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Dietary Utilization of Different Portions of Sweet Cassava Root (*Manihot palmata*) for the Nile Tilapia *Oreochromis niloticus* (Linnaeus, 1758)

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ABSTRACT

The effects of dietary parts of sweet cassava (*Manihot palmata*) root meal on growth and hematological parameters were investigated in cichlid, *Oreochromis niloticus* (Linnaeus). Mixed-sex fingerlings of *O. niloticus* (mean weight, 6.86-6.99 g) were fed with diets containing different portions of sweet cassava root meal at the inclusion level of 24.0 g kg⁻¹ in lieu of corn meal in a control, for 8 weeks. The best weight gain (2.44±0.69 g) and feed efficiency (1.62±0.57) were obtained in fish fed with diet containing maize (control), while the least (1.61±0.15 g) and (2.22±0.15) were obtained in fish fed diet containing cassava tuber. However, significant differences were not observed in weight gain and feed efficiency of fish fed on the control diet and those fed on diet containing cassava peel. Similarly, the highest specific growth rate (0.46±0.01) was obtained in fish fed the control diet followed closely by fish fed on diet containing cassava peel (0.39±0.01). The values of hematological parameters obtained in this study were within the normal range. Based on the results obtained in this study, it could be concluded that sweet cassava peel can be included into aqua feeds to replace maize, as energy source for *Oreochromis niloticus*. This would reduce the high cost of producing aqua feeds in Africa with special reference to Nigeria.

Key words: Cassava portions, Tilapia, growth performance, feed utilization

INTRODUCTION

Global aquaculture production has continued to grow in the new millennium, albeit more slowly than in the 1980s and 1990s (FAO., 2012). As aquaculture production becomes more and more intensive in Nigeria, fish feed will be a significant factor in increasing the productivity and profitability of aquaculture (Akinrotimi *et al.*, 2007).

Feed accounts for between 60-70% of the running expense involved in the operation of fish farm as an enterprise and this in most cases reduced the profit of the farmer which often results into marginal profit (Gabriel *et al.*, 2007). In Nigeria, especially with the present economic depression, cost of fish diets is increasing daily not just because of inflation, but because most of the feedstuffs used in preparing fish diets face serious competition from man as food. Some of such feedstuff includes; soybean, maize, sorghum and groundnut cake. This increasingly high demand for these feedstuffs by man and consequently the high prices calls for the attention of fish nutritionists the world over to search deeper into the environment for less competitive feedstuffs that will cost little

or nothing for inclusion in fish diets. The need to intensify the culture of the fish, so as to meet the ever increasing demand for fish has made it essential to develop suitable diets either in supplementary forms for ponds or as complete feed in tanks (Olukunle, 2006).

Maize is about 10-40% by weight in most aqua feeds and is one of the major sources of energy in fish diets (Olurin *et al.*, 2006). The high cost and scarcity of maize in formulated feeds has led to the use of under-utilized energy sources such as cassava root meal, cassava leaf meal, wheat bran and sorghum meal. Tilapia is one of the most productive and internationally traded food fish in the world (Gupta and Acosta, 2004). They are major protein source in many developing countries. FAO (2007) reported that Nile tilapia (*Oreochromis niloticus*) is amongst top ten most cultured fish species in the world, with total production of 1,703,125 mt, which is about 84% of total farmed tilapia production in 2006. The objective of this study was to evaluate the effects of replacement of maize with cassava portions on growth, nutrient utilization and hematological indices of *Oreochromis niloticus*.

MATERIALS AND METHODS

Collection and acclimatization of experimental fish: Five hundred (500) mixed-sex fingerlings of *Oreochromis niloticus* from the same broodstock (average weight, 6.90±0.06 g) were obtained from the Department of Fisheries, Ekiti State Ministry of agriculture, Ado-Ekiti, Nigeria for the study. The fingerlings were acclimatized to laboratory conditions for 14 days.

Formulation of experimental diets: Fresh whole tubers of sweet cassava specie (*Manihot palmate*) were obtained from Ekiti State University farm, Ado Ekiti, Ekiti State, Nigeria. Meals were derived from cassava peels by air drying the peels for a week at ambient temperature. The peels were milled into powder. Cassava tuber meal was obtained by peeling fresh cassava tubers, washed and blanched in boiling water for 5 min at 100°C to remove the cyanogenic glycoside, chopped, air dried and milled into powder.

Starch was obtained from peeled cassava tuber, washed, chopped and soaked in water in a sac for two days, the water leaching was collected. Cassava was peeled, washed and soaked in water for four days and sieved. The shaft from the sieved was dried at temperature 30°C and blended into powder meals. Proximate analyses of the different portions of sweet cassava root are shown in Table 1 while Table 2 shows the ingredients and proximate analyses of the test diets. These diets were designated CTR (control), CPL (peel), CTB (tuber), CST (starch) and CSH (shaft). All test diets were iso-caloric (3067.8 kcal kg⁻¹).

Experimental design: Fifteen plastic rectangular tanks (60×35×30 cm³) were used for the study and water was maintained at a constant volume of 12 L in each tank. The fish were starved overnight to empty their gut, so that their appetite and reception for the new diets will increase

Table 1: Proximate composition (DM %) of different portions of sweet cassava (*Manihot palmata*) root

Proximate composition	Cassava root portions			
	Peel	Tuber	Starch	Shaft
Moisture	5.11±0.01	61.89±0.02	3.79±0.05	2.130±0.01
Crude lipid	2.81±0.02	0.81±0.02	2.14±0.01	0.140±0.01
Crude protein	6.84±0.01	3.14±0.01	1.12±0.02	0.420±0.07
Ash	5.78±0.03	2.79±0.02	6.27±0.01	7.270±0.02
Crude fibre	26.11±0.02	1.50±0.02	14.10±0.01	38.110±0.25
NFE	53.36±0.04	29.87±0.02	72.58±0.07	51.950±0.19

Table 2: Ingredients in and proximate composition (g) of experimental diets

Ingredients	Dietary treatments				
	CTR	CPL	CTB	CSH	CST
Fish meal	30.65	30.65	30.65	30.65	30.65
Soybean meal	25.35	25.35	25.35	25.35	25.35
Corn meal	24.00				
Cassava root Portion		24.00	24.00	24.00	24.00
Vegetable oil	5.00	5.00	5.00	5.00	5.00
Oyster shell	2.00	2.00	2.00	2.00	2.00
Rice bran	3.00	3.00	3.00	3.00	3.00
Fish premix	5.00	5.00	5.00	5.00	5.00
Vitamin premix	2.00	2.00	2.00	2.00	2.00
NaCl	1.00	1.00	1.00	1.00	1.00
Lysine	1.00	1.00	1.00	1.00	1.00
Methionine	1.00	1.00	1.00	1.00	1.00
Proximate composition (DM %)					
Ash	8.83±0.77	9.49±0.51	10.64±0.56	10.33±0.53	9.46±0.01
Moisture	3.82±0.35	4.15±0.07	3.58±0.50	3.26±0.27	5.06±0.24
Crude protein	29.15±0.85	29.15±0.71	29.42±1.81	29.34±1.41	29.06±1.30
Crude lipid	15.08±0.85	15.76±0.45	17.23±0.82	15.03±0.99	15.82±0.99

Vitamin premix-A Pfizer livestock product containing the following per kg of feed: A: 4500 I. U, D: 11252 I.U, E: 71 I.U, K₃: 2 mg, B12: 0.015 mg, Pantothenic acid: 5 mg, Nicotinic acid: 14 mg, Folic acid: 0.4 mg, Biotin: 0.04 mg, Choline: 150 mg, Cobalt: 0.2 mg, Copper: 4.5 mg, Iron: 21 mg, Manganese: 20 mg, Iodine: 0.6 mg, Selenium: 2.2 mg, Zinc: 20 mg, Antioxidant: 2 mg, DM: dry matter, CTR: Control, CPL: Peel, CTB: Tuber, CST: Starch, CSH: Shaft

before the administration of the test diets. For the study, 300 mixed-sex fingerlings of *Oreochromis niloticus* were distributed randomly into 15 tanks (20 fish/tank) representing five dietary treatments. The fish were fed (3% body weight) twice daily at 0800-1000 and 1700-1800 h. Faecal samples were siphoned out and the water replaced daily before any subsequent feedings.

Fish in each experimental tank was batch-weighed fortnightly to determine the growth performance of the experimental fish. The experimental period lasted 8 weeks. The water quality parameters determined during the study period were 6.40±0.19 mg L⁻¹, 27.10±0.33°C and 7.24±0.13 for dissolved oxygen, temperature and pH, respectively.

Determination of growth performance and hematological indices: The following growth and feed utilization indices were determined and calculated at the end of the study; weight gain, Specific Growth Rate (SGR) and Food Conversion Ratio (FCR) using, the following equations as described by Brown (1957), Castell and Teiws (1980) and Miller and Bender (1955), respectively.

$$WG = \text{Final average weight (g)} - \text{Initial average weight (g)}$$

$$SGR (\% d^{-1}) = 100 \times (\ln W_t - \ln W_0) / t$$

where, W_t and W₀ represent final and initial body weights of fish, respectively and t represents the duration of the feeding trial.

$$FCR = \text{Dry weight of feed (g)} / \text{Wet weight gain by fish (g)}$$

Fifteen fish (five fish per replicate) were used for blood analysis and 5 mL blood samples from each treatment were collected by cardiac puncture using 5 mL disposable syringes, into treated Bijou bottles. The blood was stored at -40°C prior to analysis. The blood analysis followed the methods described by Svobodova *et al.* (1991).

Statistical analysis: At the end of the study, data obtained were subjected to one-way analysis of variance (ANOVA) test. Duncan’s New Multiple Range Test was carried out at $p < 0.05$ to separate the differences among the means (Zar, 1984).

RESULTS

Results of growth performance of *Oreochromis niloticus* fed the test diets for 8 week are summarized in Table 3. Fish fed diet CTR (control) had the highest weight gain (2.44 ± 0.67 g) and this was significantly different ($p < 0.05$) from the weight gain of the fish fed on diets CTB, CSH and CST. Similarly, fish fed diet CTR had the highest SGR value ($0.46 \pm 0.01\%$ /day), which was significantly, higher than ($p < 0.05$) all the other treatments except treatment CPL, while the least SGR value was obtained in fish fed diet CTB (0.30 ± 0.01 %/day).

Fish fed on diet CPL utilized the test diets better than fish in the other treatments fed dietary portions of sweet cassava root. On the other hand, fish fed diet CST had the highest feed conversion ratio (Table 3). Values of percentage survival obtained for the five experimental diets were not significantly different ($p > 0.05$).

The result of the growth performance analysis revealed that there were no significant differences ($p < 0.05$) in the final weight and weight gain of the experimental fish fed on diets CTR (control) and CPL (peel). There was improvement in the final weight of the experimental fish compared with the initial weight. Since, the protein content of the diets is the same, difference in fish weight gain can only be attributed to the acceptability and the utilization of the experimental diets particularly the control and diet containing cassava peels. The weight gain by fish fed diet containing cassava peels could be attributed to the high protein content in the peels.

Mean values of the hematological indices of the experimental fish after the feeding trials are presented in Table 4. The groups of fish fed CTB diet had the least mean values of white blood cell, which was significantly different ($p < 0.05$) from the mean values obtained for the groups of fish. The groups of fish fed CST diet recorded the highest mean values of red blood cell, which was significantly different ($p < 0.05$) from the mean values obtained for the other groups of fish.

Table 3: Growth and nutrient utilization of *Oreochromis niloticus* fed different portions of sweet cassava (*Manihot palmata*) root meal for 8 weeks

Parameters	Dietary treatment				
	CTR	CPL	CTB	CSH	CST
Initial mean weight (g)	6.99 (0.02)	6.86 (0.09)	6.88 (0.09)	6.87 (0.06)	6.88 (0.04)
Final mean weight (g)	9.42 (0.69) ^a	8.98 (0.20) ^a	8.49 (0.21) ^b	8.69 (0.39) ^b	8.59 (0.47) ^b
Weight gain (g)	2.44 (0.67) ^a	2.11 (0.21) ^a	1.61 (0.15) ^b	1.82 (0.35) ^b	1.71(0.47) ^b
SGR (% day ⁻¹)	0.46 (0.01) ^a	0.39 (0.01) ^a	0.30 (0.01) ^b	0.33 (0.01) ^b	0.32 (0.01) ^b
FCR	1.62 (0.57) ^a	1.80 (0.14) ^a	2.22 (0.15) ^b	2.01 (0.27) ^b	2.11(0.76) ^c
Survival (%)	93.33 (3.85) ^a	97.77 (2.22) ^a	95.55 (2.22) ^a	95.56 (4.44) ^a	93.33 (0.15) ^a

Values in parentheses are standard errors of means. Means in a given row with the same superscript letter were not significantly different at $p < 0.05$, SGR: Specific growth rate, FCR: Feed conversion ratio

Table 4: Hematological profiles of *Oreochromis niloticus* fed different portions cassava meal for 8 week

Blood parameters	Dietary treatment				
	CTR	CPL	CTB	CST	CSH
PCV (%)	26.33 (0.33) ^b	22.33 (0.3) ^b	24.00 (0.00) ^b	31.00 (0.00) ^b	19.33 (0.67) ^c
Hb (g/100 mL)	8.71 (0.01) ^c	7.37 (0.12) ^a	8.01 (0.01) ^b	10.31 (0.01) ^e	9.31 (0.01) ^d
WBC (×10 ³ μL)	7800 (0.00) ^c	9600 (0.00) ^e	5400 (0.00) ^a	6700 (0.00) ^b	8800 (0.00) ^d
RBC (×10 ⁶ μL)	2.85 (0.00) ^c	2.41 (0.01) ^a	2.61 (0.01) ^b	3.63 (0.02) ^e	3.07 (0.04) ^d

Means in a given row with the same letter were not significantly different at $p < 0.05$. Values in parentheses are standard errors of means. PCV: Packed cell volume, Hb: Hemoglobin estimation, WBC: White blood cell count, RBC: Red blood cell count

DISCUSSION

The best growth performance obtained in fish fed control diet is similar to the findings of Olurin *et al.* (2006). Abu *et al.* (2010) reported that 100% replacement of maize with whole cassava root meal in hybrid catfish fish diet showed no depression in growth or unfavorable feed conversion ratio. The insignificant ($p < 0.05$) in the weight gain of *Oreochromis niloticus* fed diet containing different portions of sweet cassava indicate that replacement of maize with cassava could be more profitable to fish farmer as maize is more expensive than cassava.

The food conversion ratio obtained in this study corroborates the report of Sugiura *et al.* (2000) on rainbow trout, that replacement of maize with cassava does not affect growth and feed utilization of fish. The high survival rates recorded in this study, indicate that feeding tilapia with different portions of *Manihot esculenta* does not lead to mortality of the fish. This may probably be due to the substantial reduction in the cyanide content, (by boiling and drying) of the whole cassava by-product. Cardoso *et al.* (2005) observed that good processing of cassava enhance survival and healthy state of fish at all stages of their life.

The hematological parameters measured in this study were within the recommended ranges reported for *O. niloticus* (Osuigwe *et al.*, 2005). However, the significant difference ($p < 0.05$) in the hematological values of fishes fed with the experimental diets could be attributed to the presence of higher concentration of anti-metabolites in the diets. This is in agreement with Osuigwe *et al.* (2005) who reported that the reduction in value of packed cell volume, hemoglobin and red blood cells were due to the presence of toxic substances in the diet of fish. An increase in White Blood Cells (WBCs) is usually associated with microbial infection or the presence of foreign body or antigen in the circulating system. The hematological results showed that the fish fed with different portions of Cassava diet compared favorably with those fed control diet.

CONCLUSION

Based on the results obtained, incorporation of different portions of sweet cassava root (*Manihot palmata*) in the diet of *Oreochromis niloticus* compared favorably with the control diet containing maize in terms of growth and percentage survival. The fish fed on cassava peel diet had the best weight gain and feed utilization values compared to other fish fed diets containing cassava root portions. This could be attributed to its acceptability and utilization by the fish. Hence, fish farmers can take advantage of this ingredient (cassava peels) as a replacement for more expensive maize when formulating feed for tilapia culture. More research could be conducted to ascertain the cyanide content of the cassava root portions.

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REFERENCES

- Abu, O.M.G., L.O. Sanni, E.S. Erondu and O.A. Akinrotimi, 2010. Economic viability of replacing maize with whole cassava root meal in the diet of hybrid cat-fish. *Agric. J.*, 5: 1-5.
- Akinrotimi, O.A, U.U. Gabriel, N.K. Owhonda, D.N. Onunkwo, J.Y. Opara, P.E. Anyanwu and P.T. Cliffe, 2007. Formulating an environmental friendly fish feed for sustainable aquaculture development in Nigeria. *Agric. J.*, 2: 606-612.

- Brown, M.E., 1957. Experimental Studies on Growth. In: The Physiology of Fishes, Volume 1: Metabolism, Varley, M.E. (Ed.). Chapter 9, Academic Press, New York, USA., ISBN-13: 9781483227634, pp: 361-400.
- Cardoso, A.P., E. Mirione, M. Ernesto, F. Massaza, J. Cliff, M.R. Haque and J.H. Bradbury, 2005. Processing of cassava roots to remove cyanogens. *J. Food Compos. Anal.*, 18: 451-460.
- Castell, J.D. and K. Tiews, 1980. Report of the EIFAC, IUNS and ICES working group on standardization of methodology in fish nutrition research (Hamburg, Federal Republic of Germany, 21-23 March 1979). EIFAC Technical Paper No. 36, FAO, Rome, Italy, pp: 1-24. http://www.ices.dk/sites/pub/CM%20Documents/1980/F/1980_F33.pdf
- FAO., 2007. Fishstat plus. Fisheries and Aquaculture Department, Food and Agriculture Organization, Rome, Italy.
- FAO., 2012. The State of World Fisheries and Aquaculture 2012. Food and Agriculture Organization of the United Nations, Rome, Italy, ISBN-13: 9789251072257, Pages: 209.
- 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.
- Gupta, M.V. and B.O. Acosta, 2004. A review of global tilapia farming practices. *Aquacult. Asia*, 9: 7-12.
- Miller, D.S. and A.E. Bender, 1955. The determination of the net utilization of proteins by a shortened method. *Br. J. Nutr.*, 9: 382-388.
- Olukunle, O., 2006. Nutritive potential of sweet potato peel meal and root replacement value for maize in diets of African catfish (*Clarias gariepinus*) advanced fry. *J. Food Technol.*, 4: 289-293.
- Olurin, K.B., E.A.A. Olojo and O.A. Olukoya, 2006. Growth of African catfish *Clarias gariepinus* fingerlings, fed different levels of cassava. *World J. Zool.*, 1: 54-56.
- Osuigwe, D.I., A.I. Obiekezie and G.C. Onuoha, 2005. Some haematological changes in hybrid catfish (*Heterobranchus longifilis* x *Clarias gariepinus*) fed different dietary levels of raw and boiled jackbean (*Canavalia ensiformis*) seed meal. *Afr. J. Biotechnol.*, 4: 1017-1021.
- Sugiura, S.H., J.K. Babbitt, F.M. Dong and R.W. Hardy, 2000. Utilization of fish and animal by-product meals in low-pollution feeds for rainbow trout *Oncorhynchus mykiss* (Walbaum). *Aquacult. Res.*, 31: 585-593.
- Svobodova, Z., D. Pravda and J. Palackova, 1991. Unified Methods of Haematological Examination of Fish. Research Institute of Fish Culture and Hydrobiology, Vodnany, Czech Republic, Pages: 31.
- Zar, J.H., 1984. Biostatistical Analysis. 2nd Edn., Prentice Hall, Englewood Cliffs, NJ., USA., ISBN-13: 9780130779250, Pages: 718.