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# THE EFFECT OF SUBSTITUTING MAIZE WITH GRADED LEVEL OF BISCUIT WASTE ON THE GROWTH PERFORMANCE, NUTRIENT UTILIZATION, CARCASS COMPOSITION, HAEMATOLOGICAL PARAMETERS AND ECONOMIC PERFORMANCE OF AFRICAN CATFISH *Clarias gariepinus* (BURCHELL 1822)

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## ABSTRACT

The effect of replacing maize with biscuit waste (BW) in the diet of *Clarias gariepinus* was evaluated in a 70-day feeding trial. Four isonitrogenous diets were prepared in which biscuit waste was used to replace maize at a rate of 50, 75 and 100% respectively. A diet without biscuit waste served as control. Each treatment had three replicates stocked with 10 catfish juveniles per tank with (mean initial body weight16.44±2.21g) per fish. The performance of the fish fed test diets was compared with fish fed a maize-based control diet containing 42.94% crude protein. The fish on the test diets performed better than the fish fed control diet with respect to mean weight gain (95.12±2.78g in BW 75 Vs 78.67±3.74g in control) and specific growth rate (3.04±0.04 %day$^{-1}$ Vs 2.79±0.07 %day$^{-1}$). Feed intake, feed conversion ratio and the protein efficiency ratio were not significantly different between test diets and the control. The inclusion of biscuit waste significantly improved ($P<0.05$) crude protein retention in the fish carcass. All the haematological parameters increased as a result of BW inclusion, the converse was however observed in cholesterol and triglyceraldehyde. There was significant difference ($P<0.05$) in the cost of feed intake and value of fish.

**Keywords:** Biscuit waste, blood parameters, substituting maize, economic performance, nutrient utilization.

## INTRODUCTION

Providing optimum energy level in diets for fish is important because it gives rise to protein sparing effect and allows the fish to use a higher percentage of the protein component of the feed to meet the amino acid requirements for growth and other physiological functions (Abu *et al.,* 2009). Carbohydrates are the cheapest dietary energy sources for domestic animals (Shiau and Lin 2001) and their utilization by different species of cultured fish is of interest to fish nutritionists. In addition to energy supply, carbohydrates have the physical functions of texturizing manufactured feeds and acting as a binder in the formulation of both compressed and expanded diets (Fagbenro *et al*., 2003). However, fish generally do not utilize

carbohydrates better than other domestic animals (Shiau 1997) and utilization varies among fish species (Wilson 1994). The digestibility of carbohydrates has been shown to vary with their complexity, source, treatment and level of inclusion in the diet (Adeparusi and Jimoh 2002). Maize is a cereal grain commonly used as energy source in fish diets; however, wider utilization and availability of this conventional source of energy for fish feed is limited by increasing demand for human consumption and by other animal feed industries (Eyo 2003). Hence the need to focus on using less expensive and readily available energy sources to replace maize meal without reducing the nutritional quality of the feed becomes imperative (Abu *et al.,* 2009). The use of alternative energy sources replacing conventional one have been investigated (Olurin *et al.* 2006; Abu *et al.* 2009) in African catfish.

Biscuit waste (BW) is an agro-industrial waste product found in substantial quantities in biscuit producing industries located at different industrial areas in Nigeria. It is a palatable, high energy feed produced from wheat flour, skimmed milk, vegetable fat, sugar, salt and flavor materials (Eniolorunda 2011). The waste meal was analysed and found to contain substantial amount of nutrients such as protein, energy and minerals required for animal growth and performance (Longe 1986; Olayeni *et al.,* 2007). BW has no anti-nutritional factor and could make a good replacement for maize and other cereal grains in animal diet (Eniolorunda 2011). This study therefore investigates the effect of substituting maize with graded levels of biscuit waste on the growth performance, nutrient utilization, carcass composition, haematological parameters and economic performance of *Clarias gariepinus*.

## MATERIALS AND METHODS

### *Sources of Test Ingredients and Diets Formulation*

The biscuit waste and other ingredients were obtained from Soleace and Moxie Nigeria Limited, opposite Lagos State abattoir, Oko-Oba, Agege, Lagos. The biscuit waste and other protein feed ingredients were milled and analysed for their proximate composition as shown in Table 1.

**Table 1: Proximate Composition (% dry matter) of Biscuit Waste and Maize used for the formulation**

| Parameters | Biscuit | Maize |
|---|---|---|
| Dry Matter | 93.70 | 95.11 |
| Crude Protein | 10.01 | 9.77 |
| Crude Fibre | 3.33 | 4.13 |
| Ether Extract | 4.38 | 4.35 |
| Ash | 3.53 | 7.91 |

Source: The analysis was done by the authors

Based on nutrient composition of the protein feedstuffs, four isonitrogenous experimental diets were formulated consisting of a control diet (excluding biscuit waste) and three other test diets with graded levels of biscuit waste (50, 75 and 100%) as maize replacement as shown in Table 2. Measured quantities of each feed ingredients were blended, moistened, steam pelleted (2mm) and was sundried for 24hrs.

**Table 2: Gross Composition (g/100g) of Experimental Diets fed to *Clarias gariepinus***

| Ingredients | Experimental Diets | | | |
|---|---|---|---|---|
| | CTR | BW50 | BW75 | BW100 |
| Fish Meal | 27.00 | 27.00 | 27.00 | 27.00 |
| SBM | 34.97 | 34.97 | 34.97 | 34.97 |
| GNC | 15.13 | 15.13 | 15.13 | 15.13 |
| Maize | 20.00 | 10.00 | 5.00 | 0.00 |
| Biscuit Waste | 0.00 | 10.00 | 15.00 | 20.00 |
| Palm Oil | 1.00 | 1.00 | 1.00 | 1.00 |
| *DCP | 1.00 | 1.00 | 1.00 | 1.00 |
| Vitamin C | 0.20 | 0.20 | 0.20 | 0.20 |
| Fish Premix | 0.50 | 0.50 | 0.50 | 0.50 |
| Salt | 0.20 | 0.20 | 0.20 | 0.20 |
| Calculated Nutrients Value of the Feed | | | | |
| Calculated CP (%) | 42.94 | 42.98 | 42.99 | 43.01 |
| Calculated EE (%) | 4.15 | 4.34 | 4.44 | 4.54 |
| Calculated Energy (kcal/kg) | 18.12 | 18.20 | 18.23 | 18.36 |

SBM; Soya Bean Meal, GNC; Groundnut Cake, DCP; Dicalcium Phosphate, CP; Crude Protein, EE; Ether Extract, CTR; Control, BW; Biscuit Waste.

### *Experimental Fish and Systems*

Juveniles of *Clarias gariepinus* of average weight 16.44±2.21g were obtained from a fish farm at Ikotun area of Lagos and transported to the Nutrition Unit of the Department of Marine Sciences, University of Lagos. The fish were acclimatized for seven days while being fed with a commercial diet (Coppens) of 2mm size. Groups of 10 juveniles of *Clarias gariepinus* were randomly stocked into plastic tanks (L X B X H: 52.5cm X 33.5cm X 21cm). Each diet was fed to the catfish in triplicate tanks twice daily (09.00h, 16.00h) at 5% body weight for 70 days. Total fish weight in each tank was determined every week and the amount of diet was adjusted according to the new weight. Growth response and feed utilization indices were estimated following methods of Oliver-Teles and Goncalves (2001), for specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER) and net profit value. Water temperature and dissolved oxygen were measured using a digital dissolved oxygen meter; pH was monitored weekly using pH meter. Representative samples from each replicate were sacrificed at the end of the feeding trial and analysed for their carcass composition (AOAC 2000).

### *Haematological Analysis*

Blood samples were randomly taken from fish in each experimental tank. The blood samples were collected in a 5-ml syringe and heparinised bottle for haematological assay (haemoglobin, Hb), packed cell volume (PCV), triglyceraldehyde and cholesterol) using standard formula described by Joshi *et al.,* (2002).

### *Statistical Analysis*

All data were subjected to one-way analysis of variance (ANOVA) test using SPSS 15.0 version (SPSS Inc., Chicago, IL, USA). Where ANOVA revealed significant difference ($P< 0.05$), Duncan multiple – range test (Zar, 1999) was applied to characterise and quantify the differences between treatments.

## RESULT

The results of the growth performance and nutrient utilization are shown in Table 3. There was no significant difference ($P>0.05$) in the average initial weight of the experimental fish across the diet groups. All the test diets performed better than the fish fed control diet. There was significant difference ($P<0.05$) between the mean weight gain (MWG) of the fish fed control diets and the fish fed diets up to 100% replacement level of Maize with biscuit waste. Fish fed test diet BW75 had the highest performance with respect to MWG while the fish fed with the control diet recorded the lowest value of MWG.

**Table 3: Growth performance and nutrient utilization of *Clarias gariepinus* juvenile of the different experimental diets for a culture period of 70 days**

| Parameter | Control Diet | Test Diets | | |
|---|---|---|---|---|
| | CTR | BW50 | BW75 | BW100 |
| Initial weight (g) | 16.41±0.14 | 16.58±0.14 | 16.42±0.29 | 16.33±0.14 |
| Final weight (g) | 95.08±3.64[a] | 102.40±3.35[b] | 111.54±4.45[c] | 108.85±2.91[bc] |
| 1MWG (g) | 78.67±3.74[a] | 85.82±3.48[b] | 95.12±4.23c | 92.51±2.78b[c] |
| 2DWG (g/day) | 1.20±0.17 | 1.14±0.16 | 1.38±0.09 | 1.32±0.39 |
| 3SGR (%/day) | 2.79±0.07[a] | 2.89±0.06[a] | 3.04±0.04b | 3.01±0.02[b] |
| Feed intake(g) | 91.12±3.89 | 91.78±4.48 | 100.58±0.66 | 100.61±2.40 |
| 4FCR | 0.86±0.02 | 0.94±0.05 | 0.94±0.04 | 0.92±0.04 |
| 5PER | 2.01±0.06 | 2.18±0.13 | 2.19±0.09 | 2.13±0.09 |

All values on the same row with different superscripts are significantly different (P<0.05)

[1] Mean Weight Gain (MWG) = final mean weight –initial mean weight
[2]Daily Weight Gain (DWG) = MWG/No. of experimental days
[3] Specific Growth Rate (SGR) = [ln final weight-ln initial weight] X 100
[4]Feed Conversion Ratio (FCR) =dry weight of feed fed /Weight gain (g)
[5] Protein Efficiency Ratio (PER) =fish body weight (g)/ Protein fed

The least FCR was recorded by fish fed the control diet. Fish fed with BW 50 and BW 75 diet had the highest value of FCR. However, there was no significant difference (P>0.05) in the FCR of the fish fed control diets and those of the test diets. There was no significant difference (P>0.05) in the protein efficiency ratio (PER) of the fish fed control diets and those fed test diet up to 100% replacement level of maize with biscuit waste.

The economic analysis is shown in Table 4. There was significant difference (P<0.05) in the cost of feed intake and value of fish. The the net profit value follows the same trend as that of cost of feed intake.

**Table 4: Cost Analysis of *Clarias gariepinus* juveniles fed diets containing varying replacement levels of maize with biscuits waste**

| Economic Parameter | Control Diet | Test Diets | | |
|---|---|---|---|---|
| | CTR | BW50 | BW75 | BW100 |
| Cost of Feed kg/(N) | 175.37 | 172.87 | 171.62 | 170.37 |
| Feed Intake (g) | 91.12 | 91.78 | 100.58 | 100.61 |
| Cost of Feed Intake (N) | 15.97[a] | 15.87[a] | 17.26[b] | 17.14[b] |
| *Value of fish (N) | 39.94[a] | 43.00[b] | 46.84[c] | 45.72[bc] |
| **Net profit value (N) | 23.08 | 28.19 | 26.40 | 21.57 |

All values on the same row with different superscripts are significantly different (P<0.05)

*Current Price of Clarias gariepinus/kg was N400
****** Net profit value = MWG of fish cropped (g) × No of the survival (n) × Cost of fish per kg

Table 5 shows the results of the haematological studies conducted on *Clarias gariepinus* fed graded levels of BW. All the haematological parameters increased as a result of BW inclusion, the converse was however observed in cholesterol and triglyceraldehyde.

**Table 5: Haematological Analysis of *Clarias gariepinus* fed diets containing varying replacement levels of maize with biscuits waste**

| Haematological Parameters | Control Diet | Test Diets | | |
|---|---|---|---|---|
| | CTR | BW50 | BW75 | BW100 |
| RBC x 106/L | 7.4 x $10^{6b}$ | 9.7 x $10^{6ab}$ | 9.45 x $10^{6ab}$ | 10.7 x $10^{6a}$ |
| (PCV %) | 34b | 38.50[ab] | 37.50[ab] | 41.50[a] |
| WBC (/$mm^3$) | 11000[ab] | 15000[a] | 13000[ab] | 10000[b] |
| Haemoglobin (g/dl) | 10.95 | 12.45 | 12.15 | 13.40 |
| Cholesterol (g/l) | 193[a] | 149[b] | 140[b] | 166.50[ab] |
| Triglyceraldehyde | 238.50 | 222 | 216.50 | 233 |

All values on the same row with different superscripts are significantly different (P<0.05)

Table 6 presents the carcass composition of *Clarias gariepinus* fed diets containing varying replacement levels of maize by biscuits waste. The inclusion of biscuit waste significantly improve ($P<0.05$) crude protein retention in the fish flesh. All the fish on test diets recorded higher crude protein than the control diet, while opposite result was observed for EE though not significantly different ($P>0.05$) across all the diets.

**Table 6: Carcass Composition (%) of *Clarias gariepinus* fed diets containing varying replacement levels of maize with biscuits waste**

| | Control Diet | Test Diets | | |
|---|---|---|---|---|
| | CTR | BW50 | BW75 | BW100 |
| Dry Matter | 13.62 | 13.11 | 13.37 | 13.22 |
| Crude Protein | $42.42^{b}$ | $46.62^{ab}$ | $47.67^{a}$ | $44.78^{ab}$ |
| Ether Extract | 13.80 | 12.60 | 13.20 | 12.60 |

All values on the same row with different superscripts are significantly different ($P<0.05$)

## DISCUSSION

The nutritional quality of biscuit waste used in this study seems adequate from the results obtained on growth and economic indices. There was no significant difference reported in the feed intake of the present study showing that the fish fed the test diets accepted the feed relatively well and effectively consumed the experimental diets. Domingues *et. al.* (2003) reported that one of the most common difficulties observed when alternative sources of feedstuffs are used in fish diets is acceptance and palatability by the fish. The positive influence of the test ingredient on growth could be due to the pre-cooked nature of biscuit waste. Booth *et.al.* (2001), reported that processing conditions have great impact on starch digestibility. For the weight gain recorded in this study, it may be concluded that biscuit waste being a pre-cooked feed ingredient resulted in increased feed utilization efficiency. Similar result was reported by (Aderolu *et. al.* 2009) when they fed processed cocoyam tuber to juvenile African catfish and concluded that starch treated with heat could be better digested by both carnivorous and herbivorous species. The digestibility of carbohydrates has been shown to vary with their complexity, source, treatment and level of inclusion in the diet (Adeparusi and Jimoh, 2002). The improved weight gain of the fish fed BW may be associated with positive effect of boiling which resulted into better nutritional value and digestibility (Abdulrashid and Agunmobi 2009) and the highest weight gain recorded in diet BW75 could be due to synergistic effect between the utilization of mixed carbohydrate sources as reported by Aderolu and Sogbesan 2010. The result of the FCR which is not significantly different

between the control and the test diets clearly indicated that the varying levels of BW substitution for maize in the diets showed a better utilization of the experimental diets at all level of inclusion of BW. This could be linked to improved feed palatability and utilization which is evident in average feed intake and protein efficiency ratio.

Blood is a good indicator in determining the health of an organism (Joshi *et.al.* 2002), it also acts as a pathological indicator of the whole fish body, and hence haematological parameters are important in diagnosing the functional state of an animal exposed to suspected toxicant (Omitoyin 2006). Haematological characteristics of most fish have been studied with the aim of establishing normal value range and any deviation from it may indicate a disturbance in the physiological processes (Raiza-Paiva *et.al.* 2000). The values obtained in this experiment for all the parameters tested were within normal ranges recommended for *Clarias gariepinus* (Sunmonu 2008; Adedeji 2009).

The replacement of maize with biscuit waste at any graded level up to 100% as observed in this study did not have any negative implication on the health of the fish, though a better result was realized at 75% replacement level.

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