Growth Performance of *Clarias Gariepinus* Fingerlings Fed Graded Level Inclusion of Fermented Locust Bean (*Parkia Biglobosa*) Meal

Abdullahi Orire Muhammad, and Rasheedat Muhammed

Abstract—The study investigated the growth performance of Clarias gariepinus fingerlings fed five isonitrogenus diets containing 50% crude protein at varying inclusion levels of fermented locust bean meal as replacement for fishmeal. The feeding trial was carried out on Clarias gariepinus fingerlings mean weight (1.01±0.00). Before the commencement of the experiment fishes were acclimatized in plastic tank for one week. Five isonitrogenous diets containing 50% crude protein at varying replacement level of fish meal (FM) and fermented locust bean meal (FLBM) as designated (diet 1 - 0% FLBM/100% fishmeal), Diet 2 (25% FLBM/75% fishmeal), Diet 3 (50% FLBM/50% fishmeal), Diet 4 (75% FLBM/25% fishmeal), Diet 5 (100% FLBM/0% fishmeal). The results obtained indicated significant differences ($p<0.05$) for the growth parameters calculated. Diet 1 (100% FM/0% FLBM) gave the best growth parameters in terms of FCR, SGR and PER, which was closely followed by diet 5 (100% FLBM/0% FM); which were significantly different ($P<0.05$) to other diets. In this study, it can be deduced that, fermented locust bean meal can replace fish meal up to 100% in the diet of Clarias gariepinus fingerlings without any adverse effect however, limited growth exhibited can be attributed to complete absence of fishmeal in the diet.

Keywords—Fishmeal, Farmented, Locust bean meal, Clarias gariepinus.

I. Introduction

AQUACULTURE has been the fastest growing food sector over the past 20 years with an average annually growth rate of 37% [1], [2]. Globally, Aquaculture production increased from 10.2 million metric tons (mm) as at 1984 to 54.4mmt in 2010. Aquaculture now represents approximately 37% of total fisheries production worldwide [3], [4]. Depending on the species, farmers are sensitive to rising fish meal price [1], [5], [6].

Attainment of sustainable fish production at the minimum possible cost in the shortest possible time [7] has been difficult in the developing nations because of the dependency on imported feed which are very expensive [8]. Protein is the most important nutrient for growth and the most expensive part of fish feed. The importance of fishmeal in providing easily digested protein of high biological value is well documented. In the past, this has served as a justification for promoting fisheries and aquaculture activities in several countries. Fish protein improved nutrition because it has a high biological value in terms of high protein retention in the human body [9]. In the search for plant protein and vitamin substitutes, the African locust bean was found very popular use especially in the fermented dawadawa form which is the product of the seeds which serves an ingredient in the preparation of various stews, soups and sauces for the consumption of cereal and also proteinous to fish [10].

Tropical agricultural residues based on their nutrients content. High fibre level and some toxic substances, feeds high in fibre and high in protein content, these include distillers and brewer, grain and several oil seed meals, feeds high in fibre and low in nitrogen. Inlcuding variable amount of anti-nutritional factors such as polyphenols, tannins and caffeine [11].

The tree *Parkia biglobosa* can also be called (in English) monkey cutlass tree [12], arbore a faring, two ball nitta-tree, African locust bean, fern leaf; (in Mandinka) Netto, Nété. Nér, (in Swahili) mnienzemkunde; (trade name) dadawa, dawa-dawa, soumbara. Because of the savoury taste and high protein and fat values of the seed, it is sometimes described as a meat or cheese substitute [13], [14], but is not usually eaten in large amounts. Dawa-dawa is rich in protein, lipids and vitamin B_2. but deficient in the amino acid such as methionine, cystine and tryptophan, moreover, fermented beans are rich in lysine [15].

Parkia biglobosa occurs in a diversity of agro-ecological zones, ranging from tropical forest with high and well-distributed rainfall to arid zones where means annual rainfall may be less than 400mm. it has a capacity to withstand drought conditions because of its deep taproot system and an ability to restrict transportation. The tree is native to Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Cote d'Ivoire, Democratic Republic of Congo, Gambia, Ghana, Guinea-Bissau, Mali, Niger, Nigeria, Sao Tome et Principe, Senegal, Sierra Leone, Sudan, Togo and Uganda [12], [16], [17].

The plant has variety of uses mucilage from part of fruits is made into a fluid and used for hardening earth Floors and to give a black glaze in pottery; gum exudates is

Abdullahi Orire Muhammad, and Rasheedat Muhammed are with Department of Water Resources, Aquculture and Fisheries Technology, Federal University of Technology, Minna-Nigeria. (abdul.orire@futminna.edu.ng)).

proteinaceous and contains as the constituent sugars galactose, glucuronic and 4-0-methyglucuronic acid [18].

Agricultural by –products and unconventional feed stuffs can be used as alternative to the very expensive conventional feed stuff in fish feed [10]. Thus, the justification for this research to investigate into the use of fermented locust bean meal as replacement for fishmeal in the diets of *Clarias gariepinus* fingerlings.

II. Material And Method

A. Experimental Procedures

The experiment was carried out at the Water Resources, Aquaculture and Fisheries Technology, Minna, Nigeria 's departmental farm located in Bosso Campus of Federal University of Technology, Minna. *Clarias gariepinus* fingerlings with an average weight of 1.01±0.00g were purchased and transported from T.J. Farm Ilorin, Kwara State-Nigeria to the departmental farm where they were acclimatized in plastic tank for one week. The feedstuffs for the experiment comprises maize, locust beans, fishmeal, vitamin mineral premix and vegetable oil which were procured from Minna Market in Niger state, Nigeria. The feed ingredients comprised of maize, locust beans and fishmeal were milled separately and proximate analyses including the crude protein, lipid, ash, fibre and moisture content were carried out on them according to [19]. The locust beans were fermented according to the method of [20] by first cooked the seeds for 24 hours at 100°C with additional water frequently to soften the seed coats. The cooked beans seed coats were then removed by pounding in a mortar and washed severally to remove seed coats. The seeds were then slowly boiled again for 3 hours at 30°C until they become softer. The de-coated seeds were then fermented by spreading them in a basket and covered with leaves for 72 hours at 32°C. After then, the seeds were spread to dry under the sun for several hours. The anti-nutritional factor tannin was carried out on both raw and cooked locust beans according to the method of [21] using the Folin-Denis spectrophotometric method. Readings were taken with the reagent blank at zero. The tannin content was given as follows:

$$\% \text{ Tannin} = An / As \times C \times 100/w \times Vf/Va$$

Where: An = absorbance of test sample; As = absorbance of standard solution; C = concentration of standard solution; W = weight of sample used; Vf = total volume of extract; Va = volume of extract analyzed.

The values obtained for fermented and unfarmented locust beans for Tannin analysis is in Table I below;

TABLE I
ANTI-NUTRITIONAL FACTOR MEASURED

Locust bean	Tannin values
Fermented	1.46
Unfermented	2.46

The diets were formulated using the Pearson's square method of feed formulation. And five isonitrogenous diets containing 50% crude protein at varying replacement level of fish meal and locust bean meal were formulated thus diet 1 [0% fermented locust beans (FLB)/100% fishmeal], diet 2 (25% FLB, 75% fishmeal), diet 3 (50% FLB, 50% fishmeal), diet 4 (75% FLB, 25% fishmeal), diet 5 (100% FLB/0% fishmeal) as presented in Table II with their proximate compositions. The feedstuffs were mixed thoroughly with estimated quantity of water (100g v/w of 1kg diet) to form consistent dough for each diet. The dough was then fed into a meat grinder machine for pelleting. The pelleted diets were oven dried at 60°C for 24 hours and then kept in a refrigerator at -4°C.

TABLE II
FORMULATED DIETS AND THEIR PROXIMATE COMPOSITIONS

	Diets				
Feedstuffs (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Fishmeal	68.85	26.52	19.89	13.26	0.00
Locust bean meal (Fermented)	0	13.26	19.89	26.56	91.97
Maize meal	26.18	55.00	55.00	55.00	3.03
Vegetable oil	2.00	2.00	2.00	2.00	2.00
Vitamin-mineral premix	3.00	3.00	3.00	3.00	3.00
	100.03	99.78	99.78	99.82	100.00
Proximate compositions					
Crude protein	49.00	49.25	49.28	49.00	50.75
Crude lipid	16.00	13.25	12.00	17.12	18.08
Crude fibre	5.00	5.60	5.70	6.65	5.40
Ash	12.43	10.46	14.80	18.12	5.10
Moisture	10.12	9.36	9.31	9.11	9.86

20 Fishes were randomly stocked in triplicate in total of 15tanks with dimension of 30 x 60 x 30cm filled with 20 liters of borehole freshwater. The fish were fed the test diets at 3% body weight per day the amount of which was readjusted fortnightly. Water exchange were done on a daily bases by first siphoning off faeces and uneaten feed whose values were recorded for biological analysis. The water quality parameters were taking on a weekly bases for temperature using clinical thermometer, dissolved oxygen according to the method of wrinkle's [22], [23], hydrogen ion concentration (pH) were measured using a EIL 7045/46 pH meter in the Laboratory at room temperature while conductivity were monitored using conductivity meter (Table III)

TABLE III
WATER QUALITY PARAMETERS FOR THE FEEDING TRIAL

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Temperature (°C)	21.20	21.03	21.13	21.13	21.03
pH	6.80	6.71	6.06	6.79	6.79
Dissolved oxygen (mg/ml)	1.17	1.17	1.23	1.19	1.17
Conductivity (µm/g)	2.25	2.21	2.26	2.26	2.04

III. Experimental Analyses And Growth Parameters

Final values for each group represent the arithmetic mean of the triplicates. Feed intake was monitored to measure average feed intake and their effects on growth. The growth and nutrient utilization parameters measured include weight gain, specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), and Apparent Digestibility Co-efficient (%). The growth parameters were computed according to the methods of [24], [25]:

Mean weight gain = Mean final weigh – mean initial weight

Specific Growth Rate (SGR)= $\frac{\text{Log}_e W_2 - \text{Log}_e W_1}{T_2 - T_1}$ X 100

Where, W_2 and W_1 represent – final and initial weight, T_2 and T_1 represent – final and initial time [26].

Feed conversion ratio – Feed fed on dry matter/fish live weight gain

Protein efficiency ratio (PER) =Mean weight gain per gram of crude protein fed [27].

Protein intake (g) = Feed intake x crude protein of feed.

The Apparent Digestibility Coefficient (ADC %) was also evaluated using the formula of [24], [28]

$$(ADC) = 100 - \frac{100 \times \%AIA \text{ (Acid Insoluble Ash) of diets} \times \%\text{Nutrient in Faecal}}{\%AIA \text{ of faecal} \times \%\text{Nutrient in diets}}$$

while Acid insoluble Ash as internal indicator [29] which was carried out according to the method of [30],

$$\%\text{Acid insoluble Ash (AIA)} = \frac{\text{Wt. of AIA}}{\text{Wt of sample taken}} \times \frac{100}{1}$$

IV. Statistical Analysis

The experimental design was a one-way anova and the data were analyses using statistical package Minitab Release 14 at 5% significant level. The mean were separated using Turkey's method [31], [32] while graph was drawn using the Microsoft excel window 2007.

V. Results

From the results shown in Table IV there were significant differences (P<0.05) in the growth parameters among the diets fed *Clarias gariepinus* fingerling. Diet 1 with 0% fermented locust bean meal (FLBM) and diet 5 with 100% FLBM recorded highest mean weight gain (MWG) of 1.76g and 1.36g respectively. However, diets 2, 3 and 4 gave low mean weight gain (1.15, 1.19 and 1.08 respectively) with no significant differences (P>0.05) among them.

The feed conversion ratio (FCR) of diets 2, 3, and 5 showed no significant difference (p>0.05) while diets 1 and 4 were significantly different from each other (p<0.05) as well as other diets. Diet 1 with 0% FLBM exhibited the highest FCR of 1.15 followed by diets 2 and 3 which show no significant difference (p>0.05). Diets 4 and 5 had the lowest FCR of 1.09 and 1.10 which were significantly different from each other (p<0.05). The specific growth rate (SGR) of diets 2, 3 and 5 showed no significant difference (p>0.05) among each other, while diets 1 and 4 varied significantly from each other (p<0.05) as well as other diets. Diet 1 with 0% FLBM recorded the highest SGR of 1.71 followed by diets 5, 3, and 2 with SGR of 1.53, 1.40 and 1.35 respectively which differed insignificantly (p<0.05) from each other while diet 4 recorded lowest SGR of 1.30. On the protein efficiency ratio (PER) diets 2, 3, 4, and 5 showed no significant differences (P>0.05) in their PER values but diet 1 showed significant differences (P<0.05) from other diets. Diets 4 and 5 with 75% FLBM, 25% fish meal and 100% FLBM, 0% fishmeal recorded highest PER value of 0.91 and 0.91 followed by diets 2 and 3 (75% fish meal, 25% FLBM; 0% fish meal/100% FLBM respectively with 0.90 and 0.90 with no significant differences (P>0.05) among them, while diet 1 which contained 0% FLBM /100% fish meal had lowest PER of 0.87. There was record of mortality for all the diets with significant difference (p<0.05) among them. The growth response curve in figure 1 demonstrated the growth pattern of the diets which indicated good utilization of fermented locust bean meal at various inclusion levels.

Table V showed the body composition of the initial and final carcass. There were significant difference from the final body composition among the diets (p<0.05). Diet 2 with 75% fish meal and 25% FLBM recorded highest crude protein (CP) of 59.35 with a significant difference from other diets (p<0.05). However, diets 1, 3, 4 and 5 indicated no significant (P>0.05) among diets.

The crude lipid of diets 3 and 4 showed no significant difference (P>0.05) while diets 1, 2 and 5 were significantly different from each other (P<0.05). Diet 1 with 100% fish meal has the highest lipid value of 26.85 followed by diets 3, 4 and 2 respectively while diet 5 recorded lowest values of 20.68. The ash content of diets 2, 3, 4 and 5 showed no significant difference from each other while diet 1 showed a significant difference from other diet (P<0.05). Diet 2 recorded the highest ash content with 11.60 which differed significantly from other diets (P<0.05). While diet 1, recorded the lowest ash value of 9.80 respectively. The moisture content of diets 2 and 5 showed no significant difference (P>0.05) while diet 3 were significantly different from each other (P<0.05). Diet 4 with 75% fish meal has the highest dry matter value of 97.42 followed by diets 2 and 3 while diet 1 and 5 recorded lowest values of 95.60. The fibre content of diets 1, 3, 4 and 5 showed no significant difference (p>0.05) while diet 2 were significantly from each other (p<0.05). Diet 2 with 75% fish meal has the highest crude fibre value of 9.70 followed by diets 5, 3 and 1 respectively, while diet 1 recorded lowest values of 8.60 respectively.

Table VI showed the apparent digestibility coefficient of the nutrient fed to the fish. It showed significant differences (P<0.05) in the digestibility of the nutrients in the diets. Diet 5 recorded the highest digestibility of crude protein differing significantly (P<0.05) from diets 1, 2 and 3 which bore no significant difference (P>0.05) from each other however Diet 4 recorded the lowest digestibility of crude protein. Diet 5 recorded the best digestibility of lipid differing significantly from diet 2, both diets 1, 3 and 4 recorded the least digestibility of lipid. However, they differed insignificantly from each other (P>0.05). In the digestibility of crude fibre diets 1 and 2 differed significantly from each other (P<0.05) followed by 1, 5, 3 and 4 respectively. In the digestibility of ash, diet 2 recorded the highest value of 32.60 which differed significantly (P<0.05 followed by diets 5, 1, 4 and 3 respectively. However diet 3 recorded the lowest value of 1.30 which differed significantly from other diets. Finally diets 3 and 4 recorded the highest digestibility of dry matter which differed significantly from each other (P<0.05), followed by diet 2 which differed significantly (P<0.05) from diets 1 and 5 respectively.

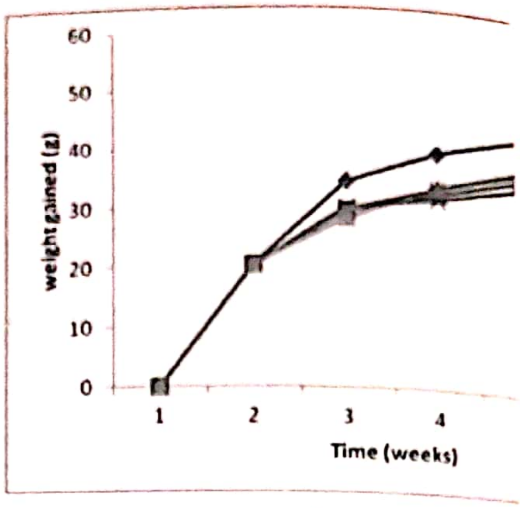

Fig 1: Growth response of *Clarias gariepinus* fingerlines fed soybean waste for 8 weeks

TABLE IV

GROWTH PARAMETERS OF CLARIAS GARIEPINUS FINGERLINGS FED FERMENTED LOCUST BEAN MEAL FOR 56 DAYS

Growth Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SD±
Mean Initial Weight Gain (g)	$1.01^{a}±0.00$	$1.01^{a}±0.00$	$1.01^{a}±0.00$	$1.01^{a}±0.00$	$1.01^{a}±0.00$	0.00
Mean Final Weight Gain (g)	$2.77^{a}±1.10$	$2.16^{c}±0.32$	$2.20^{c}±0.04$	$2.10^{d}±0.20$	$2.37^{b}±0.70$	0.48
Mean weight gain (g)	$1.76^{a}±1.10$	$1.15^{b}±0.32$	$1.19^{b}±0.04$	$1.08^{b}±0.20$	$1.36^{b}±0.70$	0.48
Feed Conversion Ratio	$1.15^{a}±0.03$	$1.11^{b}±0.76$	$1.11^{b}±0.76$	$1.09^{c}±0.03$	$1.10^{b}±0.15$	0.08
Specific Growth Rate (SGR %)	$1.17^{a}±0.70$	$1.35^{b}±0.25$	$1.35^{b}±0.25$	$1.30^{c}±0.17$	$1.53^{b}±0.06$	0.31
Protein Efficiency Ratio (PER)	$0.87^{b}±0.03$	$0.90^{a}±0.06$	$0.90^{a}±0.04$	$0.91^{a}±0.14$	$0.91^{a}±0.14$	0.70
% Mortality	$1.00^{c}±0.29$	$5.00^{b}±8.70$	$6.00^{b}±7.04$	$8.00^{a}±2.90$	$8.00^{a}±14.43$	7.00

Mean data on the same raw carrying different superscripts differ significantly from each other (p<0.05).

TABLE V

BODY COMPOSITION OF CLARIAS GARIEPINUS FINGERLINGS FED GRADED LEVELS OF FERMENTED LOCUST BEANS MEAL FOR 56 DAYS

Proximate Compositions (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Initial Body Composition	SD±
Crude Protein (CP)	$54.90^{a}±0.01$	$56.74^{a}±0.01$	$59.35^{a}±0.01$	$58.36^{a}±0.01$	$56.90^{a}±0.01$	$58.52^{a}±0.01$	0.01
Lipid	$23.34^{b}±0.07$	$26.85^{a}±0.01$	$22.42^{b}±0.02$	$24.45^{b}±0.01$	$24.22^{b}±0.01$	$20.63^{d}±0.01$	0.03
Crude Fibre (CF)	$4.68^{b}±0.01$	$8\ .60^{a}±0.01$	$9.70^{a}±0.01$	$8.80^{a}±0.01$	$8.80^{a}±0.02$	$8.90^{a}±0.01$	0.01
Ash	$8.60^{c}±0.01$	$9.80^{b}±0.01$	11.60a±0.01	$10.60^{b}±0.01$	$10.41^{b}±0.01$	$11.11^{a}±0.01$	0.01
Dry matter Content	$96.50^{a}±0.01$	$97.30^{a}±0.01$	$96.80^{a}±0.01$	$97.42^{a}±0.01$	$95.60^{a}±0.01$	$96.44^{a}±0.01$	0.01

Mean data on the same raw carrying different superscripts differ significantly from each other (p<0.05)

TABLE VI

APPARENT DIGESTIBILITY COEFFICIENT (% ADC)

ADC (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SD±
Crude Protein (CP)	$87.50^{b}±0.01$	$86.13^{b}±0.01$	$77.70^{c}±0.01$	$63.52^{d}±0.01$	$93.70^{a}±0.01$	0.01
Lipid	$55.50^{b}±0.01$	$58.26^{b}±0.01$	$36.30^{d}±0.01$	$44.50^{c}±0.01$	$80.70^{a}±0.01$	0.01
Crude Fibre (CF)	$83.80^{a}±0.01$	$80.05^{a}±0.01$	$23.30^{c}±0.01$	$12.61^{d}±0.01$	$34.51^{b}±0.01$	0.01
Ash	$20.50^{b}±0.01$	$32.60^{a}±0.01$	$1.30^{d}±0.01$	$16.44^{c}±0.01$	$23.50^{b}±0.01$	0.01
Dry Matter (DM)	$60.40^{c}±0.01$	$83.70^{b}±0.01$	$96.70^{a}±0.01$	$88.80^{b}±0.01$	40.20d±0.01	0.01

Mean data on the same raw carrying different superscripts differ significantly *from each other (p<0.05).*

VI. Discussion

The mean initial weight (MIW) of the fishes used in the experiment differed insignificantly (p>0.05) from each other. All the five feeds performed well but diet 5 performed better than all other diets. This implies that diets 5 containing 100% locust bean meal as good as the control diet with 100% fish meal. The performance was an indication of positive contribution to growth of the fish. Figure 1 shows the growth curve of the feeds on the fish. Diet 1 peaked faster than other diets, while diet 4 with 75% locust bean meal was the lowest in growth phase. This could be attributed to low digestibility of locust bean meal (Table IV) which could as a result of presence of high fibre content of the diet [33], [34].

The growth curves from week 0-2 represent the slow growth phase while from week 6-8 represent the marginal growth phase. This is in line with natural growth situation, as growth in fish is exponential [35]. The poor values observed for FCR, SGR, PER, and MWG in diets 4 (1.09, 1.30, 1.30 and 1.08 respectively) were indication of inefficient utilization of feed. This implies that as the fishes grow bigger the rate at which the conversion of feed to flesh decreases. This is not good enough especially at fingerlings stage when the fish is still going through the lag phase. The slowdown in growth could be attributed to the fibre level of locust bean meal in the diets as the percentage inclusion level increases. Clarias has been reported to have poor handling of high level of fibre in its diets [36]. However, diet 5 performed best among others despite the fact it could have high fibre content than others. The performance of the diet was reflected in the protein availability as reflected in the difference in the tannin levels in the fermented beans as against high value recorded for its raw counterpart which is in agreement with the work of [34] who stated that carcass composition should reflect the diet fed to fish.

VII. Conclusion

From the experiment 100% fermented locust bean meal inclusion level in the diet of *Clarias gariepinus* was utilized efficiently for its growth. This indicated that, locust bean seed meal if thermo-treated for anti-nutrition factor such tannin as in fermentation could replace fishmeal up to 100% in the fish feed composition. This level of inclusion would be significant replacement for the expensive fishmeal in the feed manufacturing since locust bean meal is an agricultural product with direct no competition with man.

References

[1] Tacon, A.G (2005). State of information on salmon Aquaculture feed and the environment, http: //www.westcoastaquatic.ca/Aquaculture feed and the environment. Pdf.

[2] FAO (Food and Agricultural Organizaion (2005) Globe fish commodity update, fishmeal land fish oil February Rome Italy.

[3] Zaldivar, M.J, (2004): Review of the commercial situation Offa fish meal and fish oil and the new requirement imposed on them paper presented at Technical Aquaculture 2004 (Chile) March 2004 http://www.iffo.org.uk/techAqua.htm

[4] Wray, T. (2001) making the most of Jackmackerel. Seafood International, July, 2001 Pp. 39 – 43.

[5] Anderson, J. L. (2003), International sea food trade. Wood head publishing Ltd. Cambridge England.

[6] Guttormsen A. G (2002) input substitutability in salmon Aquaculture. Marine Resource Economics 17:91 -102.

[7] Eruvbetine, D.M.A Dipeolu and E.B. Oguntona (2002): Comparison of enzyme and antibiotic inclusion in diet for laying hens. Proc. 7th Ann. NSAP. Conference; 17 – 21 March, 2002. Akure Nigeria; P: 101 – 104.

[8] Ogunlande I. (2007)Backyard fish farmersinformation needs in Osun State, Nigeria. AAAE conference proceeding University of Ilorin, Nigeria 165 – 169.

[9] Habib, M.A.B., M.R. Hassan and A.M Akande (1994): Dietary Carbohydrate Utilization by silver barb puntiusgonionotus. In S.S De Silva ed. Asian fish .soc spec. publ. Asian fisheries society, manila, phillippiness. pp: 57-62.

[10] Falaye, A. E (1992): Utilization of Agro – industrial waste as fish feedstuff in Nigeria. Proceeding of the 10th Annual conference of FISONPp 47 – 57.

[11] Mustafa, A.F (2002); Ruminant fermentation and utilization of unconventional feeds in western Canada. Department of Annual science Mac-donald Campus of Mc Gill University ste-Anne – De-Bellevue, Qc Presented at western Nutrition conference in Edmonton, 2002.

[12] Gotz, E. (1983): Timber trees of the Gabia, Hamburg, and StiflingWalderhaltung in Africa & BundeatoRechung Start TurforstundHozwirtschaft.

[13] Bonkoungou, E.G (1986); Etude Monographique du NéréParkiaBiglobosa (Jacq) Benth (Leguminosae,Mimosoidea) Burkinafaso, Institute de RechercheanBiologieetEcologieTropicate, Centre National DelaRecharchesscientifiqueetTechnologique, Ministere de I' enaergneMentsuperieuretDalaRecharcheScientifique (Unpublished Manuscript).

[14] Kercharo, J and Paccioni, J.P (1974): Considerations D' Actualite Sur Univieuxremede Senegal Emphasis on Northern Nigeria (Ed. A. Osuntokun). Davidson Press, University of Ibadan, Nigeria. Pp. 78 – 88.

[15] Campbell P. G (1986) African Locust beans (Parkia Spp.) and its West African Fermented food product. Dawadawa Ecology of Food nutrition Journal of Agriculture: Pp 123-132.

[16] Fagbemi T. (1989), Agro Forestry potential of Parkiabioglobosa (Jacq) in the Savannah Zone of Nigeria Kenya Pp. 20 – 25Falaye, A. E (1992): Utilization of Agro – industrial waste as fish feedstuff in Nigeria. Proceeding of the 10th Annual conference of FISONPp 47 – 57.

[17] Diawara, B; Sawadogo L; Jacobson; M and Awug, W.K (2000) HACCP – system of traditional fermented food (Sombala) capacity building for research and quality assurance and food fermentation technology for Africa fermented foods WAIE to Journal 26:11 – 62.

[18] Hopkins, V.A and White R.T (1983): The Taxonomy Reproductive Biology and Economics Potential of Parkia (LeguminosaeMimosoidae) In Africa and Madagascar. BotanicalJournal of the Linnean Society 84:135 – 167.

[19] AOAC(2000): Official methods of Analysis of AOAC international vol. I Agriculture chemicals; contaminants, Drugs.16thedn, AOAC. int'l., Arling,v.A.

[20] Ann Waters-Bayer (1988) Soybean Daddawa: An innovation by Nigerian women

[21] Pearson, D. (1976). Chemical Analysis of Foods. 7th Edn., Church Hill Livingstone, London, UK., pp; 72-496.

[22] Lind, O.T (1979): Hand book of Common method in limnology. The C.V moby publisher, missori, USA 2nded 199 pp.

[23] Apha, (1980): Standard Method for the Examination of water and waste 18th edition American Public Health Associate, WashinhtonDC,pp: 1288

[24] Maynard, D.N (1979) Locust Beans Characteristics Production and Marketing American society for Horticulture Science (ASHS).Horticulture Crop production series. Alexander, V.A, United State. 227pp

[25] Halver, J.E (1989): formulating practical diet for fish. Journal of Fisheries Research Board, Canada, 33:1032-1039.

[26] Brown, M.E. (1957). Experimental Studies on growth. In: Hoar, W.S and D.J Randell (Eds.) Physiology of Fishes. Academic Press New York. 361-400 pp.

[27] Osborne, T., Mendel, L. and Ferry, E. (1919) A method for expressing numerically the growth promoting value of proteins. Journal of Biochemistry, 37: 223-229.

[28] Bondi, A.A. (1987). Animal Nutrition. John Wiley and Sons, New York. 504pp

[29] Church, D.C and Pond W.G. (1988). Basic Animal Nutrition and Feeding 3rd edition. 572pp.

[30] Cockrel, I., Halliday D., Morgan, D.J. (1987). Studies on the nutrition of marine florfishe utilization of various dietary proteins by plaice. (Pleuronectes platessa). British Journal of Nutrition 31, 297-306.
[31] Steel, R.G.D and Torrie, J.H (1980): Principle and procedure of statistic McGraw-Hill New York. NY, 481pp
[32] Duncan, D.B and Binder, A.E (1995): Multiple ranges and multiple F-Test Biometrics 11:1-42pp
[33] Orire, A.M. and Abubakar, S (2013).Graded Level Inclusion of Melon Shell in The Diet of hybrid Catfish (Heteroclarias) as Energy Source. Continental Journal of Fisheries and Aquatic Science 7 (1) 8-17.
[34] Cruz, E./M. (1975). Determination of Nutrient digestibility in various classes of natural and purified feed materials for channel catfish; phD dissertation Aubom UniversityAuburn Alabama.
[35] Nwanna, L.C; Falaye, A.E; Olarewaju1, O.J & Oludapo, B.V (2009): Evaluation of NILE TILAPIA (Oreochromis niloticu) fed dietary potato peels as replacement for yellow maize. FISON Conference proceedings of where: 156-159
[36] Jauncey, K (1998): Science aquaculture M.Sc. lecture note on fish Nutrition Institute of Aquaculture University of Stirling U.K.