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Growth Response of *Clarias gariepinus* juvenile to Cocoa Husk Endocarp Based Diets

B.A. Adebowale and O. Olubamiwa
Cocoa Research Institute of Nigeria, P.M.B. 5244, Ibadan, Nigeria

Abstract: Optimum dietary inclusion of Cocoa Husk Endocarp (CHE) in the diet of *Clarias gariepinus* was investigated. Three replicate groups of juvenile *Clarias gariepinus* were fed 5 isonitrogenous diets. The diets: A, B, C, D and E, respectively contained cocoa husk endocarp at 0, 10, 15, 20 and 25% maize replacement. The fishes were fed at 5% body weight for the trial period of 12 weeks. Water quality parameters were monitored throughout the experiment. The result showed that feed conversion ratio, weight gain, protein efficiency ratio and carcass fat values were better ($p<0.05$) on Diets A (Control) and D. All the parameters assessed were lower ($p<0.05$) on diet E relative to the control and other CHE diets. Increasing replacement of maize with CHE had positive correlation on mean weight gain until diet D (20%). Feed acceptability increases across the table except for diet D which increases at a deceasing rate. Increase in feed consumption of diet A above D might be due to bitter taste of Cocoa husk endocarp and could be responsible for the higher daily and percentage weight gain in A with respect to D. The result indicated that dietary replacement of maize with CHE up to 20% level can favourably support the growth performance of *C. gariepinus*.

Key words: Cocoa husk endocarp, *Clarias gariepinus*, acceptability

INTRODUCTION

The ever-increasing demand for fish protein in Nigeria has motivated speedy development of the aquaculture sector. Of all the available culturable fish species in Nigeria, *C. gariepinus* is one of the most important species that readily adapt to culture environment and accept artificial (compounded) diets. Despite several research findings, cost of feed and feeding in fish culture remains above 70% of the production cost. It is frustrating that very few alternative feedstuffs have been found as replacement for conventional ingredients of protein source like, fish meal soya-bean meal and groundnut cake. Worse still is the financial incapability of the intending farmers to purchase the expensive protein source ingredients of the formulated feed. The production economics of this culturable fish of commerce (*C. gariepinus*) under intensive feeding management requires a careful study with respect to escalating cost of fish feed and feed ingredients in Nigeria. Dwindling supply of important conventional feedstuffs like maize, fishmeal and Groundnut cake daily pose a challenge to animal scientists to source for alternative feedstuffs as replacement. Falaye (1992) advocated the need to examine the potentials and advantages of locally available agro-industrial by-products as possible substitute for the conventional feedstuffs whose supply is irregular with continual price escalation. Dozens of works has been done on relative adaptability and feed acceptability of *C. gariepinus*. *C. gariepinus* was found to grow well at high stocking density (Eyo and Adelowo, 1991) and thrive successfully on different kinds of artificial and compounded diets (Ita *et al*., 1984; Otubunsin and Olatunde, 1992; Akande and Omorinkoba, 1994). With concerted efforts of researchers, a good number of by-products are now been converted to feedstuffs (Falaye, 1992). Falaye (1990) and Fagbenro (1992) differently evaluated Cocoa pod husk and reported that it has a replacement value for maize in livestock diet.

Cocoa husk endocarp is another by-product extracted from Cocoa pod husk. It is the innermost (third) layer of the husk. Proximate composition of CHE revealed it to contain 7.56% Crude protein, 15.12% Crude fibre, 1.12% Ether extract and 4.80 Kcal gm^{-1} gross energy (Sobamiwa and Akinwale, 1999). About 1.8 M tones of Cocoa Pod husk waste annually in the Cocoa producing States in Nigeria (Opeke, 2005). Cocoa husk endocarp is about one-third of the whole husk (dry matter basis). Hence, if 1.8 Million tonnes of the husk waste annually, about 0.6 Million tones of the husk endocarp is been wasted annually.

Corresponding Author: B.A. Adebowale, Cocoa Research Institute of Nigeria, P.M.B. 5244, Ibadan, Nigeria

This study therefore aimed at investigating the growth response of *C. gariepinus* to this new found feedstuff in an attempt to harness larger proportion of the CPH erstwhile called waste into fish farming.

MATERIALS AND METHODS

Cocoa husk endocarp preparation: Freshly broken cocoa pod husks were collected from the Fermentary Unit of the Cocoa Research Institute of Nigeria Ibadan. Sharp knives were used to extract the innermost layer of the pod husk called the endocarp. This fresh endocarp was sundried on a concrete slab at the Fermentary Unit. Analyzed proximate composition of the dry endocarp was as follows: C.P- 6.88%, C.F -15.29%, Ash-6.72%, CHO-43.93% and M.E- 4.76 kcal. This well dried endocarp was ground into fine particles and measured proportions were used to compound each of the diets.

Experimental feeds: Five isonitrogenous experimental diets containing an average of 40.00% Crude Protein were formulated. Diet A (Control) had 0% maize replacement, whereas diets B, C, D and E contained 10, 15, 20 and 25% maize replacement with the endocarp. Known quantity of each diet was weighed out and pelleted to facilitate feed intake.

Experimental fish and design: Four hundred Juvenile *Clarias gariepinus* were purchased from a fish farm within Ibadan city. The fishes were randomly grouped in triplicates of 25 fishes each into fifteen bowls. The bowls were filled with water to about half of its capacity. Mosquito (Nylon) nets were used to cover the top ends of the bowls to prevent the fishes from jumping out. The bowls were arranged and labeled in triplicate as A1, A2, A3, E1, E2 and E3, etc.

Feeding method: The fishes were acclimatized for about 2 weeks before the commencement of the experiment. Initial weights of each group were taken at the beginning of the experiment and feeds were given at 5% of body weight. Continuous water replacement was done throughout the trial period to be adjusted according to body weight till the end of the experiment. The bowls were frequently cleaned to prevent microbial contamination.

Data collection and analysis: Weights of each group were taken weekly. Water quality parameters were taken fortnightly to provide a suitable environment for the fish. Proximate composition analysis of diets and fish were determined before and after the experiment by AOAC (1990) analytical methods.

RESULTS AND DISCUSSION

Table 1 showed the ingredient composition of each diet and their analyzed nutrient values. Crude protein and fibre value of all the diets were similar to that of Falaye (1998) and is in conformity with the recommendation (40% CP) of Ita *et al.* (1985). Table 2 showed the summary of growth response and nutrient utilization of fishes fed CHE based diets. To maintain conducive environment for the fishes throughout the feeding period, water quality parameters were monitored. Average values of these parameters were shown on Table 3. Table 4 showed the proximate composition analysis of each of the experimental fish both at the beginning and at the end of the feed trial. The mean growth rate value of weight gain was best (0.34) on Diet A which has 0% maize replacement. This was not significantly different from that of diet D (0.33). Although these values were lower than 1.045 g day^{-1} obtained by Akande and Omorinkoba (1994)

Table 1: Ingredient composition of the experimental diets (%) kg

	Diets				
Ingredients	1(0%)	2(10%)	3(15%)	4(20%)	5(25%)
Maize	32.00	29.12	27.50	25.88	24.26
Cocoa husk endocarp	_	3.24	4.85	6.47	8.09
Soya bean meal	32.00	32.00	32.00	32.00	32.00
Fish meal	18.00	18.00	18.00	18.00	18.00
Groundnut cake	16.00	16.00	16.00	16.00	16.00
Bone meal	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Grower premix	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Starch	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.01	100.00	100.00	100.00
Calculated crude Protein level(%)	39.80	40.01	39.65	39.45	39.80
	Analyzed proximate composition (%dry matter)				
Crude protein (%)	40.16	40.20	38.88	40.10	38.95
Moisture	7.00	6.80	6.50	6.90	7.10
Ash	8.60	8.30	7.90	8.10	8.30
Crude fibre	5.10	4.38	4.98	5.34	5.89
Crude fat	4.82	4.51	3.42	3.66	3.22

Table 2: Growth parameter and nutrient digestibility of *C. gariepinus* fed CHE based diets

	Diets				
Parameters	A (0%)	B (10%)	C (15%)	D (20%)	E(25)%
Initial mean weight (g)	5.71	5.74	5.75	5.74	5.76
Final mean weight (g)	9.82	9.08	9.24	9.65	7.49
Mean weight gain (g)	4.11	3.34	3.50	3.91	1.73
% weight gain	172.00	158.20	160.70	168.10	130.00
Specific growth rate	2.26	2.18	2.20	2.25	1.99
Mean growth rate g day^{-1}	0.34	0.28	0.29	0.33	0.14
Mean total feed intake	4.31	4.06	4.11	4.18	3.99
Feed conversion ratio	1.05	1.22	1.17	1.07	2.31
Feed conversion efficiency	95.36	82.27	85.16	93.54	45.36
Protein efficiency ratio	2.39	2.06	2.15	2.24	1.08

Table 3: Water quality parameters for the period of the experiment

Parameter	Mean
Temperature (°C)	26.55
pH	6.88
Dissolved oxygen (mg L^{-1})	7.25
Carbon dioxide (mg L^{-1})	10.40
Total alkalinity (mg L^{-1})	72.50

Table 4: Proximate composition of experimental fish at the beginning and end of the experiment

		Diets				
	Initial	1	2	3	4	5
Moisture	71.42	70.65	72.33	76.20	71.22	75.11
Crude protein	16.92	24.46	22.44	22.16	23.12	20.16
Crude fat	1.51	2.41	1.96	2.44	2.11	1.82
Ash	2.55	1.93	1.93	2.01	1.86	2.23
Gross energy (kcal g^{-1})	187.60	192.60	221.40	190.80	168.00	170.80

This may be due to shorter rearing period of this experiment. In a polyculture trial wherein *C. gariepinus* and other fish species were fed diet containing 25% crude protein at 2% body weight, under a semi intensive condition, a mean daily weight gain of 1.6 g was recorded for *C. gariepinus*. This value was found to be significantly higher than values obtained for all the diets and the control. This may be due to predatory habit of this fish in a polyculture environment. Mean weight gain values for diet A to E were similar to those obtained by Falaye (1998), when the same specie of fish was fed plantain peel based diets at 3% body weight. According to Falaye, the trend of response of *C. gariepinus* to the plantain peel diet may be connected with a greater ability to the fish to utilize feed stuff containing higher level of starch than that with high level of simple sugars and lower level of starch. CHE s carbohydrate fraction analysis revealed it to contain lower percentage of simple sugars. Hence, lower CHE utilization by *C. gariepinus* as evidenced in the results. However, values for protein efficiency ratio of diets B-D were found to be similar to the control. Thus, confirming the report of Falaye (1999) that apparent net protein utilization was not significantly affected ($p>0.05$) by the 100 g kg^{-1} cocoa husk feed treatment fed to Oreochromis nioticus fingerlings. Values for other growth parameters were best on diet A. Table 4 revealed the increment in the body protein of all the fishes. Values of crude protein and crude fat increased gradually across table, although values obtained for treatment A were slightly higher. This could be due to highest feed intake, which occurred in A. Although CHE is fairly low in carbohydrate content, its gross energy level (4.76 g $100g^{-1}$ KcalME) is closely similar to CHE whose Kcal g^{-1} ME is higher than that of plantain peel meal. This accounted for its better performance than the plantain peel meal. There was no significant difference ($p<0.05$) between FCR for Diets A and D (20%) and these values were better than those of Diets B, C and E. Mean weight gain and feed acceptability increases until diet D, beyond which there was a fall in the trend. This observation could be attributed to slight bitter taste of the dried endocarp whose increasing inclusion led to reduced acceptability of Diet E.

According to, the report of Falaye (1998), the usefulness of unconventional feedstuffs in fish diets depends on certain factors such as palatability, energy level, composition, digestibility and availability of nutrients. It was concluded that bitter taste of CHE is one of the major factor which limits its utilization by fish. It is strongly opined that if a sweetener is used to shield the bitter taste, better feed intake can result into higher growth rate of fish. This study revealed that inclusion of cocoa husk endocarp beyond 20% in the diet of *C. gariepinus* resulted into lower feed utilization and decreased growth rate.

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