The Effects of Substituting Soyabean Meal for Breadfruit Meal on Diet Acceptability, Growth Response and Cost of Diets Fed to *Heterobranchus bidorsalis* (♂) X *Clarias gariepinus* (♀) Hybrid

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Abstract

The effects of substituting soyabean meal for breadfruit (*Tricuria africana*) meal in diets fed to *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus (♀)* hybrid fingerlings on diet acceptability, growth responses and cost benefit of fed catfishes were studied. The acceptability of breadfruit based diets by *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus (♀)* hybrid fingerlings was studied using the "time to strike and acceptability index" and their growth responses studied using "weight gain and specific growth rate". The cost benefit arising from feeding Breadfruit meal based diets to 1000 *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus (♀)* hybrid fingerlings for nine weeks was estimated. The results indicated that substituting soyabean meal for breadfruit meal in diets fed to *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus (♀)* fingerlings slightly decreased the time to strike dietary pellets. Diets containing 0 % breadfruit meal (diet A – control) were not easily stroked by fed catfishes when compared to the diets containing 100 % breadfruit meal (diet G). Furthermore, increased substitutions of soyabean meal for breadfruit meal in diets fed to catfishes slightly improved the acceptability of diets; the best acceptable diet being diets C, E and G, there was statistically no significant difference in the acceptability of the control diets and diets having breadfruit meal. Increasing substitutions of soyabean meal for breadfruit meal in diets fed to *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus (♀)* hybrid fingerlings led to weight increases in all dietary types with exception of diet G and higher growth induction in catfishes fed all diets with exception of diet B. Diets C had induced better mean growth than the control and other experimental diets, although statistically, there was no significant difference between the control diets and diets having breadfruit meal. Increased incorporation of breadfruit meal in diets fed to catfish hybrid fingerlings led to slight increased in the cost of diets. The cost benefit analysis revealed that catfishes fed diet C had comparatively better cost of diet per unit weight gain. The benefits derived by incorporation of Breadfruit meal in diets fed to *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus (♀)* hybrid are discussed.

Key words: *Heterobranchus bidorsalis, Clarias gariepinus,* African catfish hybrid, breadfruit meal, acceptability, growth responses, cost

Introduction

First class animal protein such as meat, egg and milk are expensive and often beyond the reach of many. Fish is among the cheapest source of animal protein in Africa. Apart from being relatively cheaper than meat, fish contains quality amino acids such as lysine, methionine, and tryptophan and is also richer in vitamins and minerals (Benitez, 1989). For this reason most countries in the tropics have turned their attention to the development and exploitation of their fisheries resources as a means of providing their citizens with the much needed animal protein.

The quantitative importance of fishing is reflected by the increase in world fish catch between 1961 and 1997 from about 19 to 93 million tones per year (Laureti, 1999). The extension of national jurisdiction particularly the 230 km exclusive economic zone (EEZ) by most coastal countries (Laureti, 1999) coupled with general discussion on fishing rights and laws of the sea indicates that the fish has become scarce.

To satisfy this steadily demand for fish, one option which until recently has not been given much attention is aquaculture. Aquaculture in Nigeria is a relatively new development. Currently, most endeavours in this field are government sponsored with only very few individual concern. The species of fish culture includes *Tilapia*, *Chrysichthys, Heterotis, Clarias,* and *Heterobranchus* among others.

In recent years because of the need of energy for growth and reproduction of fish, aquaculture researches have focused on the development of cheap, balance and nutritionally sound fish diets preferably from agro-waste.

In compounding fish diets, fishmeal has traditionally been used as the primary source of protein. However, because of the rising cost of fishmeal, current researches focused on the use of alternative cheaper source of protein without altering the growth and reproductive potentials of the cultured fish. In rainbow trout diets, soyabean has been substitute for fishmeal with encouraging results (Cho *et al.* 1981) In the above study, soyabean was a good replacer of fish meal because of its reasonable cost, high protein and abundant supply. In many developing countries located in the tropics, with special reference to Nigeria, the demand for soyabean is in excess of it's supply because of its use by humans (infant formula), confectionary and livestock industries (Eyo, 1999). Breadfruit (*Tricuria africana*) is readily available in Nigeria, but yet unexploited vis-à-vis development of aqua-feed for the fisheries sector. The aim of this research is to find out the suitability of breadfruit for fish diet with a view of using it as a substitute for soyabean meal in diet for *Heterobranchus bidorsalis* x *Clarias gariepinus* hybrid commonly called - *Heteroclarias*. The hybrid catfish used for the studies was produced by crossbreeding *H. bidorsalis* (♂) with *C. gariepinus* (♀) species. According to Madu *et al.* (1999), hybridization was essential because *Heterobranchus bidosalis* do not have the same high survival rate as *Clarias gariepinus* and *Clarias gariepinus* do not grow as large and as quickly as *Heterobranchus bidosalis*. Thus the blending of high survival rate and fast growth rate into the hybrid "*Heteroclarias*" may offer higher production prospects. Nutritionally, "*Heteroclarias*" is a voracious omnivore, feeding on a wide range of food, from live animal prey through aquatic plants to plankton organisms (Madu *et al.* 1999).

Material and Method

Catfish: Two hundred and ten (210) two weeks old *Heterobranchus bidorsalis* (♂) X *Clarias gariepinus* (♀) hybrid fingerling (average weight 0.85 ± 0.09 grams) produced by Aquafish, Nigeria Limited, Awka, Anambra State, were transported to the Fisheries and Hydrobiology Research Unit wet Laboratory, within the Zoological Garden, University of Nigeria, Nsukka. The catfish fingerlings were divided into ten plastic flow-through fish culture tanks containing twenty litres of water each and acclimatized for two weeks. The acclimatized catfish were then divided into twenty one flow-through (30 litres) plastic fish culture tanks comprising seven treatment groups replicated thrice. Each replicate had eight catfishes. The catfishes were allowed to stabilize for seven days in their new environment. During the acclimatization period the catfishes were fed 5 % of their body weight with 40.402 % crude protein diet twice daily in divided rations (Table 1). The water temperature during the experimental period ranged from 28.7 – 33.3 °C. The water pH and alkalinity were between 7.1 – 7.3, and 101.12 – 111. 64 mg/l, respectively. The walls and the bottom of the culture tanks were thoroughly washed weekly to reduce the risk of infection and check fungal and algal growth. All culture tanks were aerated using Whisper 800 aquarium pump (Mcmlxxvi Willinger Bros Inc. Japan) and covered with plastic mosquito net held in place by rubber band to prevent the catfishes from jumping out.

Dietary ingredients: The dietary ingredients were purchased from Ogige Market, Nsukka and individually processed thus:

a. Crayfish meal (CFM): One kilogram of dried crayfish was finely grounded into powder.

b. Corn meal (CM): Dried corn (dent yellow) (2.6 Kg) was finely ground into flour.

c. Soya bean meal (SBM): Four kilograms of soyabean were soaked overnight and autoclaved at temperature of about 110^0 C for twenty (20) minutes. The autoclaved soyabean was sun-dried for six (6) days and the dried soyabean was finally ground into powder.

d. Blood meal (BM): Twenty litres of fresh cow blood weighing 4 kg was purchased from the Nsukka abattoir, pickled with 10 grams of NaCl and pressure cooked to firmness for about thirty (30) minutes at 100^{0}C. The solidified blood was cut into tiny bits and sun dried. The dried blood was finely ground into powder.

e. Breadfruit meal (BFM): Undehulled Breadfruit (*Treculia africana*) seeds (2.7 kg) were washed and destoned by hand picking. The undehulled seeds were then soaked in water and latter boiled at 100^0 C for 25 minutes. Dehulling of seeds was achieved using Bentall plate mill preset to a clearance of about 2 mm. The dehulled grains were sorted out by hand picking and sun dried (Reichert and Young, 1976). The dried seeds were finely ground into fine powder.

All processed dietary ingredients were sieved through 0.05 µm mesh sieve and individually stored in a dry air tired plastic container. Other dietary additives included; vitamins and mineral premix (Vitalyte), and hemicellulose binding agent. Proximate analysis to ascertain the levels of crude protein, carbohydrate, fat and ash were done for all dietary ingredients (AOAC, 1975).

Diets: The diet ingredients were weighed out as presented in Table 1. 1000 grams of the diet

Table 1: Composition (g) of dietary ingredients per kilogram, proximate analysis and cost of experimental diets

Ingredients	A 0 %	B 10 %	C 20 %	D 30 %	E 40 %	F 50 %	G 100 %
Fishmeal	200	200	200	200	200	200	200
Blood meal	30	30	30	30	30	30	30
Soyabean	457	411.3	365.6	319.9	274.2	228.5	0
Corn meal	283	283	283	283	283	283	283
Vitamins[1]	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Mineral Premix[2]	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Hemicellulose	17	17	17	17	17	17	17
Bread fruit meal	0	45.7	91.4	137.1	182.8	228.5	457
Total (g)	1000	1000	1000	1000	1000	1000	1000
Cost (₦)	147.98	150.78	153.57	156.36	159.15	161.95	175.91
Percentage nutrient composition per kilogram diet							
Crude protein	40.402	38.756	36.93	35.464	33.818	32.171	23.941
Carbohydrate	24.382	25.622	26.863	28.103	29.344	30.584	36.785
Fat	15.033	14.193	13.353	12.513	11.673	10.833	6.633
Ash	9.219	9.34	9.461	9.582	9.703	9.825	10.43
Moisture	4.786	4.74	4.694	4.648	4.602	4.555	4.325
Fiber	2.221	2.127	2.033	1.94	1.846	1.752	1.284

1 Vitamin premix provided the following ingredient per gram of diet. Vitamin a, 4 IU: Vitamin D3, 2 IU; Niacin, 0.088 mg; d-panthotenic acid, 0.035 mg; Vitamin B12, 0.0009 mg; vitamin E, 0.055 IU; Riboflavin, 0.013mg; Choline chloride, 0.55 mg; Manadione sodium bisulfate complex. 0.01mg; Pyridoxine hydrochloride, 0.01mg; Thiamine mononitrate, 0.01 mg; Folic acid, 2.03 mg; Antioxidant, 0.138 mg; Ascorbic acid 0.176 mg.

2 Mineral premix provided the following trace elements per gr [illegible] 0.087 mg; I 0.001 mg; Cu 0.004 mg; Zn 0666 mg; Fe 0.033 mg; Co 30.00007 mg.

ingredients were homogeneously mixed with 2.5 litres water to produce dough. The mixed feed (dough) was transferred into heat resistance polythene bag, sealed tightly and properly labeled. The bagged and sealed doughs were then pressure cooked for 30 minutes at 110°C. The heat treatment aided in binding of the diet through gelatinization of starch and activation of the dietary nutrients (Eyo, 1997). The different diet dough was then run through a bicycle pump without value and the resulting nodular shaped strands (0.3 mm) were to cut in tiny bits and oven dried separately. The resulting diets were stored separately in labeled dry air tired plastic container. All prepared diets were proximately analyzed (AOAC 1975). Diet A, the control diet had no breadfruit meal. Diet B had 10 % breadfruit meal (BFM); Diet C had 20 % BFM; Diet D had 30 % BFM; Diet E had 40 % BFM; Diet F had 50 % BFM; and G 100 % BFM. In all the test diets, soyabean meal was substituted with breadfruit meal.

Acceptability: Acceptability was assessed using the "time to strike index" (Eyo, 1997). Fifteen catfishes starved overnight to induce hunger were left in a glass aquarium containing 15 litres of water. One pellet of each diet type was dropped into the aquarium. The time that elapsed from the moment the pellet penetrates through the water surface to the moment the last fish struck the pellet with its mouth was recorded in seconds. The above experiment was replicated thrice for each dietary type. The 'acceptability index' was calculated as the reciprocal of 'time to strike'.

owth: For the growth performance studies a domized Latin square design of seven treatment replicate thrice was employed. Each treatment was fed specific diet. Treatment A was fed diet A, B fed diet B ... and G fed diet G. Weekly record of weights for all treatment was used in adjusting the feeding levels and calculating the growth rate, using the formula: SGR = $W_1 - W_o / t \times 100$ (Rictcher, 1975), where W_1 = final weight, W_o = initial weight, t = time in days.

Cost: The cost benefit analysis of feeding 1000 catfishes with diets supplemented with bread fruit meal was estimated utilizing adjusted feeding levels as influenced by weight gain and specific growth rate. All the costing was done in Naira (Nigerian official currency) using Nsukka Urban market price and converted into US dollar based on Nigeria Apex market exchange rate of one US Dollar equivalent to one hundred and fifteen Naira (1$ Ξ ₦130: 00).

Analysis: Means and standard deviations from the different treatments were calculated. One way ANOVA and F- LSD were employed to test treatment means. Differences were consider to be significant when $P < 0.05$.

Results

Acceptability: The mean time to strike each of the dietary pellets indicated that it took the catfish 12.33 ± 3.77 seconds to strike the diet containing 100 % breadfruit (Diet G) and 31.67 ± 8.41 seconds to strike the diet containing 0 % breadfruit (Diet A - control).

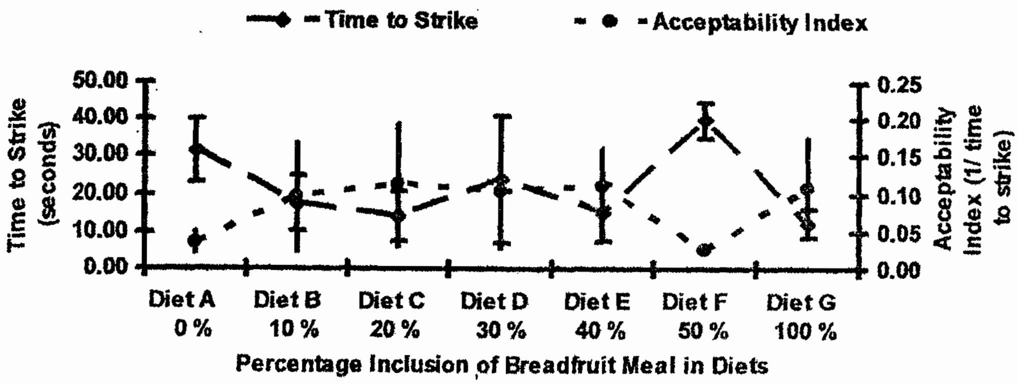

Figure 1: The acceptability of breadfruit meal base diets fed to Heterobranchus bidorsalis (male) x Clarias gariepinus (female) hybrid fingerlings

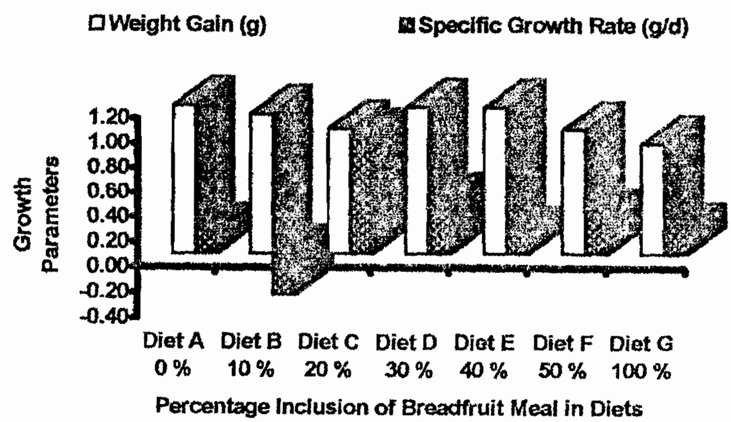

Figure 2: Mean weight gains and specific growth rates of Heterobranchus bidorsalis (male) x Clarias gariepinus (female) hybrid fingerlings fed diets having varied proportions of soyabean meal replaced with breadfruit meal for nine weeks.

There were observed inconsistency in the time to strike pellets from diet B - 17.67± 7.22 seconds. Diet C -14.00 ± 6.66 seconds, diet D -24.00 ± 17.01 seconds, diet E -15.00 ± 7.64 seconds and diet F - 40.00 ± 5.00 seconds (Fig. 1). The analysis of variance indicated that the time it took the catfishes to strike the test diets were statistically not significantly different from the time it took them to strike the control diet (P<0.05). Similarly, the acceptability index indicated that diets G, C and E (0.11 ± 0.07, 0.11 ± 0.08 and 0.11 ± 0.05 respectively) were easily accepted when compared to the control diet (0.04 ± 0.01). Other acceptability indexes were: diets B and D (0.10 ± 0.07) and diet F (0.03 ± 0.00). All test diets acceptability index were statistically not significantly different from the control diet (P>0.05).

Growth Response: The effects of increasing substitution soyabean meal for the breadfruit meal in diets fed to of *H. bidosalis* (♂) X C. *gariepinus* (♀) hybrid fingerlings on weekly mean weight gain indicated weight differentials corresponding to the nutrients in the diets (Fig. 2). Numerically diet A (1.19 ± 0.06 g) had better mean weight gain when compared to other treatments at the termination of the ninth week culture period. Other observable weights gains were: diet D (1.18 ± 0.13 g), diet E (1.18 ± 0.10g), diet B (1.12 ± 0.09 g), diet C (1.01 ± 0.11 g), diet F (1.00 ± 0.08 g) and diet G (0.89 ± 0.04 g). All treatment means were statistically significantly different from the control with the exception of treatment means diets D and E respectively (P = 0.05).

The specific growth rate of *H. biodorsalis X C. gariepinus* hybrid fingerlings fed diets with breadfruit meal substituted for soyabean meal

(Fig. 2), indicated that the catfishes fed 20 % breadfruit meal based diet (diet C, 0.94 ± 1.17 g/d) had higher specific growth rate when numerically compared with the catfishes fed 0 % breadfruit meal based diet (diet A – control, 0.17 ± 1.25 g/d) and other breadfruit meal based diets. Specific growth rates of catfishes as influenced by the substitution of breadfruit meal for soyabean meal in their diets were: 30 % breadfruit meal based diet (diet D, 0.43 ± 2.65 g/d), 50 % breadfruit meal based diet (diet F, 0.30 ± 1.31 g/d), 100 % breadfruit meal based diet (diet G, 0.19 ± 0.45 g/d), 40 % breadfruit meal based diet (diet E, 0.16 ± 1.88 g/d) and 10 % breadfruit meal based diet (diet B, -0.33 ± 2.08 g/d). All treatments means for specific growth rates of catfishes fed breadfruit meal based diets were statistically not significantly different from the control (P > 0.05).

Cost analysis: The cost analysis of feeding 1000 *H. bidorsalis* X *C. gariepinus* hybrid fingerlings with breadfruit based meal diet indicated cost differential corresponding with levels of breadfruit meal inclusion (Table 1). The highest diet cost occurred in diet G, 100 % breadfruit based meal diet (₦175.91 per kilogram of diet). Other cost differentials per kilogram of diet were; diet F, 50 % breadfruit based meal diet (₦161.95 / kg); diet E, 40 % breadfruit based meal diet (₦ 159.15 / kg); diet D, 30 % breadfruit based meal diet (₦ 156.36 / kg); diet C, 20 % breadfruit based meal diet (₦ 153.57 / kg); diet B, 10 % breadfruit based meal diet (₦ 150.78 / kg) and diet A, 0 % breadfruit based meal diet (₦ 147.98 / kg). All dietary costs differentials were not significantly different (P > 0.05). The comparative cost analysis of feeding 1000 *C. gariepinus* fingerlings at 5 % body weight with breadfruit based meal diet (Table 2) indicated that diet C produced better cost per unit weight gain (₦ 0.104) than diet B (₦ 0.047), diets F (₦ 0.03 / g), A (₦ 0.03 /g), G (₦ 0.025 / g), E (₦ 0.019 /g), and B (₦ -0.04 / g). All costs differentials per unit weight gain were not significantly different (P > 0.05).

Discussion

The interaction of the factors affecting internal motivation or drive for feeding on specific diets range from intrinsic factors related to physiology, genetic and morphology to extrinsic ecology factors involving the living conditions especially food and feeding habits of the fish (Lagler *et al*, 1977).

Specific features such as size, age, sex, season and site of collection as well as species of fish, are of primary importance in determining the nutritional status and diet acceptability in catfish fed specific dietary types (Eyo, 1997). All these factors were taken care of since the catfishes were hatchery raised hybrids, reared in the same pond and fed the same diets until they were collected for laboratory studies.

According to Hardy (1989), over 18,000 fish dietary ingredients have been identified throughout the world. For some practical reasons however, some of these ingredients cannot be used for fish diet formulation. Many of the more popular feed ingredients are over-stressed, therefore on-going aquaculture nutrition research aims at evaluating the growth potentials of some less-stressed or new dietary ingredients to fish. For instance, Eyo (1999) successfully replaced 10 % of soyabean in catfish diet with hydrolyzed poultry feather meal, and Cho *et al.* (1981) substituted fish meal with soyabean meal in diets fed to rainbow trout with encouraging results. The utilization of breadfruit meal in diets fed to *Heterobranchus bidorsalis* (♂) X *Clarias gariepinus* (♀) hybrid is in line with the works of Cho *et al.* (1981) and Eyo (1999) among others.

Statistical analysis showed that the mean weight increases and specific growth rates for the different incorporation levels were significantly different except for diets with 10 % breadfruit inclusion (Diet B). The un-encouraging performance of 10 % breadfruit based diet may be attributed to imbalances between the digestible energy, protein, nutrients in the diet and the acceptability of the diet. The best performance was observed in diet having 20 % of breadfruit seed meal substituted for soyabean (Diet C). The utilization of breadfruit meal (with comparably higher energy and low protein profiles than soybean) by *Heterobranchus bidorsalis* (♂) x *Clarias gariepinus* (♀) hybrid ascertains the fact that breadfruit may have comparable digestible energy with soyabean. This explains the present result where the catfishes fed diets A, C – G had comparable growth potentials and insignificantly different cost per unit weight gain. To create an optimum diet, the ratio of protein to energy must be determined separately for each fish species. Excess energy relative to protein content of the diet may result in high lipid deposition, because fish feed to meet their energy requirements. The incorporation of breadfruit meal lowered both the protein and lipid profiles, and increases carbohydrate and nutrient profiles of the experimental diets (Table 1). Diets with excessive energy levels may result in decreased food intake and reduced weight gain. Similarly, a diet with inadequate energy content can result in reduced weight gain because the fish cannot eat enough food to satisfy their energy requirements for

Table 2: Cost of feeding 1000 *H. bidorsalis* X *C. gariepinus* hybrid fingerlings with breadfruit based meal diets for 9 weeks

	Weeks	0	3	6	9	Total
Diet A - 0 % BFM (control)	Catfish Weight (g)	1000 x 1.17	1000 x 0.92	1000 x 1.66	1000 x 1.37	1000 x 5.12
	Diet Required (g)	1228.50	966.00	1743.00	1438.50	5376.00
	Cost of Diet (₦)	181.79	142.95	257.93	212.87	795.54
	Growth Response (weight gain) (g)	-	-0.25	0.74	-0.29	0.20
	Diet Cost per Unit Weight Gain (₦)	-	-0.04	0.11	-0.043	0.03 ($ 0.00023)
Diet B - 10 % BFM	Catfish Weight (g)	1000 x 1.15	1000 x 1.11	1000 x 1.88	1000 x 0.92	1000 x 5.06
	Diet Required (g)	1207.50	1165.50	1974.00	966.00	5313.00
	Cost of Diet (₦)	182.07	175.73	297.64	145.65	801.09
	Growth Response (weight gain) (g)	-	-0.04	0.77	-0.96	-0.23
	Diet Cost per Unit Weight Gain (₦)	-	-0.006	0.12	-0.145	-0.04 $ (0.00027)
Diet C - 20 % BFM	Catfish Weight (g)	1000 x 0.64	1000 x 0.67	1000 x 1.33	1000 x 1.32	1000 x 3.96
	Diet Required (g)	672.00	703.50	1396.50	1386.00	4158.00
	Cost of Diet (₦)	103.20	108.04	214.46	212.85	638.54
	Growth Response (weight gain) (g)	-	0.03	0.66	-0.01	0.68
	Diet Cost per Unit Weight Gain (₦)	-	0.005	0.101	-0.002	0.104 ($ 0.0008)
Diet D - 30 % BFM	Catfish Weight (g)	1000 x 0.58	1000 x 1.31	1000 x 2.26	1000 x 0.88	1000 x 5.03
	Diet Required (g)	609	1375.50	2373.00	924.00	5281.50
	Cost of Diet (₦)	95.22	215.07	371.04	144.48	825.82
	Growth Response (weight gain) (g)	-	0.73	0.95	-1.38	0.30
	Diet Cost per Unit Weight Gain (₦)	-	0.114	0.148	-0.216	0.047 ($ 0.00036)
Diet E - 40 % BFM	Catfish Weight (g)	1000 x 0.75	1000 x 1.32	1000 x 1.88	1000 x 0.87	1000 x 4.82
	Diet Required (g)	787.50	1386.00	1974.00	913.50	5061.00
	Cost of Diet (₦)	125.33	220.58	314.16	145.38	805.46
	Growth Response (weight gain) (g)	-	0.57	0.56	-1.01	0.12
	Diet Cost per Unit Weight Gain (₦)	-	0.091	0.089	-0.161	0.019 ($ 0.00014)
Diet F - 50 % BFM	Catfish Weight (g)	1000 x 0.80	1000 x 0.70	1000 x 1.57	1000 x 1.01	1000 x 4.08
	Diet Required (g)	840.00	735.00	1648.50	1060.50	4284.00
	Cost of Diet (₦)	136.04	119.03	226.97	171.75	693.79
	Growth Response (weight gain) (g)	-	-0.10	0.87	-0.56	0.21
	Diet Cost per Unit Weight Gain (₦)	-	-0.02	0.14	-0.09	0.03 ($ 0:00026)
Diet G - 100 % BFM	Catfish Weight (g)	1000 x 0.90	1000 x 0.75	1000 x 1.05	1000 x 1.04	1000 x 3.74
	Diet Required (g)	945.00	787.50	1102.50	1092.00	3927.00
	Cost of Diet (₦)	166.23	138.53	193.94	192.09	690.80
	Growth Response (weight gain) (g)	-	-0.15	0.30	-0.01	0.14
	Diet Cost per Unit Weight Gain (₦)	-	-0.03	0.05	-0.002	0.025 ($ 0.00019)

₦ Nigerian Official Currency, $ US Dollar

growth. Properly formulated and prepared feed must have a well-balanced energy to protein profile (Craig and Helfrich, 2002). However, even if the carbohydrate profile is digestible, fish only appear to be able to utilize a small amount of carbohydrate effectively (Cho and Kaushik, 1990). The increased carbohydrate profile due to incorporation of breadfruit meal, which correlates comparably with good growth potentials points to the fact that the increased in carbohydrate profile and decreased in protein profiles were within the range of energy - protein balance for catfishes. Finally, the substitution of the soyabean meal with breadfruit meal, an environmental friendly technology offers much prospects vis-à-vis (i) the conversion of breadfruit into fish protein, (ii) partial replacement of soyabean meal with breadfruit meal in catfish diets, (iii) negligible increased in fish production cost, (iv) marginal increased net benefit and (v) prospects for aqua-forestry integration systems, with fish ponds established within breadfruit plantations. The ecological and economic benefits, and associated problems vis-à-vis aquaculture cum plantation ecosystem are far beyond the scope of this study.

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