GROWTH PERFORMANCE OF *CLARIAS GARIEPINUS* JUVENILES ON COCOA POD HUSK -SUPPLEMENTED DIETS

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Abstract

An experiment was undertaken to determine the effect of boiling of cocoa pod husk and levels of inclusion that will positively affect the growth rate of *Clarias gariepinus*, a major species of importance cultured in Nigeria. Cocoa Pod husk is a by-product of cocoa industry often discarded as Waste. This study was to assess the effect of incorporation of boiled Cocoa pod husk into the diets of *C .gariepinus* juveniles.

One hundred and thirty juvenile fish (3.35 g initial mean weight) were randomly allocated to five treatments each having two replicates. Two batches of cocoa pod husk were treated differently: the first batch was beaten to smaller pieces, sun dried and ground to fine powder, while the second batch was boiled for 30 minutes in water at 100^{0}C, sun dried and ground to fine powder. These were done in an attempt to reduce the anti nutritional factor ,theobromine an alkaloid present in the CPH. The experimental diets consisted of 0% cocoa pod husk (control),10% CPH (the best diet in a previous experiment), other treatments consisted of boiled cocoa pod husk at 10,15 and 20% levels of inclusion representing treatments 1 to 5 respectively. The experimental diets were formulated to contain 36% crude protein and fish were fed at 4% of their body weight thrice daily for 8 weeks.

At the end of the trials the experimental diets were analyzed for their proximate composition, growth performance and nutrient utilization. From the result of the experiment, 10% of boiled CPH showed the best results ($p<0.05$) in terms of weight gain, protein efficiency ratio and feed intake of *C. gariepinus* juveniles. Therefore 10% inclusion of CPH was recommended for inclusion in diets of *C.gariepinus* juveniles. However further research should be carried out on other processing conditions of cocoa pod husk that will allow higher inclusion and efficient utilization by fish..

INTRODUCTION

Fish is an important source of animal protein providing 40% of the protein intake of two-thirds of the world's population (FAO, 1993). Lysine, leucine, isoleucine, arginine and valine which are essential amino acid appear to be present in the highest concentrations in fish (Akerelolu, 1991). Fish and fish by- products provide cheap but high quality protein compared to meat from wild animals, poultry, pork or beef. Fish also contains a wide range of vitamins such as vitamin A, B, C, D and E and minerals like potassium, calcium, iron, manganese, zinc, fluorine, copper and iodine (Akerelolu, 1991).

Basic nutrition in fish production is important to produce a healthy and high quality product. Feed is a major limiting factor affecting the growth of aquaculture in Nigeria (Tobor, 1991). For the purpose of nutritional and economic benefits, some research has been undertaken in recent times to increase the use of underutilized plant and animal materials to replace conventional feed ingredients like maize and fishmeal in livestock and fish production (Oyelese, 1995, Olukunle, 1996, Falaye and Oloruntuyi, 1998). This is due to the high cost and competition for the animal protein and energy sources like fishmeal and maize respectively. With the development of the fish feed processing industry it could be possible to put into profitable use some plant and animal by-products which are presently discarded as Wastes.

Cocoa pod husk is a by – product of cocoa processing often discarded as Waste. *Thoebroma cacao* is an important tropical rain forest species, grown for it rich seed cocoa and cocoa butter. Nigeria is the third largest producer and exporter of cocoa in Africa with projected production values of 160,000 metric ton by the year 2005 (FAO, 2000). Several metric tons of cocoa pod husk could be available for use as animal feed although it contains some anti-nutritional factors like theobromine a toxic alkaloid present in low quantities in cocoa pod husk and hinders digestibility. CPH provides high fibre, low protein and moderate energy (2224kcal/kg) when fed to livestock. Other uses of cocoa pod husk include ash use for soap (Arueya, 1991) cocoa pigment used in Japanese food industry (Kimura, 1979). This project looks into the incorporation of boiled cocoa pod husk into the diet of *Clarias gariepinus*.

MATERIALS AND METHODS

Experimental System:

The experiment was carried out using ten plastic bowls for 8 weeks, in the Department of Wildlife and Fisheries Laboratory of the University of Ibadan, Ibadan, Nigeria. The water sourced from the University supply was maintained at a volume of 30litres in each tank and replaced every three days to maintain relatively uniform physiochemical parameters and prevent fouling from feed residues. Each tank was well aerated using air stone and aerator pump (Lawson, 1995). The dissolved oxygen content and pH of the water were measured using a D.O. metre (Jenway 3015pH metre, 0.01 accuracy) and water temperature by mercury-in-glass thermometer.

Each dietary treatment had two replicates, with 13 fish per replicate with mean initial body weight of 3.25±0.01g. Uniform- sized fish were selected from 250 juveniles, weighed and distributed into experimental tanks. The fish were acclimatized for seven days in glass aquaria before the experiment. The fish were fed at 4% body weight with the daily portions divided into two: 2.0% given in the morning by 8.00a.m and 2.0% in the evening by 4.00 pm. Weight changes were recorded weekly and feeding rate adjusted weekly according to the new body weight.

Treatment of Cocoa Pod Husk and Diet Preparation:

CPH obtained from Cocoa Research Institute of Nigeria (CRIN), Ibadan, Oyo State was processed using physical methods: soaking, boiling and drying in attempt to reduce the theobromine content. In the first set, fresh CPH was beaten to increase the surface area, sun dried for a week and ground to fine powder while in the second set, CPH was collected and boiled for 30 minutes in water at 100^{0}C, beaten to small sizes, sun dried before grinding. Other feed ingredients were mixed together to formulate 36% crude protein diet. Each diet mixture treated separately was extruded through a 1/4mm die mincer of Hobart A-200T pelleting machine to form a noodle like strand, which were mechanically broken into suitable sizes for the *Clarias gariepinus* juveniles. The pelleted diets were sun dried, packed in labeled polythene bags and stored in a cool dry place to prevent mycotoxin formation.

Table 1: Gross Composition of Experimental Diets

Ingredients	Control	Check (10%)	10%	15%	20%
Soybean	32.50	32.50	32.50	32.50	32.50
Fishmeal	16.25	16.25	16.25	16.25	16.25
GNC	16.25	16.25	16.25	16.25	16.25
Maize	34.25	30.82	30.82	29.11	27.40
CPH	-	3.43	3.43	5.14	6.85
Premix	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	0.1	0.1	0.1	0.1	0.1
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Growth and Feed Utilization Parameters:

WEIGHT GAIN = final body weight - initial body weight

$$\text{WEIGHT GAIN (\%)} = \frac{100\,(\text{final body weight - initial body weight})}{\text{Initial body weight}}$$

SPECIFIC GROWTH RATE (SGR)

$$= \frac{100\,(\log_e \text{final body weight} - \log_e \text{initial body weight})}{\text{Time (days)}}$$

$$\text{FEED CONVERSION RATIO (FCR)} = \frac{\text{Dry weight of feed fed (g)}}{\text{Fish weight gain (g)}}$$

$$\text{PROTEIN EFFICIENCY RATIO (PER)} = \frac{\text{Body weight gain (g)}}{\text{Crude protein fed}}$$

$$\text{SURVIVAL RATE (\%)} = \frac{\text{Initial Number of Fish Stocked} - \text{Mortality}}{\text{Initial number of fish stocked}} \times 100$$

TOTAL FEED INTAKE = amount of feed intake per week for the experimental period.

Analytical Methods:

The proximate composition of experimental diets, fish and the fibre contents of boiled and unboiled CPH were determined according to A.O.A.C (1990) methods. The data obtained were subjected to one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Table 2: Proximate Compsition and Fibre Contents of the Experimental Diets and Cocoa Pod Husk (Boiled)

	CD	CH	TD_1	TD_2	TD_3	CPH
Dry matter	90.83	90.46	91.24	91.48	91.55	90.61
Moisture	9.17	9.54	8.76	8.52	8.45	8.39
Crude protein	35.88	37.84	36.31	36.31	37.73	9.84
Crude fibre	15.00	18.00	12.00	21.00	18.00	26.00
Ether extract	8.50	11.50	10.00	11.50	10.00	8.50
Ash	5.50	3.50	5.00	4.50	5.50	8.00
NFE	35.12	29.16	36.69	26.69	28.77	47.06

Fibre Content of the experimental feeds and the cocoa pod husk (boiled and unboiled)

	CD	CH	TD_1	TD_2	TD_3	CPH (boiled)	CPH (unboiled)
Crude fiber	15.00	18.00	12.00	21.00	18.00	26.00	27.00
ADF	32.00	33.00	26.00	35.00	35.00	45.00	33.00
ADL	23.10	21.20	20.80	25.70	25.70	30.00	22.70
NDF	-	-	-	-	-	-	-

Key

CD – Control (0% inclusion of CPH)
CH – Check (10% inclusion of unboiled CPH)
TD_1 – Treatment 1 (10% inclusion of boiled CPH)
TD_2 – Treatment 2 (15% inclusion of boiled CPH)
TD_3 – Treatment 3 (20% inclusion of boiled CPH)
ADF – Acid – detergent fiber
ADL – Acid – detergent lignin
NDF – Neutral detergent fiber

Water Quality Analysis:

The water quality during the experiment ranged as follows: calcium 76-96, pH 6.7-7.0, Dissolved oxygen 2.5-4 mg/l and temperature26-28^{0}C

Growth Performance aAn Nutrient Utilization of Experimental Fish

Table 3: Growth Performance of Experimental Fish

Parameters	CD	CH	TD_1	TD_2	TD_3
Initial mean weight (g)	2.75	3.15	4.20	2.99	3.19
Final mean weight (g)	8.97	9.61	12.29	10.41	9.17
Mean weight gain (g)	6.22	6.46	8.09	7.42	5.98
Percentage weight gain	62.20	64.60	80.90	74.20	59.80
Total feed fed (g)	150.38	164.78	228.57	173.35	171.61
Specific growth rate	16.90	15.94	15.31	17.84	15.12
Feed/ weight gain ratio	3.02	3.19	3.53	2.92	3.59
Mean feed intake	18.80	20.60	28.57	21.67	21.45
Feed conversion ratio	1.86	1.20	2.19	1.80	2.21
Survival %	100	84.62	100	100	100
Protein efficiency ratio	0.17	0.18	0.23	0.21	0.17
Mortality	-	15.38	-	-	-

Water is important to the survival of fish and the physico-chemical parameters of water must be kept at desirable level for fish to thrive. The water temperature, dissolved oxygen and pH during the study were 26-28^{0}C, 2.5-4 mg/l and pH 6.7- 7.0. The temperature and pH were adequate for fish (Olukunle, 2000) though the dissolved oxygen was lower than recommended (Huet, 1972).

The boiled CPH had relatively the same crude protein content as reported by Opeke (1982). The crude protein content of the 10 % inclusion of the unboiled CPH was the highest .The crude protein contents of the experimental diets fell within the range required for *C.gariepinus* (Faturoti *et al*, 1995). The low crude protein level and the high fiber content of the unboiled and boiled CPH agreed with Sobamiwa, (1996).

Crude fibre content also varied in the experimental diets but the variation was not consistent with the graded levels of inclusion of CPH. The crude fiber content in the boiled CPH was lower than that reported by Opeke, 1982; and Oguntuga, 1975). The crude fibre of the boiled CPH and unboiled CPH were 26.0% and 27% respectively. The crude fibre content in the experimental diet ranged from 12% in TD_1 to 21% in TD_2 this is probably due to different levels of inclusion of CPH. Modern nutritional studies require a more complete knowledge of the fibrous constituents of a feed and so other determinations such as acid detergent fiber (ADF) and neutral detergent fiber (NDF) were made according to the procedures recommended by Van Soest (A.O.A.C,1990).Boiled CPH had a higher value of ADF and ADL than the unboiled CPH.This could be as a result of boiling which caused the heat to expose the coating of the fiber (Babayemi *et al*, 2004). Experimental diets had variations in ADF and ADL which could result from different inclusion levels of CPH. The NDF of all the diets were not determined due to clogging which prevented the filtration of the sample for analysis (Babayemi *et al*, 2004).

Feed Intake:

Feed consumption for the control diet was significantly ($p<0.05$) lower than all other treatments. Intake of diet TD_1 (10% boiled CPH) was the highest and control diet the lowest. However, all the diets with graded level inclusion of boiled CPH were consumed more than the check (10% unboiled) and control diets by the fish. This could be as a result of the boiling of CPH which may have increased the palatability of the diet. Also metabolizable energy level of CPH is lower than that of maize which could have encouraged more consumption of diet with 10% inclusion of boiled CPH and other CPH- based diets. This agreed with the findings of Adeyemo (2005) that CPH could replace maize with no adverse effect in giant land snail. No mortalities were recorded on diets containing boiled CPH indicating that CPH could be included in the diets of *C. gariepinus* juveniles at low to moderate levels of inclusion.

Growth Performance and Nutrient Utilization:

The nutrients required by fish for growth and other physiological functions are similar to those of terrestrial animals. Fish are among the most efficient animals in converting nutrients into flesh because of low energy requirements for maintenance though dietary protein of fish are higher than those of land animals (Smith,1989).

The mean weight gain of the fish was higher on 10% boiled CPH- based diet (TD_1) , significantly different from control ($p < 0.05$) and lowest on 20% boiled inclusion (TD_3) which could be attributed to the higher percentage inclusion of boiled CPH. There was no significant difference ($p> 0.05$) between weight gain in treatment TD_1 and TD_2. These were similar to the findings of Sobamiwa, 1996) who showed successful inclusion of cocoa pod husk in the diet of animal and tilapia fish at 10% level of inclusion .The highest specific growth rate was recorded in treatment TD_2 (15% boiled) while the lowest was recorded in treatment TD_3(20% boiled CPH).

The protein efficiency ratio ranged from 0.23 in the TD_1 to 0.17 in both control diet and treatment TD_3 (20% boiled CPH). The protein efficiency ratio in the treatment containing graded level of inclusion of boiled CPH decreased with increase in boiled CPH. The feed conversion ratio also ranged from 1.20 in treatment CH (10% unboiled CPH) to 2.21 in treatment TD_3 (20% boiled CPH).

CONCLUSION

From the result obtained during this experiment, it can be concluded that boiling of the CPH had an effect on weight gain, specific growth rate and feed conversion ratio of *Clarias gariepinus*. The fish performed well on 10 % inclusion of boiled cocoa pod husk showing the best performance in terms of weight gain, feed intake and feed conversion ratio. 15%

inclusion of boiled CPH was better in terms of specific growth rate and low feed conversion ratio. All the fish from the treatment with inclusion of CPH had higher weight gain than the control with conventional feed except the 20% inclusion of boiled CPH. It can be concluded that further processing of CPH can improve its usefulness as a potential partial substitute for maize in the diet of *Clarias gariepinus*.

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