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Effect of Graded Level of Whole Cassava Root Meal as a Replacement for Maize on Growth Performance of *Clariasgariepinus* Fingerlings

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Abstract
This study was conducted to assess the possibility of replacing maize (Zea mays L.) with varying levels of cassava flour (Manihotesculenta) in the diet of the African catfish (Clariasgariepinus). The effect of replacement on growth variables and nutrient utilization were assessed. Five practical diets with varying replacement levels of maize at A (0%), B (25%), C (50%), D (75%), and E (100%), representing the replacement levels were formulated and fed to Clariasgariepinus fingerlings for 8 weeks. Complete randomized design was used and data collected were analyzed using SPSS Version 22. Fish were fed twice daily at 5% body weight/day. Optimum growth and nutrient utilization were assessed. The result of the study indicated that the best SGR (4.44 ± 2.45) was recorded in diet E (100%) while the lowest SGR (3.25 ± 2.57), was recorded in diet B (25%). Weight and Weight gain was highest (40.72 ± 16.11, 7.33± 3.64) in diet E (100%) and lowest (36.07+11.55, 5.95 ± 3.76) in diet B (25%). Daily weight gain was highest (2.32 ± 5.90) in diet E (100%) and lowest (1.00 ± 0.50) in diet B (25%) and the best feed conversion ratio (FCR) (0.19 ± 0.01) was recorded in diet E (100%) while the lowest (1.32 ± 0.04) was recorded in diet A (0%) control. It could therefore be concluded that cassava flour can replace maize in the diet of Clariasgariepinus effectively up to 100%. Fish farmers can therefore explore the use of cassava flour as an alternative to maize meal in the diet of Clariasgariepinus fingerlings.

Keywords: *Fingerlings, Growth Performance, Clariasgariepinus, Maize, Aquaculture*

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I. Introduction

Fish has continually been a source of hope towards solving the global problem of malnutrition due to its palatability and high proteinous content compared to other animal protein sources (Delgade*et al.,* 2003; Fasakin, 2008). The growth of Nigerian aquaculture sector is currently being hampered by challenges like; inadequate supply and high cost of quality fish feeds (Olusola*et al.,* 2018). Regardless, the intensification of aquaculture has been recommended in order to meet up with the global demand since capture fisheries have continued to be on the decline over decades (Delgade*et al.,* 2003). 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. According to the latest global report from the food and aquaculture organization of the United Nations (FAO, 2012) the fishery and aquaculture sector is therefore finding itself at critical crossroads, and at a time when it is facing rapid technological change, increasing demand, and rising feed prices. With the level of growth witnessed in aquaculture in recent times, issues such as high cost of feed ingredient and anti nutritional factors in feed ingredients needs to be addressed. This is due to competitive demand from humans, poultry and livestock industry, hence the need for the development of fish feed from high quality inexpensive sources and methods of reducing anti nutritional factors in feed ingredients to the minimum for the sustainability of the aquaculture industry (Baruah*et al.,* 2003; Agbabiaka, 2013). Maize is the major source of metabolizable energy in most compounded diets for catfish species, this is because it is readily available and digestible (Olurin*et al.,* 2006). However, the increasing prohibitive cost of this commodity has necessitated the need for an alternative source of carbohydrate for farmed fish at relatively low cost without compromising fish health and growth.

Cassava (*Manihotesculenta*) a perennial shrub native to South America is now grown throughout the tropics and is one of the most important energy sources in the diet of people in the tropics. Recent estimates suggest that its storage roots provide eight percent or more of the minimum calorie requirement of more than 750 million people. Its starchy root produces more calories per unit of land than any other crop in the world (Presston, 2004). Studies on the use of cassava meal in animal feed includes; Oresegun and Alegbeleye, (2001), Faturoti, *et al.* (2002) and Eyo (2003) all of which indicated a great potential for cassava to replace the conventional energy feed ingredients such as maize, broken rice and sorghum, which are commonly used in animal diets in most parts of the Africa (Tewe, 2004).

This research was therefore designed and conducted to evaluate the suitability of cassava flour in replacing maize for optimal performance of fish and for profit maximization in aquaculture enterprise.

II. Materials And Methods

2.1 Project Site

The work was carried out using the facilities of African regional Aquaculture Centre (ARAC) Aluu, Rivers State, Nigeria.

2.2 Source of Experimental Fish

Four hundred and fifty (450) fingerlings of *Clariasgariepinus* of the same stock were bought from ABU's Farm Consultant, Igbo-Etche Area of Rivers State. They were transported in oxygen bags to the experimental site at African regional Aquaculture Centre Aluu, Rivers State, Nigeria.

2.3 Acclimation of Fish

The fish were acclimated in $5m^2$ fish tank for one week. The fish were fed twice daily on diet A (0%) (control) at 5% body weight.

2.4 Experimental Design

The design of the experiment is completely randomized Design (CRD), with five treatment levels each and three replicates each based on the levels of replacement of maize.

2.5 Number and Size of Experimental Tanks

A total of 15 concrete tanks of dimension (2.5m x 2m x 1.3m) each, were used for the experiments. The tanks were randomly labeled, based on treatment levels and replicates.

2.6 Stocking Density

The fingerlings were removed from acclimation tanks, with hand net, and were placed on a plastic tray and were counted. Thirty (30) fingerlings were stocked in each of the experimental tanks. The initial total and mean weights (g) were taken before placing them in the rearing tanks.

2.7 Processing of Cassava Flour

Fresh whole cassava roots (WCR) sweet species (*Manihotesculenta*) were harvested from Abigail's rehoboth farm at Elioparanwo, Port Harcourt, Rivers State, Nigeria. They were first washed and peeled. They were washed and blanched for 5 minutes in boiling water at 100oC to remove cyanogenic glycoside of cassava the blanched cassava was chipped, dried for 2-3 days and milled. The flour was then incorporated in the diets at various levels.

2.8 Formulation and Preparation of Experimental Diets

Five practical diets were formulated and designated A (0%), B (25%), C (50%), D (75%), E (100%). Diet A (0%) (control) had maize as the main energy source, in diets B (25%), C (50%), D (75%), E (100%). Maize was substituted with cassava flour at graded levels of 25, 50, 75, and 100% respectively.

The various ingredients used in the diet were first weighed out following the formulation and mixed together properly. Water was added to the mixture at the rate of 25% of the weight of the mixed feed (w/w). After this, water and feed mixture were thoroughly mixed and pelleted using the pelleting machine. The pelleted feeds were immediately transferred to the drying slab for proper sun drying and later packed into transparent plastic containers with cover. The plastic containers were then placed on a wooden rack in a cool dry room for storage.

2.9 Feeding of Experimental Fish

The fingerlings were fed at the same feeding frequencies twice daily (8.00hrs and 17:00hrs) at 5% body weight. The daily feed was divided into two, and half fed to fish each time. The fish were cultured from fingerlings to juvenile stage for a period of 35 days. The fingerlings were fed at the same feeding frequencies twice daily (8.00hrs and 17:00hrs) at 5% body weight. The daily feed was divided into two, and half fed to fish each time. The fish were cultured from fingerlings to juvenile stage for a period of 35 days.

2.10Proximate Analysis of Experimental Diets and Fish

The experimental feeds and fish were analyzed for proximate composition using standard methods as stated by AOAC (1990).

2.11 Evaluation of Growth and Nutrient Utilization Parameters

Evaluation of growth and nutrient utilization were determined as follows

Survival = $\frac{Final\ number\ of\ fingerlings\ \times 100}{initial\ number\ of\ fingerlings\ stocked}$

Specific Growth Rate (SGR)

SGR was calculated according to the method of Brown (1957) as:

SGR = $\frac{Initial\ w_1 - inw_0 \times 100}{T\ (number\ of\ ttrial\ days)}$

$\frac{Weight\ gain\ (DWG) = Final\ weight - Initial\ weight}{Growth\ period}$ (Orisamuko, 2006)

Feed Conversion Ratio $(FCR)_{1\ 0}$

$$FCR = \frac{\text{Live weight gain (g)}}{\text{Dry Feed Fed (g)}}$$

$FCR = \frac{Live\ weight\ gain\ (g)}{Dry\ feed\ fed\ (g)}$(Tacon 1993; Ndimele*et al.*, 2011)

2.12 Statistical Analysis

Data obtained from experiment were subjected to ANOVA, using Statistical Package for the Social Sciences (SPSS) version 22 and Turkey post hoc test was used to separate means where they exist.

III. Results

The results obtained for the proximate composition of experimental diets revealed ranges for moisture as 4.39% in diet C50 to 5.54 % in the control diet A (0%). Crude protein was relatively higher (30.38%) in diet E (100%) and lowest (27.85%) in diet D (75%) Results for fat revealed relatively higher values in the experimental diets while the least value was recorded in the control diet A (0%). The highest value (10.38%) recorded for ash was in diet D (75%), while the lowest value (7.20%) was recorded in diet B (25%). Crude fibre was highest in experimental diet C (50%), followed by diet E 100, with percentage values of 17.13% and 15.67% respectively. The least value was recorded in diet B25 with a percentage value of 5.74% (Table 1).

The final weight of the experimental fish increased with feeding period or experimental period. The level of the inclusion of cassava flour impacted (P<0.05) on the final weight of fish fed the experimental diets. The highest value (40.72+16.11g) was observed in diet E (100%) with the least value (36.07+11.55g) observed in diet B (25%). Generally, fish treated with experimental diets performed better than the A (0%) (control). The highest weight gain (7.33± 3.64g) was observed in fish fed with diet E (100%), while the lowest weight gain (5.95 ± 3.76g) was observed in fish treated with diet B (25%). There was statistically significant difference (P<0.05) between fish treated with diet E (100%) and the other experimental diets. Generally the weight increased more in fishes fed with the experimental diets than the control diet (A (0%)) (Table 2). The mean weight gain was observed to be higher in fishes treated with diet E (100%) and lowest in fishes fed with diet B (25%). There was significant difference (P<0.05) recorded between fishes treated with diets D (75%) and E (100%) and the other diets. The feed input in relation to the experimental diets revealed a significantly higher (P<0.05) value in diet E (100%) followed by diet D (75%). The least feed input was recorded in diet B (25%) with a significant difference occurring between diets E (100%) and the other treatments. Daily weight gain and mean daily weight of the fish in relation to the experimental diet was observed to be highest (2.35 ± 5.90g and 0.10 ± 0.4g) in diet E (100%) and lowest (1.00 ± 0.50g and 0.08 ± 0.04g) in diet B (25%). Specific growth rate of the fishes increased significantly (4.44 ± 2.45) when fed with diet E (100%) they least increased (3.25 ± 2.57) when fed with diet B (25%). There was significant difference (P<0.05) between fishes fed with diet E (100%) and the other diets. Food conversion ratio of the fishes in relation to experimental diets was significantly lower in A (0%) control and higher in the experimental diets with the highest rate recorded in fish fed with diet E (100%). Survival rate was relatively high across experimental diets depicting that the cassava inclusion diets favoured the survival of the *Clariasgariepinus* fingerlings.

Table 1: Proximate Composition of the Experimental Diets

Parameters	Experimental diets				
Proximate	A(0%) (control)	B (25%)	C (50%)	D (75%)	E (100%)
Moisture %	5.54	4.94	4.39	4.84	4.89
Crude protein	29.86	29.24	28.24	27.85	30.38
Fat (%)	6.29	14.65	13.74	14.71	11.28
Ash	10.27	7.20	8.05	10.38	9.49
Crude fibre	12.54	5.74	17.13	11.30	15.67

Table 2: Growth Response and Nutrient Utilization parameters of catfish fingerlings (*Clariasgariepinus*) fed with experimental diets

Growth parameter	**A (0%)**	**B (25%)**	**C (50%)**	**D (75%)**	**E (100%)**
Initial weight	$14.00{\pm}0.00^{a}$	$14.00{\pm}0.00^{a}$	$14.00{\pm}0.00^{a}$	$14.00{\pm}0.00^{a}$	$14.00{\pm}0.00^{a}$
Mean weight	$3.61{\pm}1.48^{a}$	$3.61{\pm}1.40^{a}$	$3.61{\pm}1.65^{a}$	$3.61{\pm}1.41173^{a}$	$3.61{\pm}1.71^{a}$
Final weight	$38.75{\pm}11.08^{a}$	$36.07{\pm}11.55^{a}$	$39.32{\pm}15.44^{b}$	$39.34{\pm}12.76^{b}$	$40.72{\pm}16.11^{b}$
Weight gain	$7.00{\pm}3.36^{b}$	$5.95{\pm}3.76^{a}$	$7.05{\pm}3.50^{b}$	$7.19{\pm}4.65^{b}$	$7.33{\pm}3.64^{c}$
Mean weight gain	$0.64{\pm}0.21^{a}$	$0.5{\pm}\ 0.25^{a}$	$0.64{\pm}0.29^{a}$	$0.69{\pm}0.21^{b}$	$0.71{\pm}0.35^{b}$

Feed input	34.07±9.08[a]	32.03±9.12[a]	35.29±12.01[a]	36.56±11.81[a]	51.35±67.00[b]
Daily weight gain	1.02±0.66[a]	1.00±0.50[a]	1.04±0.52[a]	1.21±1.75[a]	2.32±5.90[b]
Mean daily weight gain	0.09±0.02[a]	0.08±0.04[a]	0.09±0.04[a]	0.09±0.04[a]	0.10±.0.4[b]
Specific Growth Rate	3.53±1.27[a]	3.25±2.57[a]	3.60±1.51[a]	3.96±3.32[b]	4.44±2.45[c]
Food conversion ratio	1.32.±0.04[c]	1.26±0.02[a]	1.29±0.03[b]	1.20±0.01[a]	1.19±0.01[a]
Survival	91.00±6.8[a]	86.72±9.73[b]	90.37±7.47[a]	88.61±7.721[b]	87.22±8.19 [b]

IV. Discussion

The results obtained for proximate composition of cassava flour in this study was higher than the reports posited by Bichi and Ahmad (2010) on proximate composition of cassava leaves. The difference may be attributable to the parts studied as well as processing methods. However, the proximate composition of the experimental diets fall within the range expected to support healthy growth of fish species (Liu *et al*., 2004).

A superior growth rate was observed for fishes fed with 100% cassava flour inclusion feed (diet (E100%)) this supports the assertion of Abu *et al.* (2010) that opined that 100% replacement of maize in hybrid catfish diet showed no depression in growth but at variance with the reports of Oluwaseun *et al.* (2016) that posited a higher growth rate in fishes fed with diets substituted with 50% cassava flour

The daily weight gain of the fish increased when fed with diet E (100%) and D (75%) cassava flour inclusion, compared to A (0%) and B (25%) inclusion. Observations in this study corroborates favourably with the findings of Jintasataporn*et al.* (2000) that *Clariasgariepinus* increases in weight at higher levels of inclusions which in their case was 50%. Kanchanapreutti*et al.* (2002) also observed that in channel catfish rations, partial and total substitution of maize with cassava impacted positively on weight gain of the fish. The variations in the results obtained on cassava diet may be linked to the great difference in energy value of the product. The quality of cassava varies considerably, hence, its energy value with the proportion of cellulose and silica it contains (INRA *et al*., 2012b). Midau *et al.* (2011) showed that the use of cassava in the form of pellets improved its nutritional efficiency since starch and cellulose were better absorbed. Moreover, the authors observed that by subjecting the pellets to heat treatment during preparation, certain growth inhibitors contained in the cassava were destroyed, thereby enhancing nutrients availability and consequently increasing fish growth. It is possible that based on this process, diet D (75%) and E (100%) gave better growth indices.

The higher specific growth rate in diet E (100%) recorded in this study compares favourably with the food intake results in diet E (100%) which may be caused by increased palatability of the 100% inclusion diet by *Clariasgariepinus*. However, this observation did not agree with the findings of Ufodike and Matty (1983) that reported a negative effect of cassava on the the specific growth rate of *C. carpio* by the replacement of maize with cassava flour. The variations observed in these studies may be attributable to preference by the studied species.

The food conversion ratio obtained in this study corroborates with the reports of Sogiura*et al.* (2000) on rainbow trout that replacement of maize with cassava does not affects growth and feed utilization in fish. The high survival rates recorded in this study also indicates that feeding *Clariasgariepinus* with different inclusions of cassava flour 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 cassava by product. This agrees with the assertion of Cardoso *et al.* (2005), that good processing of cassava enhance survival and healthy state of fish at all stages of their life.

The increased rate of feed input observed in this study reveals that all the experimental feed were accepted and utilized which led to increase in weight and in feed intake throughout the 8weeks. This may be because of the nutritive composition, palatability, acceptability and nutrient utilization of the experimental feed.

V. Conclusion

The results recorded from this study are proof to the fact that cassava flour is an alternative energy source for partial or total replacement of maize in feeding of *Clariasgariepinus* fingerlings. The study suggests 100% replacement of maize with cassava for optimum growth performance of *Clariasgariepinus* fingerlings. There is therefore need to create awareness and inform catfish farmers to explore this alternative source of energy to boost aqua cultural growth and supplement production.

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