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Research Article

Evaluation of Clupeids and Danish fish meal based diets on the growth of African catfish, *Clarias gariepinus* fingerlings

Lenient MO Ibiyo[1]*, Rowland MO Kayode[2], A Oresegun[3], Oluwaseyi Mogaji[1] and Felicia O Joshua[1]

[1]National Institute for Freshwater Fisheries Research (NIFFR), P.M.B. 6006, New Bussa, Niger State, Nigeria
[2]University of Ilorin, Ilorin, Nigeria
[3]Nigerian Institute for Oceanography and Marine Research, P.M.B 12729, Victoria Island, Lagos

***Address for Correspondence:** Lenient MO Ibiyo, National Institute for Freshwater Fisheries Research (NIFFR), P.M.B. 6006, New Bussa, Niger State, Nigeria, Email: oniviemercy@yahoo.com

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Abstract

Two experimental feeding trials were conducted concurrently to study the growth response of African catfish Clarias gariepinus fingerlings to graded levels (0, 5, 10, 15 or 20%) of clupeids in Danish fish meal (DFM) based diets. Chemical analysis of the DFM and clupeids fish meal (CFM) was carried out. Completely randomized design with triplicated groups of fingerlings were used for both trials in an indoor and out-door concrete tanks for six and twelve weeks respectively. The study aimed at achieving a cost effective fish meal from local aquatic resources (clupeids fish) highly prolific and abundant in Nigeria water bodies to replace foreign fish meal in West Africa Region. A project supported by West African Agricultural Productivity Project (WAAPP) in NIFFR, Nigeria.

The results of proximate, amino acid profile, mineral and fatty acid composition analysis of CFM indicated values which are very close to those of the DFM. The proximate analysis revealed CFM to contain 70.6% crude protein while DFM contains 72%. There were no significant difference between the treatments with respect to final weight, feed consumed, feed conversion ratio, digestibility and survival (P>0.05) although there was significant difference in specific growth rate (P<0.05) with the highest value obtained in the diets with both fish meal at ratio 1:1. There were no significant difference in haematological parameters (P>0.05). However the lymphocytes were high in all the groups which might not be particularly due to the treatments. The high proliferation of the body defence cells by the fish could be a mechanism of survival in the aqua-medium which is likely to be high in microbial load due to waste materials. Feed Cost/Kg for DFM was N260.16 while for CFM was N227.16. The results of chemical analysis and feeding trials indicated positive replacement of the DFM with CFM in fish feeds without negative effect on growth performance.

Introduction

Fish meal is an essential component of fish feed and it is important for good growth of fish resulting to a profitable output in fish production. A large quantity of fish meal use for feed in West African Region is imported and it is very expensive [1]. Sixty to seventy (60-70) % cost of a kilogram of fish feed is borne by fish meal, so lowering the cost of fish meal could reduce the unit cost of fish feed. Research work on replacement of fish meal with blood meal [2], soybean [3], Tadpole meal [4], frog meal [5], live maggot and maggot meal [6,7], *Moringa oleifera* leaves [8] and some other by-products had only succeeded in reducing the level of inclusion of foreign fish meal in feed formulations. There is need for a local source of fish meal to totally replace the 20% of foreign fish meal (DFM) required to impact palatability, acceptability, enticing aroma, good growth performance on the fish feed for fish production. In an attempt to do this in poultry, Ojewole and Annah [9] evaluated crayfish dust meal and shrimp's waste meal in replacement of DFM in broiler feeds. Results obtained from their study showed no significant difference. CFM was used

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by Ibiyo et al. [10], to develop un-extruded floating fish feed which compared favourably with coppens feed (Foreign feed) in all the growth parameters evaluated. African catfish (*Clarias gariepinus* Burchell 1822) is a well desired species in Culture in Nigeria due to its hardiness, good growth and flavoured flesh.

There is dearth of information regarding good quality local fish meal availability in West Africa Sub-Region. Clupeids fish produce abundantly in the Nigerian water bodies and is yet to be commercially exploited. This study aimed at making good quality local fish meal available so as to reduce cost of fish feed production to enable fish producers procure feed at lower cost for better income generation. This work was designed to harness the advantages of abundance and prolificacy of clupeids fish species to produce local fish meal to reduce its importation.

Materials and Methods

Clupeids fish was analysed for chemical (proximate, amino acid, mineral and fatty acids) composition for use in experimental feed formulation. Experimental feeds were formulated and produced by the inclusion of graded levels (0, 5, 10, 15 or 20) % of CFM into a basal diet containing 20% DFM in combination with soybean meal, groundnut cake, wheat offal, vegetable oil, starch, bone meal and micro ingredients (control) (Table 1). Completely randomized design with triplicated groups of 8 and 30 fingerlings were used for both trials in an indoor 60x30x30cm^3 aquaria and 2x2x1m^3 out-door concrete tanks for six and twelve weeks respectively. Growth performance data collection was after two weeks acclimatization. The fingerlings with average weight of 11.2 ± 2.9g were 10 weeks old from day of hatching to commencement of the study. The aquaria and concrete tanks has a capacity of 60 and 4000 litres of water respectively but were filled to two-third level for the culture to avoid swim out of the fish. Twenty fingerlings were used to determine the initial proximate composition.

Fish were fed 5% body weight daily, divided into two parts with one half given morning (0800 – 0900) and the other evenings (1600 – 1700) hours. Feeding of fish was carried out after siphoning waste materials and some water each morning with 20 litres freshwater addition to minimize pollution of the aquaria. Fortnight Sampling was adopted to monitor weight, health status and subsequently feed adjustment in both experiments. The water quality parameters were monitored at weekly intervals during the experimental period. The P-701 pH-meter was used for pH measurements. Ammonia and nitrite were measured with the aid of a visible spectrophotometer after it had been treated with Nessler's reagent. Digestibility trial was undertaken in the in-door after the first four weeks. 1% chromic-oxide was added to the feed at pelleting for this purpose. Weighed feed based on ration per day were given and three days collections of faecal materials was adopted. The feeding trials lasted 42 days and 84 days in the indoor and outdoor respectively. At the end of the feeding trials, final physical measurements were taken and four fish per replicate were randomly selected to obtain blood sample, viscera organs and carcass for final proximate analysis and histhopathological examination.

Chemical analyses

Analyses of the fish meal, feed, faecal samples were carried out following the

Table 1: Composition of Experimental Diet.

Ingredients	Diets				
	1 (control)	2	3	4	5
DFM (%)	20.00	15.00	10.00	05.00	00.00
CFM (%)	00.00	05.00	10.00	15.00	20.00
Basal composition (%)	80.00	80.00	80.00	80.00	80.00
Total (%)	100.00	100.00	100.00	100.00	100.00
Crude Protein (% Calculated)	40.00	39.90	39.80	39.70	39.60

procedures of AOAC [11]. Nitrogen was measured following the micro-Kjeldahl methods. Amino acids were measured after acid hydrolysis of protein using the Pico Tag method [12] and high pressure liquid chromatography (HPLC). Sulphur amino acids (Cysteine or methionine) were measured separately using similar methods after oxidation with performic acid. Chromic oxide in feed was measured following methods described by Cho and Kaushik [13]. Haematological values were measured following standard methods [14-16] and Dacie et al. [17]. Mineral content was determined by Atomic Absorption Spectrophotometer analysis.

Calculations and statistical analysis

Parameters such as Weight gain = (Final weight – Initial weight); Apparent Feed consumed= (Estimated feed supplied during the experimental period); Feed conversion ratio (FCR) = (Apparent Feed intake/Weight gain, Hardy and Barrow, 2005); Specific growth rate (SGR) = {(In Final weight – In Initial weight/ Experimental period) x 100%}; Hepatosomatic Index = (Liver weight / Body weight x 100%); Apparent Digestibility coefficient = {% Nutrient in feaces / %Nutrient in diet x %Cr_2O in diet / %Cr_2O in faces} x100 [13].

Data obtained were subjected to one way analysis of variance (ANOVA) using SPSS Version 15.0 for windows according to the statistical principle of Steel and Torrie [18]. Where ANOVA identified significant difference, means were separated using Duncan Multiple Range Test [19] by setting the aggregate type – 1 error at 5% level.

Results and Discussion

Chemical analysis of reference and test ingredients

Proximate Composition: The results of proximate composition analysis of the reference (DFM) and the test (CFM) ingredients are presented in figure 1. The clupeids' crude protein content (C.P.) 70.68% is not significantly different from the 72.60% C.P. of DFM (P<0.05).

Amino acid Profile of Clupeids and Danish Fish meals: Figure 2 showed the amino acids' profile of the two fish meals. The values of amino acids (AA) of both are not far from each other but CFM was higher in all AA. However, it was interesting to note that the sulphur amino acids (methionine and cysteine) values were also higher in CFM than in DFM despite the limiting nature of these amino acids in most feedstuff especially plant materials.

Mineral Composition of CFM and DFM: The mineral composition showed in figure 3, indicated higher quantities of phosphorus and potassium for CFM. Minerals play vital roles in osmo-regulation as well as nervous and muscular activities. Generally, the analytical results showed an indication of the CFM being able to replace the DFM in fish feed. The high levels of minerals could help reduce the quantity of bone meal use in fish feeds if CFM is used in formulations.

Growth performance of *C. gariepinus* fed diets with graded levels of CFM

There was no significant difference between the treatments in most of the parameters evaluated (P>0.05; Figures 4,6). The results of the indoor and outdoor studies indicated positive replacement of the DFM with CFM without negative effect on growth performance. Similar results were obtained when soybean [3], live maggot and maggot meal [6,7] replaced 25-50% fish meal in *C. gariepinus* diets and crayfish dust meal and shrimp waste meal totally replaced DFM in broiler diets [9]. In all, there was a reduction in feed cost. Floatation of un-extruded feed was possible with CFM [10] and not with DFM. Ability of un-extruded feed to float with CFM use is an added advantage for fish farmers in the West African Sub-region who cannot afford feed extrusion machine but a simple pelleting machine for feed production.

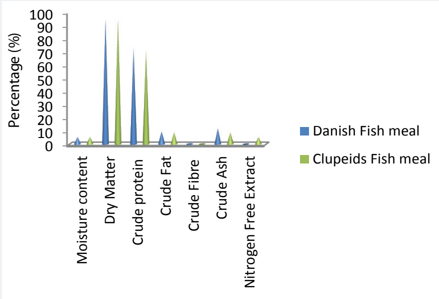

Figure 1: Proximate Composition of DFM and CFM.

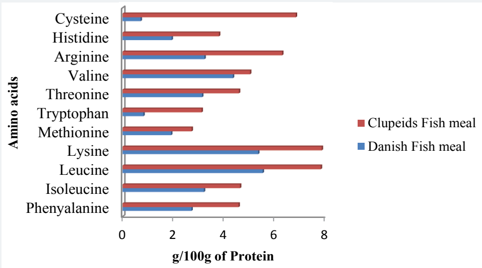

Figure 2: Amino acid composition of DFM and CFM.

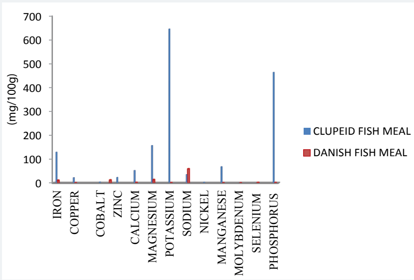

Figure 3: Mineral Compositions of DFM and CFM.

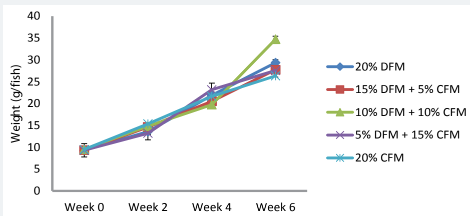

Figure 4: Growth Performance of *Clarias gariepinus* fingerlings fed diets with graded levels of CFM in a DFM Based diet (0-6wks).

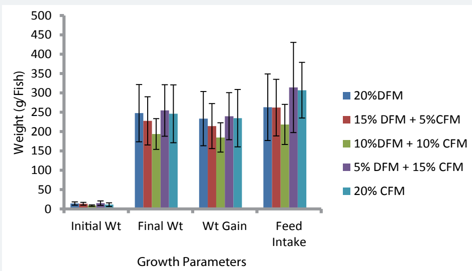

Figure 5: Growth Performance of *Clarias gariepinus* fingerlings fed diets with graded levels of CFM in a DFM based diets in outdoor (0 - 12 weeks).

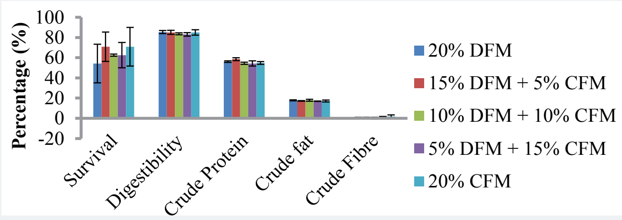

Figure 6: Survival, Digestibility and Nutrient retention of *Clarias gariepinus* fingerlings fed diets with graded levels of CFM in a DFM based diets (0 - 6 weeks).

Plate 1: Photograph of fish at the last sampling after 12 weeks.

Survival, feed conversion ratio (FCR) and specific growth rate (SGR) of *C. gariepinus*

Mortality of fish occurred across the 5 treatments which might not be associated with the treatment (Figure 5). There might be other unexplained factors responsible for the mortality observed in the first 3 weeks into the experiments. It might be connected to adjustments into the experimental system. The mean FCR obtained with the diets in this present experiment were in the range of 1.28 to 1.5 in the indoor and 1.09 to 1.35 out-door. Although FCR is dependent on ration as driving force of growth with temperature as a major factor controlling the force as it affects utilization [20]. From the water quality parameter monitored, the temperature was not outside the range recommended by Boyld [21]. High conductivity values were observed among other water quality parameter which was ameliorated by the reduction of water and replenishing with freshwater. These translated to an average SGR of 2.1 - 3.2 % day^{-1} as was also observed in heteroclarias by Salami et al. [22], when 40% C.P diet was fed in a 12 weeks rearing (Plate 1).

Haematological parameters of *Clarias gariepinus*

There was no significant differences in haemoglobin content (Hb), packed cell volume (PCV) and red blood count (RBC) (P>0.05) [23]. However, there were significant difference between the treatments with respect to white blood count (WBC) and mean corpuscular haemoglobin (MCH) (P<0.05). These differences might be due to reaction of the fish body system as a means of survival in the habitat which could have contributed to the differences in proliferation of the defence cell (WBC). The habitat was likely to be having microbial load due to waste materials in the system. The haematological results were within the range reported by Erondu et al. (1992), for a healthy *Clarias gariepinus* when he studied four catfish species (Table 2).

Feed cost analysis

Feed Cost/Kg for diets 1, 2, 3, 4 and 5 were N260.16, N251.91, N243.66, N235.45 and N227.16 respectively base on ingredient prevailing price at the time of experimentation. Economic analysis of feed production indicated a reduction of feed cost as clupeids increases in the diet. The cost of production is a determinant of the likely revenue from the fish production venture.

Table 2: Haematological parameters of *Clarias gariepinus* fed graded levels of CFM in DFM based diets.

Diets	HB	PCV (%)	RBC x 10^{12}(T)	WBC x 10^{9}(G)	MCH x10^{-12} (Pg)
0% CFM	112.32±5.00	37.00	1.80±0.11	23.55±2.00^{a}	65.24±4.38^{b}
5% CFM	110.66±7.80	32.00	1.70±0.30	20.40±1.00^{b}	66.14±3.58^{b}
10% CFM	109.11±8.50	31.00	1.80±0.40	23.50±2.00^{a}	74.22±8.82^{a}
15% CFM	109.19±15.20	28.00	1.80±0.50	19.44±3.00^{b}	69.54±5.91^{ab}
20% CFM	109.21±5.30	36.00	1.60±0.30	22.26±6.00^{a}	63.81±3.81^{b}

$^{a-b}$Means with different superscripts within columns significantly different ($P<0.05$).

Conclusion

The results indicated CFM as a good local resource that can replace DFM without a negative effect on good growth performance of fish. There was also a reduction in feed cost with total use of local resources. A bag of 15 kg of foreign feed which cost N9,000.00 in New Bussa can be produced at N6,500.00 with local resources. There will be need to try the CFM in diets of other fish species cultured in West African region.

Recommendation

* Fish farmers can conveniently use CFM in fish feed with expectations of increased income.
* There is need of a fish meal processing plant to receive clupeids fish trawl by fishermen directly instead of the sun drying used in this experiment.
* The processing plant can assist in improving the quality of the fish meal produced from clupeids.

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References

1. Odesanya BO, Ajayi SO, Agbaogun BKO, Okuneye B. Comparative Evaluation of nutritive value of Maggots. Int J Sci and Eng Res. 2011; 2: 1-5. **Ref.:** https://goo.gl/uaAesz

2. Otubusin SO. Effects of different levels of blood meal in pelleted feeds on tilapia Oreochromis niloticus, production in floating bamboo net-cages. Aquaculture.1989; 65(3-4): 263-266. **Ref.:** https://goo.gl/vZaCrC

3. Eyo AA. Some aspects of utilization of soybean meal by young mudfish, Clarias anguillaris Linnaeus. Ph.D. Dissertation, Ahmadu Bello University, Zaria, Nigeria. 1990; 401.

4. Fagbenro OA, Balogun AM, Ibironke AA, Fasina FA. Nutritional value of some amphibian meals in diets for Clarias gariepinus (Burchell 1822) (Siluriformes Claridae). Journal of Aquaculture in the Tropics. 1993; 8: 95-101.

5. Fagbenro OA, Jauncey K, Krueger R. Nutritive value of dried lactic acid fermented fish silage and soybean meal in dry diets for juvenile catfish, Clarias gariepinus (Burchell, 1822). Journal of Applied Ichthyology. 1997; 13: 27-30. **Ref.:** https://goo.gl/L9P7Yr

6. Nwanna LC, Fagbenro OA, Ihinmekpen FA. Use of shrimp head (Waste) silage as fish meal substitute in African catfish (Clarias gariepinus x Heterobranchus bidorsalis) production. Responsible Aquaculture in the New Millennium, Abstracts of International Conference-Aqua 2000; 510 (R. Flos & L. Cesswell, eds). European Aquaculture Society Special Publication No. 28. Oostende, Belgium.

7. Madu CT, Ufodike EBC. Growth and survival of catfish (Clarias gariepinus) juvenile fed live tilapia and maggot as unconventional diets. Journal of Aquatic Sciences. 2000; 18: **Ref.:** https://goo.gl/n99dgV

8. Ritcher N, Siddhuraju A, Becker K. Evaluation of nutritional quality of moringa (Moringa oleifera Lam.) leaves as alternative protein source for Tilapia (Oreochromis niloticus L.). Aquaculture. 2003; 217: 599-611. **Ref.:** https://goo.gl/SyDD93

9. Ojewole GS, Annah SI. Nutritive value of Danish fish meal, crayfish dust meal and shrimp waste meal inclusion in Broiler diets. International Journal of Poultry Science. 2006; 5: 390-394. **Ref.:** https://goo.gl/HNvBPW

10. Ibiyo LMO, Ovie , Babalola TOO, Eze SS. Growth Response of Clarias gariepinus (Burchell 1822) fed NIFFR Floating Feed and Coppens Feed. Biological and Environmental Sciences Journal for the Tropics. 2011; 8: 33-36.

11. AOAC. Association of Official Analytical Chemists. 17th Edition, Washington D.C.., U.S.A, 2000; 14: 47.

12. Cohen SA, Mcys M, Turvin TI. The Pico-Tag Method. A Manual of Advanced Techniques for Amino acid analysis. Waters Chromatography Division Millipore Milford MA. 1988; 12.

13. Cho CY, Kaushik SJ. Nutritional energetics in fish energy and protein utilisation in rainbow trout (Salmo gairdneri). World Review of Nutrition and Dietrics. 1990; 61: 132-172. **Ref.:** https://goo.gl/XA2uKR

14. Joshi PK, Bose M. Harish D. Changes in certain haematological parameters in a siluroid catfish Clarias batrachus (Linn) exposed to cadmium chloride. Pollution Res. 2002a; 21: 119-131. **Ref.:** https://goo.gl/itfiqJ

15. Joshi PK, Harish D. Bose M. Effect of lindane and malathione exposure to certain blood parameters in a fresh water teleost fish Clarias batrachus. Pollution Res. 2002b; 21: 55 - 57. **Ref.:** https://goo.gl/rL883G

16. Joshi PK, Bose M, Harish D. Haematological changes in the blood of Clarias batrachus exposed to mercuric chloride. Clarias batrachus exposed to mercuric chloride. Ecotoxicological Environmental Monitoring. 2002c 12: 119- 122. **Ref.:** https://goo.gl/DaxYgc

17. Dacie SIV, Lewis SM. Practical haematology (7th edition) J. and A. Churchill Ltd. Livingston, London Melborne and New York. 1991; 67. **Ref.:** https://goo.gl/BkAdmP

18. Steel RGD, Torrie JH. Principles and procedures of statistics A Biometrical Approach. Mc Graw Hill Book Co. In., New York. 1980; 633. **Ref.:** https://goo.gl/FHYZLN

19. Duncan DB. Multiple range and multiple (F) test. Biometrics. 1955; 11: 1-42. **Ref.:** https://goo.gl/Q3ZWXD

20. Carl FM, Donald T, Brett JR, Iwama GK. The effects of feeding and rearing density on growth, feed conversion an survival in Chinok salmon (Onchorynchus ishawytscha) rearing in salt water. Aquaculture. 1993; 117: 129-140. **Ref.:** https://goo.gl/5QMT7v

21. Boyd CE. Water quality in ponds for Aquaculture. Alabama Agricultural Experimental Station Ausbum University, Alabama. 1998; 359. **Ref.:** https://goo.gl/Lcjtgx

22. Salami AA, Fagbenro OA, Sydenhan DHJ. The production and growth of Clariid catfsh hybrids in concrete tanks. The Israeli Journal of Aquaculture- Bamidgeh. 1993; 45: 18-25.

23. Erondu ES, Nnubia C, Nwadukwe FO. Haematological studies on four catfish species raised in freshwater ponds in Nigeria. Journal of Applied Ichthyology. 1993; 9: 250 – 256. **Ref.:** https://goo.gl/uZEJhd