that waste can be converted to wealth. The achievements on the inclusion of Melon seed peels enhanced the palatability of feed pellets to the duration of acceptability and improved the growth performance of the fish. Hence fish farmers are advised to include Melon seed peels to fish feed.

REFERENCES

1. Lim, C. and G. Cuzon, 1994. Water stability of shrimp pellet: A review. Asian Fish. Sci., 7: 115-126.
2. Sawaya, W.N., N.J. Daghir and J.K. Khalil, 1986. Citrullus colocynthis seeds as a potential source of protein for food and feed. J. Agric. Food Chem., 34: 285-288.
3. National Research Council, Policy and Global Affairs, Development, Security, and Cooperation, 2006. Lost Crops of Africa: Volume II: Vegetables. National Academies Press, Washington, DC, ISBN: 9780309103336, Pages: 378.
4. Sadou, H., H. Sabo, M.M. Alma, M. Saadou and C.L. Leger, 2007. Chemical content of the seeds and physico-chemical characteristic of the seed oils from *Citrullus colocynthis*, *Coccinia grandis*, *Cucumis metuliferus* and *Cucumis prophetarum* of Niger. Bull. Chem. Soc. Ethiop., 21: 323-330.
5. Asyaz, S., F.U. Khan, I. Hussain, M.A. Khan and I.U. Khan, 2010. Evaluation of chemical analysis profile of *Citrullus colocynthis* growing in Southern Areas of Khyber Pukhtunkhwa Pakistan. World Appl. Sci. J., 10: 402-405.
6. Sadiku, S.O.E. and K. Jauncey, 1995. Digestibility, apparent amino acid availability and waste generation potential of soybean flour: Poultry meat meal blend based diets for tilapia, *Oreochromis niloticus* (L.), fingerlings. Aquacult. Res., 26: 651-657.
7. Hilton, J.W., C.Y. Cho and S.J. Slinger, 1981. Effect of extrusion processing and steam pelleting diets on pellet durability, pellet water absorption, and the physiological response of rainbow trout (*Salmo gairdneri* R.). Aquaculture, 25: 185-194.
8. Ekanem, A.P., V.O. Eyo, A.I. Obiekezie, U.I. Enin and P.J. Udo, 2012. A comparative study of the growth performance and food utilisation of the African catfish (*Clarias gariepinus*) fed unical aqua feed and coppens commercial feed. J. Mar. Biol. Oceanogr., Vol. 1. 10.4172/2324-8661.1000101.
9. Gabriel, U.U., O.A. Akinrotimi, D.O. Bekibele, D.N. Onunkwo and P.E. Anyanwu, 2007. Locally produced fish feed: Potentials for aquaculture development in Subsaharan Africa. Afr. J. Agric. Res., 2: 287-295.
10. Ikwor, T.N., J.N. Nwakpa, J.S. Awoke, M.U. Agim and E.U. Onwe, 2020. Effects of replacement of maize with cassava stem meal on growth and haematology of african catfish (*Clarias gariepinus*, Burchell 1822) fingerling. J. Aquat. Sci., 35: 47-55.
11. Bichi, A.H. and M.K. Ahmad, 2010. Growth performance and nutrient utilization of African catfish (*Clarias gariepinus*) fed varying dietary levels of processed cassava leaves. Bayero J. Pure Appl. Sci., 3: 118-122.
12. Mustapha, M.K., B.F. Akinware, C.A. Faseyi and A.A. Alade, 2014. Comparative effect of local and foreign commercial feeds on the growth and survival of *Clarias gariepinus* juveniles. J. Fish., 2: 106-112.
13. Hashim, R. and M.A.M. Saat, 1992. The utilization of seaweed meals as binding agents in pelleted feeds for snakehead (*Channa striatus*) fry and their effects on growth. Aquaculture, 108: 299-308.
14. Ajani, F., M.O. Dawodu and O.A. Bello-Olusoji, 2011. Effects of feed forms and feeding frequency on growth performance and nutrient utilization of *Clarias gariepinus* fingerlings. Afr. J. Agric. Res., 6: 318-322.