DIETARY EFFECTS OF YAM PEELS ON THE GROWTH AND HAEMATOLOGY OF *Clarias gariepinus* (BURCHELL, 1822) JUVENILES

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Abstract

This study investigated the growth performance, nutrient utilization and haematology of *Clarias gariepinus* juveniles fed with graded levels of yam peels (YMP). Replacement levels of 0 % (Control diet, CTR), 5 % (Diet 1), 10 % (Diet 2) and 15 % (Diet 3) for maize meal were tried. Feeds were fed to triplicate groups of ten fish per tank twice daily to satiation for eight weeks. Diet had effects ($p<0.05$) on Mean weight gain (MWG), Specific growth rate (SGR) and Mean voluntary feed intake (MVFI) across treatments. Fish fed with CTR recorded highest values for MWG (138.00±2.21g), SGR (2.12±0.01%) and MVFI (0.95±0.06g) while Diet 3 had least values for MWG (92.82±5.85g), SGR (1.69±0.06%) and MVFI (0.66±0.01g). Feed conversion ratio (FCR) and Protein efficiency ratio (PER) had significant differences ($p<0.05$) among the test diets, with the control diet having the highest values for FCR (0.95±0.05) and PER (2.32±0.13). Significant differences ($p<0.05$) were also recorded in the values of Packed cell volume (PVC), Red blood cells (RBC), Haemoglobin (Hb) and White blood cells (WBC) across diets. The poor growth performance coupled with reduced physiological activities of YMP at different inclusion levels tested, suggests that it could not favourably replace maize meal in the diet of *C. gariepinus*.

Keywords: dietary effects, *Clarias gariepinus*, maize, yam peels, growth performance.

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Introduction

The report of Food and Agriculture Organization on aquaculture global status showed that Latin America and Caribbeans showed the highest average annual growth in the period 1970-2008 (21.1 %), followed by the Near East (14.1 %) while Africa (12.6 %) had the least annual growth (FAO, 2010).

Nutritionally, fish is one of the cheapest and direct source of animal protein and micro-nutrient for millions of Africans (Bene and Heck, 2005). With steady decline in capture fishery, aquaculture is a readily, veritable tool in the provision of fish for the teeming population in Africa. However, the current supply trends combined with ever increasing population, the per capita consumption of fish in Africa is stagnating and in sub-Saharan Africa has fallen drastically (Muir *et al* 2005). Therefore, there is need for substantial expansion in aquaculture development. Feed, a major input in aquaculture production, is a fundamental challenge facing the development and growth of aquaculture (Gabriel *et al* 2007). According to Jamu and Ayinla (2003), feed accounts for 60% of the total cost of fish production in Africa, which to a large extent determines the viability and profitability of fish farming enterprise. As aquaculture becomes intensive, most farmers depend largely on imported fish feeds from European countries. The low quality of fish feed and its high cost are the major factor limiting the development of

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aquaculture in Africa (Gabriel *et al* 2007). Thus, research in fish nutrition geared towards utilization of locally available ingredients becomes imperative for sustainable aquaculture in sub-Saharan Africa.

Maize is a major source of dietary energy in most compounded diets for culturable fish because it is readily available and digestible; however, this ingredient is highly competed for by man and livestock (Olurin *et al* 2006). Consequently, the quest for replacement of the expensive conventional feedstuffs with cheaper available alternative feed ingredients could be of considerable advantage. Yam (*Dioscorea* spp.) peels is one of the various household that have such potentials and is cheaply available in Nigeria (Ekenyem *et al* 2006). Yam peels has been reported to contain carbohydrates, crude protein and ash (Ogbuewu *et al* 2010).

The present study was aimed at investigating the effects of different inclusion levels of yam peels meal on the growth performance, nutrient utilization and haematology of *C. gariepinus* juveniles.

Materials and methods

The experimental design

The experiment was a complete randomized design with four experimental diets in triplicates carried out for a period of eight weeks, at the Fish Nutrition Unit of the Department of Marine Sciences, Faculty of Science, University of Lagos, Nigeria.

Preparation of yam peels (YMP)

Fresh yam peels was obtained from a canteen left-over at Mushin Market, Lagos. The yam peels collected were dehydrated by sun-drying for seven days to reduce moisture which could lead to the growth of microbes leading to spoilage. All the ingredients (yam peels, maize, soybean, groundnut cake, and fishmeal) were crushed and milled into very fine powder, and stored in polythene nylon for future use.

Experimental animals

One hundred and twenty juveniles of *C. gariepinus* were purchased from Fuard Farms at Cele-Egbe, Ikotun, Lagos, and transported in aerated aquaria. The fish were acclimatized for two weeks in plastic holding tanks ($52.5 \times 33.5 \times 21.0$ cm^3) and fed with 2 mm Coppens feed. Water was changed every two days with de-chlorinated water from a borehole to maintain good water quality. The dissolved oxygen ranged from 4.5 to 6.0 mg/L while pH ranged from 6.5 to 7.0 during the experimental period.

Feed preparation

The proximate compositions of yam peels and maize meal were carried out at the Department of Animal Science, University of Ibadan, Nigeria according to the Association of Analytical Chemists Method (AOAC, 2004) (Table 1). Yam peels were incorporated into the experimental diets at replacement levels of 0% (Control diet, CTR), 5% (Diet 1), 10% (Diet 2) and 15% (Diet 3) for maize meal.

Table 1: Proximate composition of yam peels and maize.

Parameters	Yam peels	Maize
Dry matter (%)	91.66	88.0
Crude Protein (%)	11.33	10.0
Ether extract (%)	1.20	4.0
Crude Fibre (%)	9.50	2.0
Ash (%)	9.80	1.4

Feeding regime

Fish were weighed and randomly stocked into the experimental chambers at the rate of ten fish per tank with average weight of 40 g. They were starved overnight before the commencement of the feeding trials. Fish were fed the compounded isonitrogenous diets (Table 2), to satiation by hand, twice daily (9.00 am and 4.00 pm) for 8 weeks period. The weight of the experimental fish were assessed at the beginning of the experiment and at the end of every week to determine the average weight gain while the quantity of the feed fed for each week was also recorded.

Table 2: Composition of the experimental diets.

Ingredients	Treatments (% yam peel meal)			
	Control Diet	Diet 1	Diet 2	Diet 3
Maize	25	20	15	10
Yam peels meal	0	5	10	15
Soybean meal	25	25	25	25
Groundnut cake	22	22	22	22
Fish meal (72%)	25	25	25	25
Fish premix	0.5	0.5	0.5	0.5
Dicalcium sulphate	1.1	1.1	1.1	1.1
Salt	0.25	0.25	0.25	0.25
Palm Oil	1	1	1	1
Vitamin C	0.25	0.25	0.25	0.25
Calculated CP (%)	40.93	41.03	41.1	41.17

Growth performance and nutrient utilization

Growth was estimated in terms of Mean Weight Gain (MWG) and Specific Growth Rate (SGR) according to Morais *et al* (2001).

MWG g = Mean final body weight (MFW) – Mean initial body weight (MIW)

$$\text{SGR} = \frac{(\text{Log}_e\, W_1\, g - \text{Log}_e\, W_2\, g \times 100}{T_2 - T_1\ (\text{day})}$$

Where; e = natural logarithm.
$T_2 - T_1$ = experimental period.
W_1 = initial weight.
W_2 = final weight.

Nutrient utilization indices were expressed in terms of Feed Conversion Ratio (FCR), Mean Voluntary Feed Intake (VFI) and Protein Efficiency Ratio (PER) as follows:

$$\text{FCR} = \frac{\text{Feed Intake (FI) (dry weight of feed fed in } g)}{\text{Fish wet weight gain } g}$$

$$\text{MVFI} = \frac{100 \times \text{FI}}{[(W_1 + W_2) \times T]}$$

$$\text{PER} = \frac{\text{Mean weight gain}}{\text{Protein intake}}$$

$$\text{Where Protein Intake} = \frac{\text{Total feedintake}}{\text{Protein content of feed}}$$

Haematological analysis

Blood samples of fish for haematological assay were collected in a 2 ml syringe and heparin bottles for the analysis of Haemoglobin (Hb), Red blood cells (RBC), White blood cells (WBC) and Packed Cell Volume (PCV) following Joshi *et al* (2002). The analysis was carried out at Bioassay Diagnostic Laboratory, Cele Egbe, Ikotun, Lagos.

Statistical analysis

Data were analyzed with one-way ANOVA using SPSS version 10.0 for windows and means were compared for the significant difference (p<0.05) following Ogbeibu (2005).

Result

There were significant differences (p<0.05) among treatments in the mean weight gain (MWG), specific growth rate (SGR) and mean voluntary feed intake (MVFI) with the Control Diet (CTR) having the highest values and Diet 3 having the least values (Table 3). Feed conversion ratio (FCR), Protein efficiency ratio (PER), and Protein intake (PI) also showed significant differences (p<0.05) among the test diets, the best and least performances for FCR, PER and PI were recorded in the CTR and Diet 3 respectively (Table 3). Haematological indices equally differed significantly (p<0.05) across diets. With increased dietary levels, there was remarkable decrease in PCV, RBC and Hb values among the treatments, while the WBC value showed a significant (p<0.05) increase with increased inclusion levels of YMP in the test diets compared with the CTR (Table 4).

Table 3: Growth and nutrient utilization of *C. gariepinus* fed graded levels of yam peels as replacement for maize meal.

Parameters	Control Diet (CTR)	Diet 1	Diet 2	Diet 3
Mean Initial Weight (g/fish)	40.53±0.21	40.71±0.52	40.37±0.55	40.57±0.29
Mean Final Weight (g/fish)	178.53±2.41^{a}	148.82±3.03^{b}	149.13±5.33^{b}	133.39±5.83^{c}
Mean Weight Gain (g/fish)	138.00±2.21^{a}	108.11±2.55^{b}	108.77±5.49^{b}	92.82±5.85^{c}
Specific Growth Rate (%/day)	2.12±0.01^{a}	1.85±0.01^{b}	1.87±0.06^{b}	1.69±0.06^{c}
Mean Voluntary Feed Intake *g*	0.95±0.06^{a}	0.71±0.02^{b}	0.68±0.04^{b}	0.66±0.01^{b}
Feed Conversion Ratio	0.95±0.05^{c}	1.15±0.03^{ab}	1.12±0.11^{a}	1.16±0.02^{ab}
Protein Efficiency Ratio	2.32±0.13^{c}	2.81±0.08^{ab}	2.97±0.26^{a}	2.82±0.04^{ab}
Protein Intake	59.66±4.42^{a}	38.54±0.97^{b}	36.72±1.38b^{c}	32.91±1.57^{c}

Figures in each row with different superscript are significantly different (p<0.05) from each other.

Table 4: Haematological indices of *C. gariepinus* fed graded levels of yam peels as replacement for maize meal.

Parameters	Control Diet (CTR)	Diet 1	Diet 2	Diet 3
PCV (%)	30.73±0.46^{a}	28.07±1.85^{ab}	26.73±3.00^{ab}	23.40±5.89^{b}
RBC (x10^{12}/L)	6.91±0.16^{ab}	6.11±0.53^{abc}	5.71±0.88^{bc}	5.37±1.17^{c}
Hb (g/L)	10.02±0.31^{ab}	8.82±0.73^{abc}	8.42±1.07^{bc}	7.55±1.82^{c}
WBC (x10^{9}/L)	12138.89±240.56^{bc}	14805.56±2068.84^{ab}	16138.89±3223.54^{a}	18472.22±914.14^{abc}

Figures in each row with different superscript are significantly different ($p<0.05$) from each other.

Discussion

The final body weight and growth rate were higher in fish fed the control diet relative to fish fed with experimental diet. This could be due to the high fibre level of up to 9.5% in cell wall materials and non-soluble polysaccharides in the yam peels, which invariably limit the rate of digestion and nutrient absorption (Aderolu and Oyedokun, 2009). Similarly, the decrease in weight gain at high fibre level has also been reported by Keembiychetty and De Silva (1993), when they fed *Oreochromis niloticus* with cowpea and black grain. The reduced growth observed with the test diets could also be as a result of decrease in voluntary feed intake due to the presence of phenolic compounds which inhibit the activity of trypsin and amylase (Sasikiran *et al* 1999). Because, according to Ponigrahi and Powel (1991) to achieve efficient growth rate, feed intake must correspondingly increase to meet up with the anticipated growth rate of the animal.

Furthermore, the reduced voluntary feed intake recorded could be due to diet palatability, since one of the most common difficulties observed when alternative sources of feed stuffs are used in fish diets is acceptance and palatability by the fish as reported by Domingues *et al* (2003). The highest weight gain was recorded in fish fed the control diet while the weight gain decreased linearly as inclusion levels of yam peels increased and the least weight gain was observed in fish fed with Diet 3. This could be due to the presence of anti-nutritional factors which limit the efficient utilization of YMP as observed by previous studies (Sasikiran *et al* 1999; Rekha and Padmaja, 2002). According to Shajeela (2011) anti-nutritional factors like free phenolics, tannins, hydrogen cyanide, oxalate, amylase inhibitor and trypsin inhibitor that are present in yam (*Dioscorea* spp.) make their wider utilization limited. Moreover, activities of these substances could lead to poor FCR and PER as recorded in this study at different dietary levels tested. This result also agreed with Omoregie *et al* (2009) when they incorporated graded levels of sweet potato peel at 5, 10, 15, 20 and 25% respectively in the diet of *O. niloticus*. Additionally, simple-stomached species such as swine, poultry and fish do not have hydrolytic enzymes in their digestive tracts hence; phytate in feed is poorly digested by these animals and is largely excreted into faeces (Jackson *et al* 1996; Liebert and Portz, 2005). Likewise, oxalate hinders minerals such as calcium bio-availability in feed, thereby rendering it unavailable for normal physiological and biochemical roles (Noonan *et al* 1999).

Blood condition is a good indicator in determining the health status of an organism (Joshi *et al* 2002). The remarkable decrease in PCV, RBC and Hb values at different inclusion levels of YMP recorded in this study is in agreement with earlier studies, which might be due to stress stimulus (Chen *et al* 2004; Martins *et al* 2004) or toxins (Worle *et al* 2007). Aderolu *et al* (2009) corroborated these observations by attributing the low values of RBC, PCV and Hb concentration of *C. gariepinus* fed with processed cocoyam tuber as carbohydrate source, to the anti-nutritional substances inherent in the plant ingredient. Since the values of haematological indices (PCV, RBC and Hb) recorded in this study were significantly below that of the control, it could be suggested that the diets tested had major physiological stress on the health status of the fish (Aderolu *et al* 2009). Consequently, the elevated value recorded in WBC was a response to the stress caused by the anti-nutritional factors in yam peel.

Conclusions

The present study showed remarkable decline in the growth rate of experimental fish, caused by poor physiological activity of YMP at different inclusion levels tested. Hence, yam peels' meal cannot favourably replace maize meal in diets of catfish, *C. gariepinus*.

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