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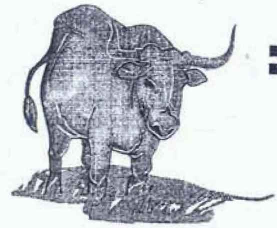
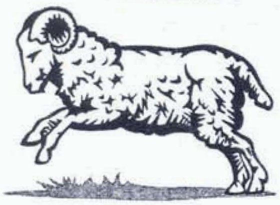

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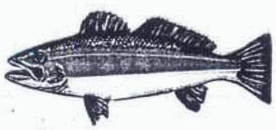

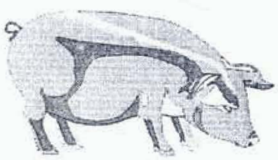

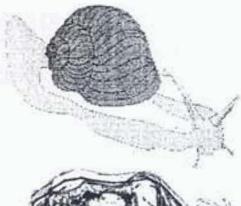


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GROWTH PERFORMANCE AND NUTRIENT UTILIZATION OF *CLARIAS GARIEPINUS* (BURCHELL) FRY FED PROCESSED SWEET POTATO (*IPOMEA BATATA*)

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ABSTRACT

Maize is an expensive energy source for feedstuff in fish management especially during the off-season, hence the need to source and utilize other cheaper, and non–conventional energy sources. This study investigated the growth performance of *Clarias gariepinus* fry fed processed sweet potato meal as an energy source and its effect on the hematological values.

Three experimental diets were compounded such that maize was 100% energy source in Diet 1 (Control). In diets 2 and 3, maize was replaced with sweet potato tuber (SPT) and sweet potato peel (SPP), respectively at 25% inclusion level. The diets were fed at 5% body weight to the *C. gariepinus* fry (0.21 ±0.03) in polystyrene net cages suspended in 3 concrete tanks (2x3x1.2) m^3 for 42 days in triplicates. Growth, nutrient utilization and hematological parameters were measured.

The Mean Weight Gain (MWG) of the fry fed the maize based diet (1.96) was significantly higher ($p < 0.05$) than the fry fed SPT (1.37) and SPP (1.27) respectively. The MWG of fry fed diets 2 and 3 were not significantly different from each other. The FCR of the control and the SPT based diets were not significantly different from each other but both were significantly different ($p<0.05$) from fish fed the SPP diet. The Growth Efficiency Feed Conversion (GEFC) values of the 3 diets (0.50, 0.51, and 0.40) respectively are not significantly different from each other. However, the PER and the survival rates were significantly better in fry fed the SPT based diet (0.51; 95%) than in fry fed the maize based diet (0.50; 92%) and the SPP based diet (0.40; 82%) respectively. The haematology results showed that the fry fed the control diet had the lowest MCV and WBC counts while the fry fed SP based diets manifested moderately severe normocyctic normochromic anemia and leucocytosis, which means that the maize diet showed better hematological indices.

This study showed that SP based diets have potential as substitute for maize. Maize based diet and especially the SPT, have similar FCR, dietary energy, GEFC values.

Key Words: Growth Performance; Nutrient Utilization; Processed Sweet Potato; *Clarias gariepinus*; Hematology

INTRODUCTION

The processing and utilization of sweet potatoes (*Ipomoea batatas*), has been the focus of several researches in Nigeria (Oyenuga, 1968; Tewe *et. al*, 2000: Ojeniyi and Tewe, 2001) and outside Nigeria (Woolfe 1992). These works have demonstrated the agronomic potentials of sweet potato (SP), in the humid zone of Africa, its nutritional value as well as the processing and utilization of SP in human cuisine, livestock feed and industries.

In Nigeria, SP is regarded agriculturally as a minor root crop but according to Woolfe (1992), it is classified as a major crop in the developed world. It does not feature as a main food in Nigerian dishes quite unlike yam and rice. Most farmers in humid Africa grow SP for family consumption (Odebode, 2004). Moreover, in Nigeria, very little processing of SP is being done; it is usually added to yam, cassava or millet to prepare different Nigerian dishes (Odebode, 2004).

Other SP products such as chips, starch, puff-puff, chin-chin, buns, bread, jam and crisps, when introduced into the food industry will enhance the demand for new SP varieties (Odebode, 2004). However, very limited use of SP, if any, has been reported in fish diet. Since it is not a major food crop in Nigeria, there will be limited competition for its usage in man's food if found appropriate for fish. Hence, the objective of this study was to determine the performance of *C. gariepinus* fry fed SP meal and peel as a cheaper source of energy and its effect on some hematological parameters.

Problem Description

The pressure on the utilization of maize for energy in man's food and that of livestock causes the price of maize to fluctuate especially during the off-season. This phenomenal increase affects the cost of fish feed, which represents over 60% of the cost of inputs on a fish farm. SP is a minor crop in Nigeria and the pressure for its utilization in man's food and livestock feed is not as great as that of maize. In addition, there is a dearth of research on the utilization of SP (tubers or peels).

In the Tropics, SP has a 5-month growth cycle, which implies that SP can be grown twice a year. In calorie deficient diets Woolfe, (1992) reported two significant advantages of SP over most staple crops. As a crop, it has the highest useful energy production rate among the major tropical food crops (e.g., SP – 194 MJ ha^{-1}x day^{-1} ; rice – 149; maize –145; cassava –138; banana –113; sorghum –101; yam –94; millet –82). Hence, SP can provide significantly more calories on a given unit of land per unit of time. It is a nutritious food, providing a good supply of vitamin C, calcium and iron and can be an excellent source of provitamin A (Tsou and Hong, 1992). Many Asian countries such as China are utilizing SP as an industrial starter product for manufacturing starch and alcohol and as a replacement for conventional crops, which constitute major energy sources for humans, such as maize, Irish potatoes and rice (Woolfe, 1992). However, in Nigeria, sweet potatoes especially the peels are products for the waste bin because research has not highlighted the potential for their utilization in livestock feed. The usage of the SP peels needs to be encouraged to reduce the pressure on conventional sources of energy food like maize for livestock feed, especially for fish if research highlights its potentials. The carotene content in the red variety of SP and its influence on the pigmentation of catfish fry will be another potential point for the utilization of SP in its nursery management.

MATERIALS AND METHODS

Preparation of Flours of SPT and SPP

White variety of SP planted in 4 rows $(4.0 \times 1.0m)^2$ of homestead gardens gave 11.0kg of tubers. The SP was peeled and immediately the peels were soaked for 1 hour to reduce the concentration of sugar (Woolfe, 1992). Finally the peels were drained and dried. The peeled SP tubers (SPT) were sliced and soaked for 1 hour and dried to constant weight within 3 days with at least 5 hours/day of sun drying. The dried slices of SPP and SPT were ground to flour separately and incorporated in the experimental diets as source of energy to partially replace maize in diets 2 and 3 while diet 1 had maize as the main source of energy.

Experimental Diets

Three experimental diets: 1, 2 and 3 were formulated. Diet 1 is the control and had 0% SP inclusion. Diets 2 and 3 had 25% maize replaced by SPP and SPT, respectively (Jackson *et. al.* 1982; Olukunle, 1996; Olukunle and Agboola 2005). The dietary energy content of the feed was calculated by using the conversion factor of 4, 9, and 4 for protein, carbohydrate and lipid respectively. The crude protein level of the diets had a mean of 46.9 $\pm$ 0.57%. Previous researches recommended between 45-50% protein inclusions in the diet of fry/fingerling stages of catfish (Viveen and Huisman, 1985; Adekoya *et. Al*,. 2004). The three diets were iso-calorific (3.47 kcal/100g). The experimental ingredients were weighed, thoroughly mixed, moistened, pelleted, sun dried for 6 hours and stored in polythene bags until used.

Experimental Tanks

Three concrete tanks with dimensions 2.0 x 3.0 x 1.5 m^3 were used as experimental tanks. Three net-cages were suspended on bamboo stakes, with each tank representing each treatment. The tanks were impounded with tap water, a depth of 1.2m in all the tanks and allowed to fallow for 14 days. Subsequently, fresh water was supplied from connected municipal tap at 0.25ml/min to replace water loss by evaporation. The water quality parameters such as temperature, dissolved oxygen, pH, and alkalinity were weekly taken and blood samples were monitored at the initial, mid (at three weeks) and at the end (six weeks) of the experiment using standard methods (Boyd, 1982).

Experimental Fish

One hundred (100) advanced fry of *Clarias gariepinus* with mean weight of 0.21$\pm$ 0.03g were allotted per cage, and were fed 5% of total body weight per day at 10.00hr, 14.00hr, and 18.00hr daily. Bimonthly weighing was done and the quantity of feed fed to the fish was adjusted relative to the weight gained. The experiment lasted 42 days. The diets and carcasses were analyzed for proximate composition using Standard Analytical Methods (AOAC, 1991). At 21 days, and at the end of the experiment, blood samples were taken from the caudal peduncle of randomly selected fingerlings pooled from each treatment for hematological studies according to Falaye *et al.* (1999) and Olukunle *et al.* (2002). The data obtained were analyzed using the analysis of variance (ANOVA) and standard error was used to estimate the probability of significant differences among the treatments (Armitage, 1980; Norman 1981).

RESULTS AND DISCUSSION

Dry Matter Content of SPP and SPT

The dry matter composition of processed SPP and SPT in this study, 25.45% and 36.36%, respectively are higher than those earlier reported by Oyenuga (1968) and Ashida (1982). This may be due to difference in variety of SP, time of harvest, and/or length of storage. The SP used in this work was processed immediately it was harvested.

Water Quality Parameters

Table 1 shows the water quality analysis in the experimental tanks used in this study. While temperature variations in all the tanks were limited to 27.0 ± 1.12° C, all the other parameters (dissolved oxygen, pH and alkalinity) were within acceptable ranges as recommended (Boyd 1981; Viveen and Huisman 1985).

Gross Composition and the Proximate Composition of the Diets

Tables 2 and 3 show the gross composition and the proximate composition of the experimental diets, respectively. The mean crude protein in the diets ranged from 45.58 % in Diet 2 to 48.13% in the control, while the dietary energy values have a mean value of 3.47 ± 0.16 mg/l. These values are not significantly different ($p>0.05$) from each other. The mean crude protein of the experimental diets range fall between 45-50% that is within the recommended range (Viveen and Huisman, 1985; Adekoya *et al.* 2004). The FCR of the diets range from 1.97-2.5 as shown in Table 4, which is an indication of the acceptability and good conversion of the diets by the experimental fish.

Premix Composition (per kg)

Vit. A 12,500,000 IU; Vit. D_3 2,500,000 IU; Vit. E 40,000mg; Vit K_3 2,000mg; Vit B, 3,000 mg; Niacin 5,500mg; Calcium Panthothenate 55,000mg; Vit. B_6 11,500mg; Vit. B_{12} 25mg; Chloride 500,000mg; Folic Acid 1,000mg; Biotin 80mg; Mn 120,000mg; Fe 100,000; Zn 80,000 mg; Cu 8,500mg; 1_2 - 1,500mg; C0 300mg; Se 120mg; Antioxidant 120,000mg.

Table 1: Water Quality Parameters

	Alkalinity (mg/l)	Dissolved oxygen (mg/l)	pH	Average Temperatures (°C)
Initial	10	6.2	7.2	27.0
Tank 1	10	7.4	7.4	27.0
Tank 2	7	8.4	7.2	27.0
Tank 3	5	9.2	7.1	27.6
Tank 4	10	7.0	6.9	27.0

Table 2: Gross Composition of Experimental Diets

	Treatments		
Ingredients	1	2	3
Fish meal	50.86	51.26	49.43
Soyabean meal	33.90	34.17	32.95
Maize	3.00	3.00	3.00
Wheat Offal	3.24	0.23	1.42
SPT	-	2.34	-
SPP	-	-	4.20
Palm oil	3.00	3.00	3.00
Premix (growers)	2.00	2.00	2.00
Lysine	1.00	1.00	1.00
Methionine	1.00	1.00	1.00
$Ca_3(PO_4)_2$	1.00	1.00	1.00
Salt	1.00	1.00	1.00
	100.00	100.00	100.00

Table 3: Proximate Composition of Experimental Diets

	Treatments			
Diets	1	2	3	Mean
% Moisture	10.03	8.83	9.84	9.57±1.03
% Crude protein	48.13	45.58	46.32	46.67±1.21
% Crude lipid	6.78	9.28	7.57	7.88±1.42
% Crude ash	9.33	8.64	9.33	9.10±0.41
% NFE	21.32	22.80	22.36	22.16±0.11
Dietary energy (kcal/100g)	3.57[a]	3.57[a]	3.42[a]	3.47±0.16

Table 4: Growth performance and nutrient utilization of *C. .gariepinus* fed processed SPT and SPP

	Treatments			
Diets	1	2	3	Mean
Total No of fish stocked	100	100	100	100
Mean initial weight (g)	0.23[a]	0.23[a]	0.19[a]	0.21±0.05
Mean final weight (MFW) (g)	2.19[a]	1.59[b]	1.46[b]	1.75±0.15
Mean weight gained (MWG) (g)	1.96[a]	1.37[b]	1.27[b]	1.53±0.14
Mean daily wt. gain (g/day)	0.05[a]	0.04[a]	0.03[a]	0.04±0.02
Total percent wt. gained (%)	852[a]	623[c]	668[b]	714.3±2.97
Specific growth rate (SGR) (g/day)	0.70[a]	0.33[b]	0.25[c]	0.45±0.07
Total feed intake (g)	362.2	256.8	264.4	294.5±0.18
Mean feed intake/fish (g)	3.94	2.70	3.22	2.55±1.91
Average No. of survivals	92.0[b]	95.0[a]	82.0[c]	90.0±1.05
Feed conversion ratio (FCR)	2.0[b]	1.97[b]	2.5[a]	2.2±0.16
Gross efficiency feed conversion (GEFC)	0.50[a]	0.51[a]	0.40[a]	0.45±0.7
Daily protein intake (g/day)	8.62[a]	6.11[b]	6.30[b]	7.01±0.29
Protein efficiency ratio (PER)	0.50[b]	0.59[a]	0.39[c]	0.49±0.07

The FCR of the SPT diet (1.97) and the control (2.0) are not significantly different ($p>0.05$) from each other while that of the SPP (2.5) is higher and significantly different ($p<0.05$) from that of the control.

There were no significant differences ($p>0.05$) within the values of GECF in all the diets. The PER values were however significantly different ($p<0.05$) within the treatments. The PER values indicate that crude protein in SPT diet was better utilized than SPP and maize based diets. The higher fiber content of the SPT diet probably aided faster digestion of diet 2. The MWG was highest in the maize based diet (control), and it was significantly different ($p<0.05$) from the two SP diets. However, the MWG of the SP based diets were not significantly different from each other. A treatment using whole SP (tuber and peels) flour would probably make little difference in MWG. However, using SPP for fish feed formulation, while utilizing the tuber for human consumption will be a better economic option than using maize. Peels are products meant for the garbage heap; so finding use for them will be environmental friendly. The maize-based diet, i.e. the control diet, elicited a significantly ($p<0.05$) better growth performance and utilization than the SP based diets .The SPT based diet was not much different in the MWG and GEFC values from the SPP statistically but in the other parameters the SPT fed fish performed better than the fish fed the SPP diet.

Hematology of Experimental Fish

The hematology results (Table 5) indicated that blood parameters for fries fed the control diet were better ($p<0.05$) in terms of PCV, RBC counts, Hb concentration , MCV and MCHC, as well as lower WBC values that those fries fed SP diets.

Table 5: Hematology of *Clarias gariepinus* fingerling fed the Experimental Diets

Parameters	Treatments		
	1	2	3
PCV (%)	31.8 ± 0.3[a]	28.3 ± 0.3[b]	28.3 ± 0.5[b]
Hb conc. (mg/dl)	10.0 ± 0.1[a]	8.7 ± 0.2[b]	8.5 ±0.3[b]
RBC counts (x10^6/ml)	2.6 ± 0.1[a]	2.3 ± 0.2[b]	2.2 ±0.2[b]
WBC counts (x10^3/ml)	17.8 ±2.4[b]	23.2 ± 0.8[a]	24.1± 1.5[a]
MCV (fl)	122.3 ±2.2[b]	123.2 ± 3.2[b]	128.6 ±3.1[a]
MCHC (%)	31.4 ± 0.6[a]	30.7 ±3.1[b]	30.1±2.2[b]

These observations are similar to those reported by Olukunle *et al.* (2002) and Taiwo *et al.* (2003) in the examination of the nutritional values of cow blood meal and grasscutter faeces in the diets of hybrid catfish and *C. gariepinus* bloodstock, respectively. However the hematology of fries fed SP-based diets were not significantly different from each other except in the MCV values, where erythrocytes are largest (p<0.05) in fish fed SPP. The high WBC counts in the SP-based diets may be an indication of microbial contamination of the diets 2 and 3, and elicitation of leucocytic defense reaction by the experimental fries. The 25% SP inclusion level may not elicit the optimal performance level in the experimental fish. Similar observations were reported by Olukunle (1996); Falaye and Oloruntuyi (1998) where high concentrations of sesame seed cake (SSC) and plantain peel meal respectively suppressed fish growth in *Clarias* fingerlings. Falaye and Oloruntuyi (1998) made the suggestion that further researches should be conducted to obtain the optimal inclusion levels of SSC and plantain peel meal in the diets of *C. gariepinus* fingerlings. Hence, there may be a need to include the SPP and SPT at a lower inclusion levels (for instance 5-20%) to obtain optimal performance in the diet of advanced fry of *Clarias gariepinus.*

CONCLUSIONS

This study has highlighted the potential of SP-based diets in the fattening of catfish fry in its nursery management. However the hematological analysis does not appear to support the utilization of the SP processed product at the level used in this work, probably because of level of inclusion or microbial contamination. A more stringent hygienic preparation and lower inclusion level of SP tuber or peels in the diets of catfish fry may be more beneficial. It is also suggested that other modes of processing the SP like applying dry or moist heat to kill bacterial and/or fungal agents, be employed so as to elicit better growth and utilization comparable to maize based diets for the catfish fry.

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