FSN-NU 0003

EFFECT OF REPLACING MAIZE WITH COCOA POD HUSK IN THE NUTRITION OF *Oreochromis Niloticus*

¹ASHADE, O.O AND ²O.M. OSINEYE

¹Dept. of Biological Sciences, Yaba College of Technology, Lagos.

²Dept. of Fisheries Technology, Federal College of Fisheries and Marine Technology, Lagos.

Copyright 2010, Fisheries Society of Nigeria.

This paper was prepared for presentation at the 25th Annual International Conference and Exhibition in Administrative Staff College of Nigeria (ASCON), Topo-Badagry, Lagos, Nigeria, 25th – 29th October, 2010.

This paper was selected for presentation by an FISON Program Committee following review of information contained in an abstract submitted by the author(s). Contents of the paper, as presented, have not been reviewed by the Fisheries Society of Nigeria and are subject to correction by the author(s). The material, as presented, does not necessarily reflect any position of the Fisheries Society of Nigeria, its officers, or members. Papers presented at FISON meetings are subject to publication review by Editorial Committees of the Fisheries Society of Nigeria. Electronic reproduction, distribution, or storage of any part of this paper for commercial purposes without the written consent of the Fisheries Society of Nigeria is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgement of where and by whom the paper was presented. Write Librarian, Fisheries Society of Nigeria (FISON), P. O. Box 2607 Apapa, Lagos.

ABSTRACT

The study was carried out to evaluate the potential of cocoa pod husk CPH as a replacement for maize in the diet of Oreochromis niloticus (tilapia). Triplicated groups of 20 fish per plastic tank (replicate) with average weight of 0.9±0.2g per fish were randomly allocated into 5 groups in a completely randomized design in an 8-week, trial. The treatment included the control diet (Diet E) having maize as the only major energy source and diet A in which maize was completely replaced with cocoa pod Husk, also Diets B, C, D contained different proportions of maize and cocoa pod husk which ranged from 10-30 in percentage. Result revealed that 100% maize substitution with CPH had no significant effect on survival, weight gain and feed conversion ratio at reduced cost. The study suggests that CPH could suitably substitute up to 100% maize in the diet of Oreochromis niloticus with an irresistible increase in profit margin.

Keyword- Maize, Replacement, Cocoa Pod Husk, Nutrition, *Oreochromis Niloticus*.

INTRODUCTION

The rapid increase in the world population with unmatched food production has resulted in shortage of food supply, most especially protein rich food like fish, and vegetables consumed by man and processed into feed for feeding farm animals and cultured fish. The problem facing fish culturists around the world is that of finding cheap and nutrient rich ingredients for the reduction in the cost of fish production, thus bringing down the cost of fish and making it affordable to the common man (Bayne, *et al* 1976). There is a high demand for fish, higher than its supply, which has resulted in high cost of fish and its products, preventing a large proportion of human population, especially in the developing countries from having access to fish, (Ibe, 2000). Presently, in Nigeria and other developing countries, despite the recent relatively rapid expansion in the live stock industry, protein consumption is 75% below the FAO requirement (Ibe, 2000). This is due to the fact quantities produced are inadequate, a situation which is principally due to high cost of feeds and feed-stuff] including the highly expensive fish meal], which together represent about 70% of the total cost of production (Ogunfowora, 1984).

The establishment of economically viable fish culture ventures requires the utilization of agro-industrial waste or by-product, such as cassava peels, rice bran, cocoa pod husk (Osei *et al*, 1991), Kolanut husk (Osineye *et al* 2008), mango kernels (Teguia, 1995), Shrimp Waste and Fish Waste (Osineye *et al*, 2008) cocoa bean

cake (Odunsi *et al*,1999) and yam peel (Fagbenro, 1988) as feed ingredient (Olubamiwa *et al*, 2000). These have proven to be valuable in replacing certain proportion of maize in monogastric nutrition. Considerable quantities of the crop residues and agro industrial wastes suitable for use as feed components are lost or underutilized. *Oreochromis niloticus* is one of the most important tilapia species farmed in aquaculture in Africa and especially Nigeria. The need to intensify the culture of fish to meet the ever increasing demand for fish has made it essential to develop suitable diets either in supplementary forms for ponds or as complete feed in tanks and raceways.

For the purpose of nutritional and economic benefits previous researchers have made attempt in recent times to increase the use of non-conventional plant and animal materials to replace conventional feed ingredients like maize and fish meal in livestock and fish feed ration. The possibilities of designing practical fish diets with the use of plant feed stuffs have been reported. The development of the fish feed processing will encourage the profitable use of some plant and animal products, which are presently discarded as wastes.

This study therefore focused on evaluating the effect of replacing maize with increasing levels of cocoa pod husk meal on the growth and performance of *Oreochromis niloticus*

MATERIALS AND METHODS

Sample Collection

Cocoa pod husk was collected from Igunshin, Ondo west local government, Ondo state and transported to Yaba College of Technology, Yaba, Lagos. The cocoa pod husk contains the ground and also un ground particles. The fingerlings of *Oreochromis niloticus* was obtained from a private farm in Lagos.

Experimental Diets

There were five treatment groups, represented by 5 Isocaloric and Isonitrogenous diets, containing graded levels of cocoa pod husk, as depicted in Table 1, having 3 replicates each. The fingerlings were randomly allotted to each of the 5 diets in a completely randomly design.

Others feeds ingredients were purchased from Oko Oba feed mills Agege Lagos. The ingredients were thoroughly ground, to become powdery and then made into 0.2mm pellets. The pellets were sun dried for a day and stored in a dry and airy room to prevent fungal growth.

TABLE 1: COMPOSITION OF EXPERIMENTAL DIETS

	DIET A (%)	DIET B (%)	DIET C (%)	DIET D (%)	DIET E (%)
Fish Meal (%)	57.00	57.00	57.00	57.00	57.00
Cocoa-pod Husk (%)	40.00	30.00	20.00	10.00	-
Maize (%)	-	10.00	20.00	30.00	40.00
Premix (%)	2.50	2.50	2.50	2.50	2.50
Salt (%)	0.50	0.50	0.50	0.50	0.50
	100.0	100.0	100.0	100.0	100.0

Experimental Procedure

Oreochromis niloticus fingerlings were procured from Agboola's fish farm, Lagos and transported to Yaba College of Technology Yaba Lagos. The fingerlings were acclimatization for 48hours. The feeding trials were conducted in 15 circular tanks of 35 liter capacity. Dichlorinated water supply was from environmental biology laboratory. Stale water was drained out of the tanks everyday to prevent fouling. Twenty (20) fingerlings per tank (replicate) of average weight of 1g were used. The fingerlings were fed ad-lib 3 times daily i.e. 7am, 1pm and 7pm for eight (8) weeks. Fish were weighed weekly and feed adjusted accordingly. Faecal samples were collected in the forth week by siphoning. Unconsumed feed was also siphoned. The samples were bulked for each replicate, sun-dried and kept in freezer for digestibility studies. Mortality was monitored weekly and recorded.

Chemical Analysis

Dry matter (DM) of the samples was determined by drying in an oven at 65°C to constant weight, ground through a 1mm screen and used for chemical analysis. Nitrogen concentration was analyzed by the kjeldahl method, crude protein content

was calculated (Nx6.25) ash was the residue after ashing the samples in a muffle furnace at 550-600°C, ether extract and crude fibre were measured all determined as described by A.O.A.C (1990). Digestibility values were determined using Acid insoluble Ash, (AIA) method as described by Halver et al. (1993).

$$\% \text{ AIA} = \frac{\text{Weight of Ash} - \text{weight of AIA}}{\text{Weight of Ash}} \times 100$$

Digestibility Coefficient

$$\frac{(\% \text{ AIA in feed}) (\% \text{ nutrient in faeces})}{X}$$

$$\frac{(\text{AIA in faeces}) (\% \text{ nutrient in feed})}{X}$$

Gross energy values of samples were determined using a Gallenkamp Oxygen Ballistic Bomb Calorimeter with thermo-chemical grade benzoic acid as a standard.

Weight Gain, Dry Matter Intake, Feed Conversion Ratio, Degree of Mortality and Digestibility Co-Efficient were Determined.

Cost evaluation of experimental diets was based on the current prices of the

ingredients in the market. Cost of transporting the cocoa pod husk from Igunshin, Ondo West. Local Government Area, Ondo State to Yaba College of Technology (the site of experiment) was recorded.

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) Statistical Analysis System (SAS) 1999.

RESULTS

TABLE 2: DETERMINED PROXIMATE COMPOSITION (g/100g DM) AND GROSS ENERGY (kcal/g) OF DIETS

	DIET A	DIET B	DIET C	DIET D	DIET E
g/100gDM	(%)	(%)	(%)	(%)	(%)
Crude Protein	43.60	43.74	44.06	44.31	44.44
Crude Fibre	9.37	7.34	5.27	3.44	1.41
Ether Extracts	3.01	3.32	3.62	3.94	4.26
Ash	4.10	3.50	2.90	2.00	1.20
Dry Matter	98.61	98.46	98.12	97.91	97.68
Energy (kcal/gDM)	2,630.00	2,691.40	2,716.80	2,779.20	2,901.60

TABLE 3.0: GROWTH RESPONSE & NUTRIENT UTILIZATION OF EXPERIMENTAL FISH

	Treatment					SEM
	A	B	C	D	E	
Initial weight (g)	1.90	2.00	2.20	1.80	2.10	0.15
Final weight (g)	3.69 ^a	3.56 ^a	3.57 ^a	2.95 ^c	3.37 ^b	0.23
Mean weight gain (g)	1.79 ^a	1.56 ^b	1.37 ^c	1.15 ^d	1.27 ^c	0.27
Feed Cost per kg (N:K)	72.40	80.10	91.40	109.00k	120.00k	
Feacal output (g/fish/day)	0.020 ^a	0.015 ^c	0.019 ^a	0.017 ^b	0.018 ^b	0.002
No of mortality	7	6	-	9	1	3.84
Dry matter intake	0.12	0.11	0.15	0.13	0.14	0.001
Survival rate %	86.7 ^c	90 ^b	100 ^a	85 ^c	93.3 ^b	4.12
Experimental period	56	56	56	56	56	-
Feed conversion ratio	0.06 ^b	0.07 ^b	0.1 ^a	0.1 ^a	0.1 ^a	0.22
No of fish	60	60	60	60	60	-

a,b,c.....Means with different superscripts on the same horizontal are significantly different (P<0.05).

TABLE 4: WEEKLY WEIGHT GAIN (G)

Week	Treatments					SEM
	A	B	C	D	E	
1	0.31 ^a	0.20 ^b	0.18 ^b	0.10 ^c	0.12 ^c	0.004
2	0.22 ^a	0.20 ^b	0.17 ^c	0.18 ^c	0.20 ^b	0.001
3	0.20 ^b	0.29 ^a	0.17 ^c	0.18 ^c	0.13 ^d	0.002
4	0.23 ^a	0.24 ^a	0.18 ^b	0.11 ^c	0.19 ^b	0.003
5	0.17 ^a	0.18 ^a	0.19 ^a	0.11 ^b	0.12 ^b	0.002
6	0.25 ^a	0.19 ^b	0.15 ^c	0.17 ^b	0.17 ^b	0.002
7	0.17 ^b	0.15 ^c	0.19 ^a	0.16 ^c	0.16 ^c	0.001
8	0.23 ^a	0.13 ^c	0.18 ^b	0.18 ^b	0.18 ^b	0.003

a,b,c.....Means with different superscripts on the same horizontal are significantly different (P<0.05).

Table 5: DIGESTIBLE RESULTS

Parameters	Treatments					SEM
	A	B	C	D	E	
NFE in faeces (%)	31.66 ^c	32.10 ^d	34.15 ^c	35.82 ^b	36.70 ^a	1.32
NFE in feed (%)	39.92	39.75	39.53	39.31	39.69	0.21
AIA Value for faeces (%)	90.01 ^a	89.15 ^a	89.14 ^b	87.20 ^c	86.70 ^d	1.01
AIA Value for feed (%)	87.01 ^a	86.91 ^a	86.16 ^b	85.35 ^c	84.00 ^d	0.32
Digestibility Co-efficient (%)	76.9 ^e	78.0 ^d	83.1 ^c	89.1 ^b	90.0 ^a	5.10

a,b,c.....Means with different superscripts on the same horizontal are significantly different (P<0.05).

DISCUSSION

Table 2 depicts the densities of the various nutrients present in the Isonitrogenous and isocaloric diets, containing $44.0 \pm 0.4\%$ crude protein and $2,750 \pm$ kcal/g, gross energy. These values are higher than the recommended values (Oguntuga, 1975; NRC, 1984). The crude fibre contents (with the exception of diets A & B), Other extract and ash contents are within the recommended limits (NRC, 1984); Mean Voluntary DM1value (g/day) of the fish varied from 0.11 to 0.15. Treatment effects were not significant. All the fish groups consumed between 5.0 to 7.0% of their body weights which is greater than 3.0% (NRC, 1982) and 3.0 to 5.3% (perera, et al, 1996) as the minimum recommended for maintenance and growth respectively.

Mean weight gain (g/day) of the fish groups varied from 1.15 to 1.79. treatment effects were significant ($p < 0.05$). fish group on cocoa pod husk as sole energy source (treatment) recorded the highest weight gain, a result comparable to that obtained with poultry (Sobamiwa and Longe, 1994b) although, this same treatment group recorded the highest fecal output and this is attributable to high crude fibre content, which was not digestible by the fish.

The relatively lower (NRC, 1982) metabolizable energy required by fish for maintenance and growth (reflected on Table 5), which recorded high NFE levels in faeces, explains why the effect of high energy density in maize was not apparent when compared to that of cocoa pod husk in the fish performance.

The relatively lower gross energy of diet A, was adequate enough to meet the requirements of the group, resulting in effective feed utilization, as reflected in the values recorded for mean feed conversion ratio, which significantly ($p < 0.05$) varied between treatments A and E, with insignificant gradation between these two extremes. Treatment A (on only cocoa pod husk) recorded the lowest feed conversion ratio.

Digestibility Values (%) varied from 76.9 to 90.0 (table 5), treatment effects were significant ($p < 0.05$) i.e. digestibility of rations decreased with increasing quantities of cocoa pod husk, but despite this the performances of all the treatment groups were comparable with treatment a (on cocoa pod husk based ration) recording the lowest cost (table 3).

RECOMMENDATION

The result of this study on CPH as a feed stuff (major energy store) in fish diets as

presented in table 3.0 revealed that up to 100% maize substitution with CPH has no significant on feed intake, average daily weight gain, feed conversion ratio and survival. Cocoa-pod husk is a by-product during cocoa production constituting an environmental nuisance and costing the government so much money to render it physically, chemically biologically harmless. Harnessing this by-product and utilizing it in the formulating and compounding of livestock (especially fish) feed, will not only eradicate its environmental disturbance in the cocoa producing areas, but will remove the rivalry for maize between man and animals thus bringing about a great reduction in the cost producing of fish and other livestock. From the result the comparable feed intake of diets A and other diets (B, C, D, E) suggests an equally comparable palatability of the treatments both of which constitute large proportion of there respective diet, though, CPH has higher crude fibre which is responsible for higher faecal output in Treatment A than other treatment. The close similarity of these parameters on the five diet indicates that they were equivalent in biological efficiency. The combination of similar feed conversion ratio and gram weight gain of test diet in comparison with the control is a comparison development. It indicates the biology and economic suitability of the use of CPH in complete replacement for maize in the diet of *Oreochromis niloticus*.

REFERENCES

- Adebowale B. A., and Olubamiwa O., (2008): Growth Response of *Clarias Geriepinus* Juvenile to Cocoa Husk Endocarp Based Diets. *Agricultural Journal* 3 (5): 425- 428.
- AOAC, (1990). Official methods of analysis 15th edition. Association of Official Analytical Chemists. Washington D. C.
- Bayne, D. R. Dunseth, D. and Ramirolos, C. G. (1976). Alimento Supplemartario Contaviendo Ruipa De Care para La Crianza De Tilapia en cento America. *Aquaculture* 7, 133-146.
- Fagbenro, A. B. (1988). Result of Preliminary Studies on the Utilization of Cocoa Pod husk in fish production in South West Nigeria. *Biowaste*, 25 No. 233/7.
- Fagbenro, O. A. (1996). Apparent digestibility of Crude Protein and Gross Energy in Some Plant and Animal Based Feeds stuffs by *Clarias Isheriensis* in Appl. Lchthy 12. (1999), Pp 67-68.
- Falaye, A. E, (1988). Utilization of Cocoa husk in the Nutrition of Tilapia (*oreochromis niloticus*). PhD Thesis, University of Ibadan, Nigeria.
- Halver, J. E, Yiman, A. Smith, R. R. (1993): Acid insoluble Ash as a convenient method for Estimating Digestible Components in Diet Abstract of Contribution Presented at the int. conf. *World Aquaculture*, fresh water, Fish Posters Pp 230.
- Ibe, S. N. (2002). Proceedings of 27th Annual Conference of Nigerian Society of Animal Production, Zaria, Nigeria Macdonald, P., Edward, R. A. and GREEN-Halgh, J. F. D(1991):*Animal Nutrition* 4th Edition McGraw Hill Book Company New York.
- Odunsi, A. A., Sobamiwa, O. and Longe, O. G. (1999). Comparative of Utilization of alkali treated and untreated cocoa bean cake in diets of egg-type chickens. *Trop. I. Anim. Sci.* 2 (1) 63-68.
- Ogunfowora, O. (1984). Paper Presented Feedmill Management Workshop. Dept. of Econoimics, University of Ibadan, Nigeria. April 10-May 2, 1984.

- Oluwabaimiwa, O. Iyayi, E. A. and Ayodele, E. A. (2000) Kola-pod Husk as a partial substitute for maize in layers mash. *Trop. J. Anim. Sci.* 3(1): 63-68.
- Omage, J. J. Sekoni, A. A. Bawa, G. S. and Esuga, P. M. (2007). Evaluation of Enzyme (Maxiggain) Treatment of Graded Levels of Palm Kenel Meal(PMK) on the performance of Broiler chickens: *Journal of Agriculture, Forestry and the Social Sciences (JOAFSS)*, Vol. 5, No 1.
- Osei, S. A., Atuahene, C. C. Heathook, D.,m Frimpong, E. B. and Adomako, D. (1990). Cocoa-Pod husk meal as a feed ingredient in Layer Diets. *Animal feed Science and Technology*, 40:267-273.
- Osineye, O. M., Ashade, O. O., Oshisanya, K. I. Adegbile, O. M. and Ariyo A. A. (2008). Kola-Pod husk as a total substitute for maize in the Diet of Tilapia. *Nigerian Journal of Fisheries* Vol. 5(2) 123-129.
- Osineye, O. Akinfemi, A., Musa, B. O. and Apata E. S. (2008) Comparative Digestibilities of Treated Shrimp waste, shrimp waste, fish waste and Fishmeal (Control) as Protein Sources in the Nutrition of *Clarias Geriepinus*. *LASPOTECH journal of Technology* Press Vol. 2, No 1.
- Oyin Olukunle (2006) Nutritive Potential of Sweet Potato Peel Meal and Root Replacement Value for Maize in Diets of African Catfish (*Clarias geriepinus*) Advanced fry. *Journal of Food Technology* 4(4): 289 -293.
- SAS (1999). Statistical Analysis System. SAS Institute, Gray. N.C.
- Teguia A and Beynen A. C. (2004). Nutritional aspect of broiler production in small farms in Cameroon. *Livestock Research for Rural Development*, 16(1) 2004 [http://www.cipau.org.co/irrd\(6\)1/tegu161.htm](http://www.cipau.org.co/irrd(6)1/tegu161.htm).
- Teguia A., Awah-Ndukum J. and Peune C. (2002a). The effects of replacing maize with dried leaves of *Desmodium ssp* on the growth performance of broiler chickens. *Bulletin of Animal Health and Production in African* 50: 106-114.
- Teguia A., Endeley HNL and Beynen A.C. (2004). Broiler Performance upon dietary substitution of cocoa husks for mazing. *International journal of poultry Science* 3 (12): 779-782.
- Teguia A., Tchoumboue J., Mayaka B.T. and Tankou C. M. (1993). The growth of broiler chickens as affected by the replacement of graded levels of maze by sweet potato leaves (*ipomoea batatas*) or Ndole (*Nemonial spp*) in the finisher diet. *Animal feed science and Technology*, 56:155-158.
- Sobamiwa, O. and O.G. Longe (1994b). Utilization of cocoa pod pericap fractions in broiler chick diets. *Animal Feed Science Technology* 47: 237- 244.
- Oguntunga, D.B.A. (1975). Chemical Composition and potential commercial uses of cola nitidavent (Schott and Endlicher). *Ghana J. Agric. Sci.* 8: 131.
- National Research Council (1984). Nutrient requirement of poultry. National Academy Press, Washington, D.C.
- NRC (1982). United States – Canadian Tables of Feed Consumption: 3rd Ed. National Research Council – National Academy of Sciences, Washington, D.C.
- Herrera, M., Rodero, E., Gutierrez, M.J., Pena, F., and J.M. Rodero (1996). Application of multifactorial discriminant analysis in the morph structural differentiation of Andalusian Caprihe breeds. *Small Ruminant Research* 22; 39- 47.
- Pauzenga, U. (1985). Feeding Parent Stock. *Zootecnical International*, December 1985. pp. 22- 24.