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Growth response of *Clarias gariepinus* fingerlings fed *Parkia biglobosa* diet as protein source

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Abstract

A feeding trial was conducted in the laboratory for 12 weeks to evaluate the growth response of *Clarias gariepinus* fingerlings using *Parkia biglobosa* (Locust bean) as the protein source in place of fish meal. Five experimental diets (40% crude protein) were formulated, four of these diets contained *Parkia biglobosa* (Locust bean) meal at varying levels of 25%, 50%, 75% and 100% while the diet with fish meal served as control. Fish fingerlings were fed weekly at 5% body weight. It was discovered that the percentage weight gain was not significantly different ($p<0.05$) among the controlled diet and the experimental diets; specific growth rates were also not significantly different ($p<0.05$) among the controlled diet, diets A and B but different in diets C and D with diet D (100% of *P. biglobosa*) having the highest value. The highest weight gain was recorded in diet D containing 100% of *P. biglobosa* (18.89 g) while the least at 50% inclusion (10.01 g). The fish protein increased with increasing locust bean substitution. Based on the result of this study we conclude that *C. gariepinus* could tolerate 100% inclusion of locust bean meal in the diet in place of fishmeal.

Keywords: Growth response, nutrient utilization, *Clarias gariepinus, Parkia biglobosa,* protein.

Introduction

In fish farming, nutrition is critical because fish feed represents 40-50% of the total production costs. Fish nutrition has advanced dramatically in recent years with the development of new balanced commercial diets which promote optimal fish growth and health. The development of new species-specific diet formulations support the aquaculture i.e. fish farming industry as it expands to satisfy increasing demand for affordable, safe and high quality fish and sea food products. Aquaculture is the rational rearing of fish and other aquatic organisms in man-made ponds. As previously reported by Miles and Chapman (2006) one of the areas which the fisheries potential of Nigeria could be exploited is through aquaculture, the development and expansion of which would however depend mainly on many factors. These include the availability of good quality and relatively inexpensive feed ingredients for the formulation of compounded food since supplement feed brings greater yields in ponds than if the fish were left to depend on natural (aquatic) food. Various feeds are used in culturing fishes to enhance adequate fish growth, reproduction and survival (Miles & Chapman, 2006). Fishmeal which serves as the main protein source for fish feed because of its high quality protein content, is not only expensive but also usually unavailable (Tacon & Barg, 1998) particularly in developing countries. Fagbenro and Davies (2003) and Ogunji *et al.* (2003) reported the efforts to replace fishmeal with vegetable protein from more sustainable sources by many workers.

Plants proteins have been extensively studied for use in fish feed formulations for aquaculture (Gatlin *et al.,* 2007); these include various pulses and lupins in carnivorous fishes such as rainbow trout *Oncorhynchus* mykiss (Glencross *et al.*, 2004, 2007). Ordinarily, plants provide nearly two thirds of the world supply of food protein for human and animal in which 10-15% come from legumes. Among the leguminous plants used by man is the African locust bean tree (*Parkia biglobosa)*. Earlier reports of Cook *et al.* (2000) and Lockeett *et al.* (2000) showed that *P. biglobosa* is a plant legume with an outstanding protein quality and its protein and amino acid composition has been reported. The most conventional protein sources used in fish feed such as soya bean, cotton seed, fish meal etc, and are becoming expensive especially to small scale fish farmers in Nigeria. Also, the competing demand for fish feed stuff such as corn, soya bean and groundnut cake has made feed production expensive. This high demand for this feed stuff by man and consequently the high price has made other means such as "*P. biglobosa*" (African locust bean) inevitable.

Since the primary objective of fish nutrition work is geared towards reducing protein cost in fish feed, it is of interest to investigate and utilize the suitable abundant conventional and non-conventional feed resources available in Nigeria for feed formulation. This work is therefore intended to evaluate effects of locust beans in the feed of *Clarias gariepinus* as a protein source.

Materials and methods

Fish feed stuff that are protein based were computed in diet formulation using the popular Pearson square method as applied by Wagner and Stanton (2010) to determine the proper dietary proportion of feed stuff bearing about the protein requirement of the fish. After preparing the ingredients, they were weighed and mixed in appropriate proportions to give the desired protein level required by the fish. Four experimental feeds were formulated at varying percentage inclusion of locust

Table 1. Gross composition of experimental diets.

Ingredient	Control	Diet A 25%	Diet B 50%	Diet C 75%	Diet D 100%
Fish meal	24.72	18.54	12.36	6.18	-
Maize bran	21.85	21.85	21.85	21.85	21.85
Locust bean	-	6.18	12.36	18.54	24.72
Groundnut cake	24.72	24.72	24.72	24.72	24.72
Soya bean cake	24.72	24.72	24.72	24.72	24.72
Oil	1.0	1.0	1.0	1.0	1.0
Bone meal	1.0	1.0	1.0	1.0	1.0
Premix	1.0	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5	0.5
Starch	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100

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bean meal (A-25%, B-50%, C-75% & D-100%) and a control diet having fishmeal solely as the source of protein. Locust bean is a tree crop commonly found in south western, middle belt and the northern parts of Nigeria and mostly used as condiment in soup preparation. There is however no negative economic impact on the use of locust bean in aquaculture in Nigeria. The proximate analyses of the feed stuffs and experimental diets were carried out using the (AOAC, 1990). Gross composition of all diets is shown in Table 1. The experimental tanks used for the research were 20 l capacity plastic tanks filled with water.

Table 2. Proximate composition of experimental diets.

Components (%)	Control diet (0%)	Diet A (25%)	Diet B (50%)	Diet C (75%)	Diet D (100%)
Crude Protein	40.09	39.84	40.02	40.05	40.15
Moisture	10.64	10.73	10.41	10.11	10.46
Fat	4.54	4.37	4.07	4.06	3.98
Crude fibre	9.62	9.77	10.41	9.88	10.06
Ash	10.07	10.59	10.87	11.14	11.03
CHO	25.06	24.71	24.24	24.78	24.33

The fingerlings of *C. gariepinus* were procured at Fedak fish farm in Ekiti State and stocked at the rate of 10 fingerlings per tank using 20 l capacity plastic tanks. The initial mean weights of the fingerlings were control (16.79 g), treatment diet A (15.74 g), diet B (11.58 g), diet C (12.21 g) and diet D (13.89 g). The fingerlings were fed at 5% body weight twice daily at 9 a.m and 5 p.m except on sampling days. Feeding trial lasted for 12 weeks. Weights of specimens were taken weekly with a sensitive weighing balance (Metler P200) to the nearest gram. Water quality parameters measured during feeding trials included temperature determined using a standard laboratory thermometer (Jenway 9071); dissolved oxygen was measured using oxygen meter calibrated in mgl^{-1} (Jenway 9071) and pH determined using a digital pH meter (Teledo 320). Biological evaluations carried out include: Weight gain = final weight-initial weight.

$$\text{Percentage weight gain} = \frac{\text{Initial weight}}{\text{Final weight}} \times 100$$

$$\text{Specific Growth Rate (SGR)} = \frac{\text{Log e}W_2 - \text{Log e}\,W_1 \times 100}{T}$$

Where W_2 is the final weight of the fish; W_1 is the initial weight of fish; T is the period of experiment in days; e is the base of natural logarithm.

Statistical analysis: Data were subjected to analysis of variance (ANOVA) test and the means from the various treatments were compared for significant differences using Duncan's multiple range test (Duncan, 1955).

Results

Table 2 shows the proximate composition of the experimental diets. The crude protein was slightly higher in diet D (40.15%) than the control diet while % fat was higher in the control diet (4.54%) than all the experimental diets. The % moisture were highest in diet A (10.73%) and least in diet C (10.11%). The % crude fibre was highest in diet B (10.41%) and least in control diet (9.62%). The % ash was highest in diet C (11.14%) and least in control diet (10.07%). Carbohydrate was highest in control diet (25.06%) and least in treatment diet B (24.24%). Growth performance of *Clarias gariepinus* (Fingerlings) fed experimental diets as shown in Table 3 revealed that weight gain (W.G), percentage weight gain (% WG) and specific growth rate (SGR) of the fish specimens were not significantly different ($p<0.05$) i.e. the fish showed good appetite in all the treatment diets as attested to by the increased weight and length. However, the highest weight increase was in diet D-100%, (18.89 g) and least in diet B-50%, (10.01 g).

Table 3. Growth evaluation of Clarias gariepinus fingerlings fed experimental diets for 12 weeks.

Parameters	Control diet (0%)	Diet A 25%	Diet B 50%	Diet C 75%	Diet D 100%
Initial mean	16.79± ^{b}	15.74± ^{bc}	11.58± ^{a}	12.21± ^{ab}	13.89± ^{ab}
Weight(g)	1.01	2.40	0.89	1.48	2.08
Final mean	21.55 ± ^{c}	18.73 ± ^{b}	15.18 ± ^{a}	17.10± ^{a}	21.04± ^{c}
weight (g)	7.20	4.98	3.81	5.95	8.21
Weight	16.39 ± ^{a}	11.18 ± ^{ab}	10.01 ± ^{ab}	16.32± ^{a}	18.89± ^{a}
Gain(g)	6.34	6.57	5.02	2.66	12.85
%Weight	51.74 ± ^{a}	57.94 ± ^{a}	56.03 ± ^{a}	44.26 ± ^{a}	46.67± ^{a}
Gain	8.61	9.52	16.48	6.46	18.39
Specific	25.70 ± ^{a}	28.05 ± ^{a}	26.31 ± ^{a}	36.92 ± ^{ab}	35.79 ± ^{ab}
Growth rate	3.23	7.77	2.02	5.34	19.60

Means on the same row with different superscripts are significantly different ($p<0.05$).

Table 4 shows the results of the carcass analysis of *C. gariepinus* (fingerlings) fed experimental diet after 12 week experiment. Control diet has the highest moisture content (10.08%) and least in diet C (6.27%). The highest crude protein was obtained in diet D (67.29%) while control diet has the lowest crude protein (64.47%). The ash content was highest in diet C (14.69%) and least in control diet (11.64%). The highest % fat was in diet A (13.66%) while the least was in diet D (11.94%). Carbohydrate content was least in the control diet with 0.16% and while diet D has the highest percentage of 0.52%. The average dissolved oxygen in the culture water ranged between 8.04-8.23 mgl^{-1}, pH value ranged from 6.7-7.4 and temperature ranged between 24.7-25°C.

Table 4. Carcass composition of flesh of Clarias gariepinus fingerlings fed with experimental diets after the experiment.

Components (%)	Control diet (0%)	Diet A (25%)	Diet B (50%)	Diet C (75%)	Diet D (100%)
Crude protein	64.47	65.29	65.76	65.89	67.29
Moisture	10.08	6.69	6.79	6.27	6.83
Fat	13.66	13.93	13.62	12.69	11.94
Crude fibre	N.D	N.D	N.D	N.D	N.D
Ash	11.64	13.67	13.27	14.69	13.43
CHO	0.16	0.42	0.35	0.46	0.52

N.D: Not Detected

These ranges fall within acceptable limit in aquaculture (Boyd, 1979).

Discussion

This study reveals the possibility of utilizing locust bean in the diet of fish using *Clarias gariepinus* as a case study. From the analysis carried out, proximate composition of the carcass of the fish fed experimental diets

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agrees with the findings of Ugwumba and Abumoye (1998) who obtained the best growth performance, food conversion and survival rate of *C. gariepinus* fingerlings (1-3 g body wt.) when maggot was fed as supplemental food (maggot + artificial feed). The increase in lipid deposits in the carcass of fish fed experimental diet of locust beans may be responsible for the better growth in terms of weight rather than the crude protein. It has also been reported that locust bean is rich in essential amino acids necessary for growth and development. Also present are other amino acids such as arginine and histidine as previously reported by (Hassan & Umar, 2005). Protein requirement is given high priority in any nutritional study because it is the single nutrient that is required in the largest quantity for growth and development and also the most expensive ingredient in diet formulation (Lovell, 1989; NRC, 1993). Dietary lipids function as a ready source of energy for fish and also provide essential fatty acids which are needed for fish growth and survival. Fish generally require omega-3 fatty acids rather than omega-6 fatty acids in contrast to terrestrial animals which require omega-6 fatty acids (Kanazawa, 2000). Previous work of Audu *et al.* (2004) showed the need to use plant meal in combined form to produce the cheapest and required nutrient for fish and this formed the basis of this research work. The replacement of fishmeal by alternate sources of protein has met with varied degree of success, depending on the nature and composition of ingredients, inclusion level and method of processing. This study agrees with the findings of Audu *et al.* (2004) who conducted a study on the effect of substituting fishmeal diets with varying quantities of ensiled parboiled beniseed (*Seasamum indicum*) and raw African locust bean (*Parkia biglobosa*) on the growth responses and food utilization of the Nile Tilapia *Oreochromis niloticus*.

Conclusion and recommendation

Based on the findings of this study, it is inferred that *Parkia biglobosa* is rich in protein and with essential amino acids. It can also be inferred that inclusion of locust bean in the diet of fish will improve growth yield of *Clarias gariepinus.* Though the locust bean meal can be included up to 100%, since the fish showed good appetite for all the treatment diets, the results of this study recommends the inclusion of locust bean is best at 25%. It is also recommended that locust bean seed should be available in large quantity because it is rich in valuable protein. Therefore, the diet of fish can include a combination of locust bean and fish meal as protein sources which will be considerably cheaper than using solely the fishmeal. Despite this finding, there is need for further research in this area.

References

1. Audu, PA, Oniye SJ and Okechukwu PU (2004) Helminth parasites of domesticated pigeons {*Columba livia domestica*} in Zaria. *Nigerian J. Pest, Diseases & Vector Management.* 5,356-360.
2. AOAC (1990) Official methods of analysis.14th edn. Assoc. of Official Analytical Chemists, Washington DC.
3. Bard J, Dekinpe P, Lemmesson J and Lessat P (1976) A handbook of tropical fish culture. Edited by Ministry of Foreign Affairs, France: pp:87-90.
4. Brown ME (1957) Metabolism in fish. In: Physiology of fishes. Hoar WS & Randall DJ (Eds.), NY Acad. Press. pp:104-107.
5. Cook JA, VanderJagt DJ, Pastuszyn A, Mounkaila G, Glew RS, Millson M and Glew RH (2000) Nutrition and chemical composition of 13 wild plant foods of Niger. *J. Food Composition Analysis*. 13, 83-92.
6. Duncan DB (1955) Multiple range and multiple F-test. *Biometrics*.11, 1-42.
7. Fagbenro OA and Davies SJ (2003) Use of high percentage of soy protein concentrate as fishmeal substitute in practical diets for African catfish, *Clarias gariepinus* (Burchell, 1822): Growth, feed utilization and digestibility. *J. Appl. Aqua.* 16 (1)
8. Gatlin DM, Barrows FT, Brown P, Dabrowski K, Gaylord TG, Hardy RW, Herman E, Hu G, Krogdahl A, Nelson R, Overturf K, Rust M, Sealey W, Skonberg D, Souza EJ, Stone D, Wison R and Wurtele E (2007) Expanding the utilization of sustainable plant products in aquafeeds: A review. *Aquacult. Res.* 38, 551-579.
9. Glencross BD, Booth M and Allan GL (2007) A feed is only good as good as its ingredients: A review of ingredient evaluation strategies for aquaculture feed. *Aquacult. Nutr.* 13, 17-34.
10. Glencross BD, Evans D, Hawkins W and Jones B (2004) Evaluation of dietary inclusion of yellow lupin *Lupinus luteus* kernel meal on the growth, feed utilization and tissue histology of rainbow trout *Oncorhynchus mykiss. Aquaculture.* 235, 411-422.
11. Hassan LG and Umar KJ (2005) Protein and amino acid composition of African locust bean *Parkia biglobosa. Trop. Subtrop. Agroecosys.* 5(1), 45-50.
12. Kanazawa A (2000) Essential fatty acids and lipid requirements of fish. In nutrition and feeding in fish, Academic press London. pp:70-87.
13. Lockeett CT, Calvert CC and Grivetti LE (2000) Energy and micronutrient composition of dietary and medicinal wild plants consumed during drought. Study of rural Fulani, North eastern Nigeria. *Int. J. Food Sci. Nutr.* 51,195-208.
14. Lovell T (1989) Nutrition and feeding of fish. Van Nostrand Reinhold, NY, U.S.A. pp:240.
15. Miles RD and Chapman FA (2006) Benefits of fish meal in aquaculture diets. IFAS Extension, University of Florida.
16. NRC (1993) Nutrition requirement of fish, Committee on Animal Nutrition, Board on Agriculture. National Research Council. National Academy Press, Washington, D.C.
17. Ogunji JO, Wirth M and Osuigwe DI (2003) Nutrient composition of some tropical legumes capable of substituting fishmeal in fish diets. *J. Agric. Rural Dev. Trop. Subtrop.* 104,143-148.
18. Tacon AGJ and Barg UC (1998) Major challenges to feed development for marine and anadromous finfish and crustacean species, In S.de Silver (ed) Tropical mariculture. Acad. press, San Diego, Carlifonia. pp:171-204.
19. Ugwumba AAA and Abumoye OO (1998) Growth response of *Clarias gariepinus* fingerlings fed live maggots from poultry droppings. In: Sustainable utilization of aquatic/wetlands resources. Nigerian Assoc. for Aquatic Sciences, selected papers from 9th/10th Annual Conf. Otubusin *et al* (Eds,). pp:60-66.
20. Wagner J and Stanton TL (2010) Formulating rations with Pearson's square. Colorado State University, US Dept. of Agri. Bull. No.1, pp:618.