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Abstract

The nursery management of Clarias gariepinus is expensive and usually accompanied by high mortality. A good quality feed represents more than 60% of production cost. Maize seasonally become an expensive energy source in fish management, hence the need to utilize cheaper, non –conventional sweet potato (SP). Three experimental diets were designed with 25% maize replaced by peeled tubers of SP (SPT); peels of SP (SPP); 0% SP as the control. The experimental fish were fed in triplicates per treatment. All data were subjected to statistical analysis (ANOVA). The hematological result recommends lower than 25% SP inclusion for optimum utilization and growth

Key Words

Clarias gariepinus, sweet potato, fish feed, utilization, growth,

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Introduction

The processing and utilization of sweet potatoes, *Ipomoea batatas,* has been the focus of several researches in Nigeria (Ojeniyi and Tewe 2001). These works have demonstrated (i) The agronomic potentials of sweet potatoes (SP), done at the Institute of tropical Agriculture (IITA) and the National Root Crops Research Institute (NRCRI), in the humid zone of Africa. (ii) The nutritional value of SP in Nigeria has been published (Oyenuga, 1968). (iii) The processing and utilization of SP in human cuisine and live stock feed has been discussed effectively (Ojeniyi and Tewe 1992). (iv) The industrial usage of SP universally has been documented (Woolfe 1992).

In Nigeria, SP is regarded agriculturally as a minor root crop but it is classified as a major crop in the developing world (Woolfe 1992). It does not feature as a main food in Nigeria dishes quite unlike yam and rice. Most farmers in humid Africa grow SP for their family's consumption. It is usually added to yam, cassava or millet to prepare different Nigerian dishes. However, very limited use, if any, has been reported in fish diet. A word search in scientific electronic records returned a zero output for the utilization of SP in fish diet. Hence, the objectives of the project are to determine the nutrient utilization of SP, as well as it use as a source of energy in the nursery management of catfish fingerling production. Another application of this research in extension is to encourage greater production of SP through information technology among the poorer populace especially the women folks.

Problem Description

Sweet potatoes especially the peels are products for the waste bin because research has not highlighted their importance. More importantly, very little has been reported in literature on the potentials of sweet potato peels (SPP). In the tropics, SP has a 5-month growth cycle, which implies that SP can be grown twice a year. 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). The usage of the peels will reduce the pressure on conventional sources of food if farmers are encouraged to cultivate more SP and use it for livestock feed, especially for fish.

MATERIALS AND METHODS

Preparation: 11.0kg of SP (white variety) was harvested from 4 rows (4.0m x 1.0m) of homestead gardens. The SP were 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 (PSP) 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 SPP and PSP were ground to flour separately and incorporated in the experimental diets as shown in Table 1. The other ingredients were obtained from a reputable livestock feed store in Ibadan, Nigeria.

Experimental Diets

Three experimental diets 1, 2, 3 were formulated with 25% maize replaced by SPP and PSP (Olukunle, 1996; Olukunle *et.al.* 2005). The control diet had 0% SP inclusion. The crude protein level of the diets was a mean of 46.9 $\pm$ 0.57% (Viveen 1983). Previous research recommends between 45-50% protein inclusions in the diet of fry/fingerling stages of catfish (Adekoya *et. al.* 2004).

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 0.25/min to replace water loss by evaporation. The water quality parameters such as temperature, dissolved oxygen, pH, ~~ammonia, nitrite~~ alkalinity levels were monitored at the initial, mid and at the end the experiment using standard methods, (Boyd 1982).

Experimental Fish

~~One Hundred~~ (100) advanced fry of *Clarias gariepinus* mean weight 0.21± 0.03g were allotted per cage, fed 5% of their total body weight and fed at 10.00hr, 14.00hr, 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 analysed 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 juveniles pooled from each treatment for hematological and plasma enzyme studies, (Falaye *et al* 1999; Olukunle *et al* 2002).

The data obtained was analyzed using the analysis of variance (ANOVA) and standard error was used to estimate the probability of deviation from the mean among the treatments (Steel *et. al*. 1960; Norman 1981).

RESULT AND DISCUSSION

Table 1: Result of Processing SP

	Total wt. of SP (kg)	Wt. of PSP tubers (kg)	Wt.of SPP (kg)
Wet weight	11.0	8.25	2.75
Dry weight		2.05	2.05
% Dry matter		24.85	34.15

Water Quality

The water quality analysis for the experimental tanks is shown in Table 2. They were within acceptable ranges as recommended (Boyd 1982; Viveen *et al.* 1983)

Table 2: Water Quality Parameters

	Alkalinity	Dissolved oxygen	pH
Tanks 1	10mg/1	7.2	7.4
Tanks 2	7mg/1	8.4	7.2
Tanks 3	5mg/1	9.2	7.1
Tanks 4	10mg/1	7.0	6.9
Initial	3mg/1	6.2	7.2

Table 3a: Composition of Experimental Diets

Ingredients	**Treatments**		
	1	**2**	**3**
Fishmeal	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
Sweet potatoes (SPP)	-	2.34	-
Sweet potatoes (SPS)	-	-	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

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; Chlorine 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 3(b): Proximate Composition of Experimental Diets

Diets	1	2	3	Mean
%Moisture	10.03	8.83	9.84	9.56±0.25
% Crude protein	48.13	45.58	46.32	46.91±0.50
%Crude lipid	6.78	9.28	7.57	7.8±0.24
%Crude ash	9.33	8.64	9.33	9.1±0.25
%Crude fiber	3.81	4.87	3.98	4.22±0.17
%NFE	21.32	22.80	22.36	22.0±0.39
DE kcal/100g	3.57	3.57	3.42	3.47±0.16

Table 4: Growth Performance and Nutrient Utilization of *C.gariepinus* fed on Processed SPP and SPS

Growth Parameters	Treatments			Mean
Diets	1	2	3	
Ingredients	Maize	SPP	PSP	
Total No of fish stocked	100	100	100	
Mean initial weight (g)	0.23^{a}	0.23^{a}	0.19^{a}	0.21±0.05
Mean final weight (g) MFW)	2.19^{a}	1.59^{b}	1.46^{b}	1.75±0.15
Mean weight gained (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±2.02
Total percent wt. gained (%)	8.52^{a}	623^{c}	668^{b}	714.3±2.97

Specific growth rate (g/day)	0.70^{a}	0.33^{b}	0.25^{c}	0.45±0.07
Total feed intake SGR (g)	362.2	256.8	264.4	294.5±0.18
Growth Parameters	**Treatments**			**Mean**
Diets	**1**	**2**	**3**	
Ingredients	**Maize**	**SPP**	**PSP**	
Mean feed intake/fish (g)	3.94	2.70	3.22	2.55±1.91
Average No of survivors	92.0^{b}	95.0^{a}	82.0^{c}	90±1.05
Feed conservation ratio (FCR)	2.0^{a}	1.97^{a}	2.5^{b}	2.2±0.16
Gross Efficiency Food Conversation (GEFC)	0.5^{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^{a}	0.59^{b}	0.39^{c}	0.49±0.07

Table 5: Composition of Ingredients

	Maize1	**SPP[1]**	**SPP[2]**	**SPS[1]**	**SP[1] Whole**	**SP[2] Whole**
Dry Matter	90.38	28.72	30.0	11.73	28.08	86.8
% Crude Protein	10.65	5.24	1.5	6.33	5.36	3.3
% Crude Fibre	0.06	0.41	0.40	0.34	0.33	N.A
% Crude Lipid	4.09	0.46	0.3	1.34	0.54	0.6
% Ash	2.13	2.96	N.A	4.18	3.21	2.7
% NFE	83.20	91.49	78.3	87.44	90.56	79.20
Gross Energy Kcal/100g	409.65	391.06	111.0	N.A	N.A	337.0

Sources : 1. Oyenuga (1968); 2. Ashida (1982) p.48

The result of processing SP into SPP and SPS is shown in Table 1. The % dry matter of the processed product varied from 24.85% in the SPP to 34.15% in SPS. Table 3 (a) and (b) show the composition and the proximate composition of the experimental diets. The mean crude protein in the diets is 46.91±0.5% while the carbohydrate content has a mean value of 22.0 ± 0.39%. The dietary energy content of the feed was obtained by using the conversion factor of 4, 9, and 4 for crude protein, carbohydrate and lipid.

The mean crude protein of the experimental diets range from 45-50% (Viveen *et. al.*1983; Adekoya *et al.* 2004). The FCR of the diets range from 1.97-2.5 as shown in Table 4 is an indication of the acceptability and good conversion of the diets by the experimental fish. The FRC of the SPP diet and the control are insignificantly different from each other while that of the SPS (2.5) is higher and significantly different (P<0.05) from the control.

There are no significant differences (P≤ 0.05) within the values of GECF. The PER values are however significantly different (P≤0.05) within the treatments. The PER values explain the fact that the crude protein in the SPP diet was better utilized than the SPS and the maize based diets. The higher fiber content of the SPP diet probably aided faster digestion of diet 2. The MWG was highest in the maize based diet (control), and significantly different P<0.05 from the two SP diets and from each other. A treatment using whole SP (tuber and peels) flour would probably make little difference since the SP diets are significantly different (P≤ 0.05) from the control. However using the peels and utilizing the tuber for human consumption will be a better economic option. Peels are products meant for the garbage heap so finding use for them will be environmental friendly. This is the core of this experiment i.e. the result supports the objective of this project.

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 SPS based diets were not much different in the MFW gained and GEFC than the SPP statistically but in the other parameters the SPP fed fish performed better than the fish fed the SPS diet.

Table 6: Haematology of *Clarias gariepinus* Fingerling fed the Experimental Diets.

Parameters	Control	SPP	SPS	Mean Values
PCV (%)	31.8 ± 0.3	28.3 ± 0.3	28.3 ± 0.5	29.47
Hb Conc.	10.0 ± 0.1	8.7 ± 0.2	8.5 ±0.3	9.07

(mg/dl)				
RBC counts ($x10^6$/ml bld)	2.6 ± 0.1	2.3 ± 0.2	2.2 ±0.2	2.37
WBC counts ($x10^3$/ml bld)	17.8 ±2.4	23.2 ± 0.8	24.1± 1.5	21.7
MCV (fl)	122.3 ±2.2	123.2 ± 3.2	128.6 ±3.1	124.7
MCHC (%)	31.4 ± 0.6	30.7 ±3.1	30.1±2.2	30.7

The hematological result as shown in Table 5.0 indicate that an SP-based diet, either tuber or peels, is not optimal for maintaining good hematological indices, because it caused moderately severe mormocytic norm chromic anemia and leucocytosis. The SP based diets were compounded at 25% replacement level which may not represent the optimal performance level .Hence there is a need to include the SPP at a lower inclusion level for instance (5%- 20%) to obtain optimal performance in the diet of advance fry/juvenile of *Clarias gariepinus*

Recommendations

The SPP based diet encouraged a higher average number of survivors, insignificantly different FCR and better PER than the control. This knowledge should encourage higher production and usage of SP during the scarce period when the price of maize/tone is high in the market. There is a need to synchronize the growth cycle of SP and / or the encourage irrigated planting of SP or reduce the percentage of maize in fish diet and then replacing maize with SP at a lower percentage than used in this project i.e. get growth performance values for 5-20% replacement values of maize for SP. The later suggestion has been demonstrated by many authors; with the use of sesame seed cake (Jauncey *et al. 1982*; Viveen *et al* 1985; Olukunle 1996), cocoa husk (Falaye *et. al* 1999) and cow blood meal (Olukunle 2002). The hematological result in Table 5 also supports the suggestion by these authors to add SP flour to catfish diets at a lower inclusion level so as to reduce the effect of the antinutritional factor, which probably affected the availability of the SP proteins to the test fish during digestion at 25% inclusion level. This reduced inclusion level will be a future research work.

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