UTILIZATION OF AGRICULTURAL WASTES (COCOA POD HUSK) IN THE DIET OF *Clarias gariepinus* (Burchell 1822).

BY

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ABSTRACT

The inclusion of agricultural waste (cocoa pod husk) in the diet of *Clarias gariepinus* was investigated in a feeding trial. *Clarias gariepinus* with a mean weight of 3.53±0.23g was placed on 5 test diets at inclusion levels of 0, 5, 10, 15 and 20% cocoa pod husk (CPH) for 56 days. At the end of the feeding trial, the result obtained indicated significant differences (P<0.05) among treatments.Growth rate declined as cocoa pod husk inclusion level increased. Cocoa pod husk as energy source in the diet of *Clarias gariepinus* was found to be utilized up to 15 % inclusion beyond which there was a decline in growth.

Keywords: Agro-waste, Fish feed, Growth parameters.

INTRODUCTION

High cost of feedstuffs is a major constraint in aquaculture (NRC,1993; Olukunle and Falay, 1998). Cocoa (*Theobroma cacao*) is an economic cash crop in tropical Africa, Asia and Latin American countries and its waste - Cocoa pod husk (CPH) constitutes about 75% of its constituent (ICCO, 2003). Opeke (1984) reported that over 4.5million metric tonnes of cocoa by-products which include the cocoa pod husk are available annually in the southern part of Nigeria. The utilization of cocoa pod husk has been reported in the diet of monogastric animals (Atuahene *et al.*, 1984; Sobamiwa, 1998). However,its use has been limited due to its high lignin percentage (14 % w/w), non-starch polysaccharides (NSPs) like hemicelluloses (11 % w/w) cellulose (35% w/w) and low protein value (Annison, 1990; Smith *et al.* 1988; Sobamiwa 1983). Nutritionally, cocoa pod husk is reported to contain about 6-10% crude protein, 24-42% crude fibre, 49-61% nitrogen-free extracts and 9-16% ash (Otchere *et al.* 1983; Smith and Adegobola, 1985). Its nutrient is similar in profile to many tropical grasses and as such is considered suitable to feed ruminant animals (Smith, 1984). Moreover, cocoa pod has been improved upon for utilization as a feed ingredient with chemical treatment (Doyle *et al.* 1986; Atuahene *et al.* 1984). This research seeks to evaluate the growth performance of *Clarias gariepinus* fed diets with different levels of cocoa pod husk as an alternative energy source in feedstuffs.

MATERIALS AND METHOD

Experimental procedure

The feeding trial was conducted using 15 circular plastic bowls of 20litres each. The bowls were filled with borehole water up to 12litre depth. Water quality parameters were routinely monitored weekly throughout the feeding trial. Water quality parameters obtained for Dissolved oxygen (6.50 – 7.60 ± 3.00) according to Wrinkler's method (Lind, 1979, APHA, 1980). pH (6.0 - 7.2) was measured using a KENT-EIL 7045/46 pH-Meter in the laboratory at room temperature. Temperature (24.0-25 °C) and conductivity (70.0 - 104.5) were measured with portable switchgear electrolytic conductivity meter model JENWAY 4010 conductivity meter expressed in micro-ohms/cm (µ/cm). The fishes were fed 3% of their body weight and adjusted to 5% towards the end of the feeding trial. The fishes were fed twice daily (09 .00hrs and 16.00hrs). Fishes were individually weighed at the commencement of the experiment and bulk weighed fortnightly for the evaluation of the growth parameters.

Experimental diet

The experimental diet was made up of five isonitrogenous formulations each with varying cocoa pod husk meal inclusion level at 0, 5, 10, 15 and 20% formulated at 40% crude protein. The cocoa pod husk was prepared by slicing the freshly discarded ripe pods into flakes, oven dried and milled with a hammer mill machine. Other ingredients were added and the diets processed into 3mm diameter pellets. The resultant pellets were dried and stored in transparent polythene bags and frozen until used. The four experimental diet and control were formulated using the Pearson Square method as presented in table 1

Experimental Fish

Clarias gariepinus fingerlings with mean initial weight (3.53± 0.23g) were stocked at 15 each in 20litre circular plastic bowls in triplicates. Fortnightly, the fishes were bulk weighed for the determination of growth parameters. Faecal samples were collected once a day at about 08.30am before feeding commenced. Faeces collection was performed by siphoning material from the bottom of each tank according to treatment, which was then freeze-dried at – 4°C until analyzed for apparent digestibility coefficient (ADC %).

Experimental Analysis

For the determination of growth performance and nutrient utilization parameters, initial and final carcass analyses were conducted where 7 fishes were sacrificed according to the method of (AOAC, 2000). The growth parameters were determine as follows:the Mean weight gain (g) as the difference between the Mean final body weight (g) and Mean initial body weight (g). The Specific Growth Rate (SGR % / Day), the average percentage weight change per day between any two weightings = [(LnW2 - LnW1) / (T2 - T1) X100] (Brown, 1957), where W1 is the initial fish weight (g) at time T1 (day) and W2 is the final fish weight (g) at time T2 (day) and Ln as natural logarithm. Food Conversion Ratio (FCR) was evaluated as the weight of feed fed in dry weight per fish live weight gain (Feed fed (g dry weight)/Live weight gain (g). Protein Utilisation was determined as Live weight gain (g) / Crude protein fed (g) (Osborne *et al.*, 1919). Apparent Net Protein Utilisation (ANPU) expresses the percentage of ingested protein that is retained by deposition in the carcass calculated by the carcass analysis method of Miller and Bender (1955), ANPU (%) = (P2 - P1) / Total protein consumed (g) X100

Where, P1 is the protein in fish carcass (g) at the beginning of the study and P2 is the protein in fish carcass (g) at the end of the study. The Apparent Digestibility Coefficient (ADC) was evaluated according to Maynard *et al* (1979) and Bondi (1987) using Acid insoluble Ash (AIA) as internal indicator as reported by Church and Pond (1988).

$$\% \text{ Acid insoluble Ash} = \frac{\text{wt. of Acid Insoluble Ash}}{\text{Wt. of sample taken}} \times \frac{100}{1}$$

$$\% \text{ ADC} = \left[100 - \left[\frac{100 \times \% \text{AIA in diets} \times \% \text{ Nutrients in Feaces}}{\% \text{AIA in feaces} \times \% \text{ Nutrient in diets}} \right] \right]$$

Statistical Analysis

Results of carcass composition, the evaluation of biological parameters, composition of diets and all other data obtained were subjected to one way analysis of variance (ANOVA) using Turkey's test (Steel and Torrie, 1980) at 5% probability level. Multiple parameter means comparison of treatments was according to Duncan multiple range tests (1955). All statistics analyses were executed using the software Minitab Release 14 and graphical analyses were plotted with Microsoft Excel Window 2007.

Table 1 Formulated Cocoa pod husk based diets

Feed Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	55.70	52.76	49.83	46.90	43.97
Cocoa pod husk	0.00	5.00	10.00	15.00	20.00
Fish meal	39.31	37.24	35.17	33.10	31.03
Vitamin-premix	5.00	5.00	5.00	5.00	5.00
	100.01	100.00	100.00	100.00	100.00
Proximate Composition (%)					
Crude protein	41.96	40.06	41.49	41.01	39.70
Crude lipid	9.00	10.00	15.00	10.00	7.00
Moisture	10.50	10.00	10.50	11.50	11.50
Ash	9.00	8.30	10.30	8.70	9.70
NFE	29.54	31.64	22.71	28.79	33.31

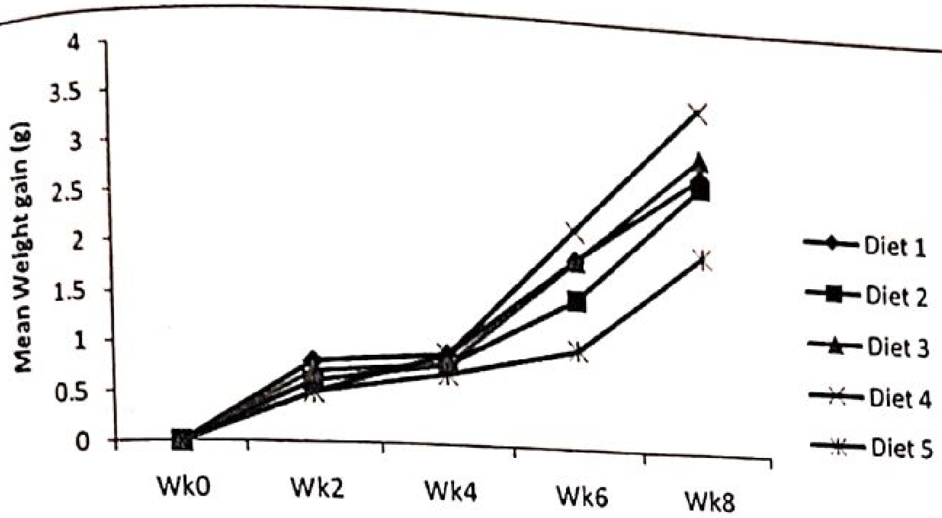

Fig. 1: Growth Response of *Clarias gariepinus* fed Cocoa Pod Husk Substituted Diets for 8 Weeks

RESULT AND DISCUSSIONS

Table 2 shows that there was a significant difference ($p < 0.05$) in the mean weight gain (MWG) between diets 1 and other diets but there was no significance difference ($P>0.05$) between diets 2 and 3 (Figure 1). The Feed conversion ratio (FCR) also indicated significant difference ($P<0.05$) among diets. There was no significance difference ($P>0.05$) between diets 1 - 4 with diet 5 having high fcr value. The specific growth rate (SGR) exhibited significant difference ($P<0.05$) among the treatments. Moreover, there was no significant difference ($P>0.05$) between diets 2 and 3 both of which were significantly ($P<0.05$) higher than diets 4 and 5. On the protein efficiency ratio (PER), there was no significant difference ($P>0.05$) between diets 1 and 4 both of which were significantly ($P<0.05$) higher than diets 5. The Apparent Net Protein Utilization (ANPU), also showed in-significant difference ($p > 0.05$) between diets 2 ,3 and 4 all of which were significantly ($P<0.05$) higher than diet 5.

On the body compositions, there were significant differences ($P<0.05$) in the body protein and body lipids for all the treatments. The ash and the moisture contents indicated significant differences ($P<0.05$) in some cases (Table 3). The Apparent Digestibility Co-efficient values (ADC %) also showed significant difference ($P<0.05$) in the lipid and dry matter contents while the protein and ash contents indicated significant difference ($P<0.05$) in some cases (Table 4).

Table 2: Growth performance of *Clarias gariepinus* fed cocoa husk (CPH) and control diet for 8 weeks.

Growth Parameters	D 1	D2	D3	D4	D5
M IW gain (g)	3.59 ±0.08[a]	3.57±0.06[a]	3.57±0.09[a]	3.40±0.33[b]	3.52±0.05[a]
MFW gain (g)	7.27±0.32[c]	6.66±0.27[ab]	6.69±0.22[ab]	6.45±0.05[b]	5.68±0.20[c]
MWG (g)	3.68±0.06[a]	3.09±0.06[b]	3.12±0.06[b]	3.05±0.06[b]	2.16±0.06[c]
FCR	2.79±0.06[a]	2.84±0.01[a]	2.90±0.03[a]	2.82±0.01[a]	3.81±0.07[b]
SGR (%/Day)	1.11±0.90[a]	1.04±0.04[b]	1.04±0.02[b]	0.98±0.02[c]	0.87±0.11[d]
PER	3.49±0.28[a]	3.30±0.15[b]	3.19±0.22[c]	3.42±0.01[a]	3.32±0.38[b]
ANPU (%)	67.54±0.06[a]	54.56±0.01[b]	54.56±0.01[b]	54.86±0.01[b]	18±0.01[c]
Survival (%)	93.32[a]	91.11[b]	82.22[c]	80.00[d]	71.11[e]

Key: MIW-Mean Initial Weight gain; MFW-Mean Final Weight gain; MWG-Mean Weight gain; FCR-Feed Conversion Ratio; SGR- Specific Growth Rate; PER-Protein Efficient Ratio; ANPU-Apparent Net Protein Utilization

Table 3: Body compositions of *Clarias gareipinus* fed cocoa pod husk diet.

Body Compositions (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Crude Protein	68.67±0.01[a]	66.76±0.01[b]	65.80±0.06[c]	63.04±0.06[d]	61.05±0.01[e]
Crude lipid	8.30±0.01[a]	5.90±0.01[d]	5.60±0.01[e]	7.21±0.02[b]	6.40±0.01[c]
Ash	29.85±0.01[b]	23.76±0.01[e]	27.50±0.01[c]	34.37±0.01[a]	26.37±0.01[d]
Moisture	6.20±0.10[b]	5.97±0.01[c]	5.56±0.01[d]	4.30±0.01[e]	6.67±0.01[a]

Table 4: Apparent Digestibility of nutrient in experimental diets by *Clarias gariepinus*.

Apparent Digestibility Co-efficient (ADC %)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Protein	64.56±0.01[b]	68.89±0.12[a]	68.65±0.36[a]	62.84±3.38[c]	68.68±0.01[a]
Llipid	58.41±0.01[c]	70.45±0.01[a]	73.48±0.01[a]	68.88±0.01[b]	46.72±0.01[d]
Ash	31.04±0.01[e]	34.96±0.01[d]	47.59±0.01[c]	52.97±0.01[b]	61.55±0.01[a]
Dry matter	89.92±0.01[c]	93.69±0.01[a]	90.82±0.01[c]	92.37±0.01[b]	93.08±0.01[a]

Clarias gariepinus fed graded levels of cocoa pod husk indicated its utilization with progressive decline in growth as the level of inclusion increased beyond 15 %. Diet 2 and 3 containing cocoa pod husk (CPH) 10 and 15% inclusion levels respectively gave significant growth performance in term of FCR, SGR, PER and ANPU (Table 2), however from figure 1 diet 4 containing 15% CPH gave best growth performance while diet 5 with highest inclusion level (20%) gave the least performance. The poor performance observed with diet 5 can be attributed to the presence of high fibre in the cocoa pod husk diets. NRC, 1993; and Wang *et al.*, 1985 reported that carbohydrates such as fibres, hemicelluloses, lignin and pentosans form indigestible fractions in the feed which *Clarias gariepinus* was not well equipped to digest. Fagbenro (1990) reported presence of microbes that digest cellulose material in the gut of *Clarias isheriensis* The result observed in this experiment with *Clarias gariepinus* is in agreement with Fagbenro (1992) who reported an appreciable weight gain with 15% inclusion level of cocoa pod husk in the diet of *Clarias isheriensis* which was attributed to best utilization of the CPH for tissue development.

The thebromine content of cocoa pods reduces feed intake and nutrient digestibility in non-ruminant animals (Adebowale, 1985).This can also be a reason for its low digestibility in fishes as observed with diet 4 and 5, both of which gave the lowest SGR values as well as the lowest body proteins. Annison, (1990), Sobamiwa, (1983) and Falaye (1987) reported on the anti-nutritional property of thoebromine which was said to be responsible for the low digestibility of CPH diets in *Oreochromis niloticus* which was also reported by (Fagbenro, 1992) with *Clarias isheriensis*.

CONCLUSION AND RECOMMENDATION

The results obtained indicated that, CPH can be included in the diets of *Clarias gariepinus* with best performance at 15 %. Further studies should be done on how to reduce the theobromine content of cocoa pod husk to improve its utilization by the teleost.

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