Original Research Article

Effect of fish meal replacement with Blood meal on the growth response and utilization of Hybrid (*Clarias gariepinus* ♀ X *Heterobranchus bidosarlis* ♂) fingerlings

Abstract

This study examined the replacement of fishmeal with Bloodmeal (BM) in Practical diets of clariid catfish hybrid "*Heteroclarias"* (*Clarias gariepinus* ♀ x *Heterobranchus longifilis* ♂) fingerlings. Five diets containing varying levels were formulated. Diet 1, (10% BM); Diet 2, (15 % BM); Diet 3, (20% BM); Diet 4 (25 % BM) and Diet 5 (30 % BM) as a replacement for fishmeal were fed to three replicate of *Heteroclarias* with an initial weight of 5.9±0.01g. Diet 1, (10%BM) had the best growth rate and feed utilization ($p<0.05$) as it had the highest value of weight gain (1.60), feed intake (2.53), relative weight gain of 15.66 and Specific Growth Rate of 1.58. There was no significant difference ($P<0.05$) in the feed conversion ratio across all five treatments. Therefore, bloodmeal can replace fishmeal totally but will be best at 10% replacement level in diets of *Heteroclarias* without compromising the growth and carcass composition.

Keywords: catfish diet, *Heteroclarias*, Blood meal and fingerlings

Introduction

The increased competition between the expanding aquaculture and livestock sectors for a limited supply of fishmeal and fish oil continues to drive the price upwards and the price would reach a level where the use of fishmeal and fish oil may no longer be financially viable (FAO of the United Nations, 2006). The development of a more sustainable aquaculture feed production will depend on identifying and establishing alternative feedstuffs to fishmeal (Olukayode and Emmanuel, 2012). Research has shown that most imported feedstuff (fishmeal) can be replaced by locally available feedstuff (Agbebi *et al*., 2009; Otubusin *et al*., 2009; Gabriel *et al.*, 2007; Okanlawon and Oladipupo, 2010; Faruque *et al.*, 2010). This, therefore, entails the production of fish feed from locally available materials using local technology in order to reduce the cost and improve availability of feed to farms.

Fish feed is the single most expensive input in intensive fish culture especially for catfish as they require high protein diets (Olevera-Nora, 1996). Catfishes of the family Clariidae comprise the most commonly cultured fishes in Nigeria (Adekoya *et al*., 2006). Of all the ingredients needed for the formulation of the fish diet, fishmeal is considered to be the most expensive due to its scarcity, well balanced amino acid and fatty acid, excellent quality, high protein content and also its palatability to fish (Eyo, 1985). A fish farmer would profit more if a less expensive alternate protein source is used to replace the more expensive fish meal without compromising the quality, acceptability and palatability of the feed (Aliu and Esume, 2016). Although blood meal was found to be a good substitute of fish meal (Adikwu, 1991) in terms of crude protein requirement and amino acid profile there is need to conduct a feeding trial to determine the performance of fish to this waste. This current study therefore is designed to determine the growth performance and optimum inclusion level of blood meal in the diet of *Heteroclarias* fingerlings.

Materials and Methods

This study was conducted in the Wet Laboratory of Department of Fisheries and Aquaculture Management, Faculty of Agriculture, University of Benin, Benin-city Edo state for Seventy

(70) days. One hundred *Heteroclarias* fingerlings (initial mean body weight of 5.9±0.01g) were obtained from outdoor fish tanks of the Department of Fisheries, University of Benin, Benin city and were stocked randomly at five (5) fingerlings per aquarium in 40 litres of domestic water of university of Benin in the laboratory. Temperature of water ranged from 27-29^{o}C and PH of 6.9-7.6. The fingerlings were fed crumbled 2.0 mm size pellet of experimental diets twice daily to satiation between 09.00hrs and 16.00hrs. Feeding was monitored for each unit to ensure that fishes were not underfed or overfed. Experimental units were cleaned daily while Weekly weight gain and feed consumption were monitored weekly for 70 days.

The experimental design consists of five (5) dietary treatments with three (3) replicates each. Diet 1, (10% BM); Diet 2, (15 % BM); Diet 3, (20% BM); Diet 4 (25 % BM) and Diet 5 (30 % BM). The blood meal was collected from the Slaughter Unit of the University of Benin Farm Project in Benin-City, Edo State. The blood was boiled for about 30minutes to get rid of micro-organisms that may cause certain effects like dropsy (bloated belly), popeye to the fish and also to coagulate the blood. It was then dried in the Altona Smoking kiln for 12hours at a temperature of 105^{o}C. The dried blood was then ground finely before it was used in compounding the feed.

Table 1: Gross Composition of the Experimental Diets (%) on as fed basis

INGREDIENTS	DIET 1	DIET 2	DIET 3	DIET 4	DIET 5
Blood meal (80%CP)	10	15	20	25	30
Fish crumb (50% CP)	30	25	20	15	10
Brewers waste meal (23.8% CP)	8.4	8.4	8.4	8.4	8.4
SBC (44.0% CP)	35	35	35	35	35
Yellow maize (9.6% CP)	5	5	5	5	5
Palm oil	7	7	7	7	7
Bone meal	4	4	4	4	4
Vitamin premix	0.6	0.6	0.6	0.6	0.6

Chemical Analysis The various diets, Bloodmeal and the experimental fish (initial and final carcass) were analyzed for their proximate composition which include their moisture content, nitrogen, ether extract, crude fibre and nitrogen-free extract (NFE) according to the procedures of Association of Official Analytical Chemists (A.O.A.C., 2000). The nitrogen was converted to protein by multiplying the nitrogen level with a factor of 6.25.

Growth and Feed Utilization Parameters Determination of parameters such as Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) were carried out. Parameters determined and their formulae include:

1. Weight gain = W1 – W0
2. Relative Weight Gain (RWG%)=(W1 – W0) / W0 × 100
3. Specific Growth Rate (SGR %)= {(In W1 – In W0)/ T} × 100

W0: mean initial weight (g) W1: mean final weight (g) T: time in 7 days between weightings

4. Feed conversion ratio (FCR) = feed intake (g) / weight gain (g)
5. Protein efficiency ratio (PER) = weight gain (g) / protein intake (g)
6. Net protein utilization (NPU) = {(BP1 – BP0)/ CP} × 100

Where; BP0: Initial body protein content (g) BP1: Final body protein content (g) CP: Protein intake (g) Sampling was carried out weekly by weighing the whole fish in each replicate. **Statistical Analysis:** All analyzed data were tested for significant differences using analysis of variance (ANOVA) test and the means were compared using Genstat 2012 version, all at 5% level of significance.

Result

Table 2: Growth Performance and Feed Utilization of Heteroclarias Fingerlings Fed Blood Meal Based Diets.

Parameters	TRT1	TRT2	TRT3	TRT4	TRT5	SEM
	10%BM	15%BM	20%BM	25%BM	30%BM	
Weight Gain(g)	1.60^{a}	0.96^{b}	0.90^{b}	0.36^{c}	0.24^{c}	0.32
Specific Growth Rate (%/day)	1.58^{a}	1.12^{a}	1.10^{a}	0.14^{b}	0.30^{b}	0.58
Relative Weight Gain (%)	15.66^{a}	10.19^{b}	10.08^{b}	6.30^{c}	5.72^{c}	3.82
Protein Efficiency Ratio	83.23^{b}	74.41^{ab}	79.62^{ab}	36.81^{a}	21.30^{a}	3.86
Feed Intake(g)	2.53^{a}	2.14^{a}	2.07^{a}	1.22^{b}	1.02^{b}	0.33
Feed Conversion Ratio	1.58	2.23	2.30	3.39	4.25^{NS}	2.68

N/B: Mean Values with the same superscript on the same row are not significantly different, (P> 0.05) SEM = standard error of mean. NS = No significant difference

Result from the growth performance and feed utilization of Heteroclarias (Table 2) showed that Weight gained by Heteroclarias fingerlings after ten weeks of culture was significantly higher (P<0.05) in Diet 1 (1.60) while Diet 5 (0.24) recorded the least value.

The Specific growth rate for Diet 1 (1.58), Diet 2 (1.12) and Diet 3 (1.10) were not significantly different (P>0.05) from each other while Diet 5 (0.30) and Diet 4 (0.14) were also not significantly different (P>0.05).

The Relative Weight in Diet 2 (10.19) and Diet 3 (10.08) showed no significant difference (P>0.05) from each other as well as Diet 4 (6.30) and Diet 5 (5.72) showed no significant differences (P>0.05). The Relative Weight gain for Diet 1 (15.66) was significantly superior (P<0.05) than all the other treatments.

The Protein Efficiency Ratio for Diet 2 (74.41) and Diet 3 (79.62) were not significantly different (p>0.05) from each other. The Protein Efficiency Ratio for Diet 1 (83.23) was significantly superior (P<0.05) than all the other treatments.

Feed intake in Diet 1, 2 and 3 were not significantly different (P > 0.05) from each other but they were significantly different from Diet 4 and 5 meaning that feed were consumed at different levels within each treatment. Diet 1 had the highest feed intake value of 2.53g while the lowest feed intake value was recorded in Diet 5 (1.02g).

Feed conversion ratio showed no significant difference (P > 0.05) between all treatments as this was similar with Diet 5 (4.25) being the highest and Diet 1 (1.58) being the lowest.

Discussion

The weight gain was significantly higher (p<0.05) for fish fed 10% blood meal. As the level of blood meal inclusion increased, the response of the fish to the diet became poor. This finding indicate that fishmeal in the diet of *Heteroclarias* can only be efficiently replaced with 10% blood meal and this observation agree with the result of Otubusin (2001) who reported that the replacement of fish meal with 10% blood meal in pelleted feeds was adequate for *Oreochromis niloticus* production in floating bamboo net-cages. However, this finding is in contrast to that of Agbebi *et al.* (2009) who reported that a 25% blood meal substitution of fishmeal in diets gave the best growth performance.

The specific growth rate and feed conversion ratio was significantly higher in Diet 1; this result is different from that indicated by Adejoke (2012) on the use of bovine blood and rumen digest in catfish diet to replace fish meal at 0%, 25%, 50%, 75 and 100% where he reported that the best growth performance was recorded in fish with inclusion level of 25% bovine blood and ruminant digest meal. The results obtained from this study showed that fish meal can be replaced partially with blood meal at 10% inclusion level which differs from the report of Agbebi *et al.* (2009) who stated that fish meal can be replaced completely by blood meal at 100% with no adverse effects on the growth, survival and feed conversion ratio of *Clarias gariepinus* juveniles.

The relative weight gain varied with the different inclusion level of bloodmeal, it was highest in treatment 1 (15.66%) and decreased variably as the inclusion level of bloodmeal increased. This variation in growth rate that was highest in diet 1 can be attributed to the use of high level of fishmeal as the major animal protein source. Fish meal is known to have balanced amino acid profile, high digestibility and palatability which promote good growth of fish (Hardy and Tacon, 2002). The poor performance of the high blood meal based diets on the fishes agrees with the study carried out by Otubusin (1987) in which the feed containing the highest amount of bloodmeal gave the poorest performance in terms of growth and feed conversion ratio. This could be due to the imbalance nature of the essential amino acid composition in the bloodmeal which was translated into the diet (Fasakin, *et al.,* 2005; Kirimi *et al.,* 2016).

In general, performance of the fish reduced as the level of fishmeal inclusion was reduced. The replacement of the fishmeal with bloodmeal not only changed the nutritional profile of the diet (generally reduced methionine levels) but it also affected the palatability. Poor performance was attributed to shifts in palatability as fish meal was replaced with other protein sources (Davis *et al.,* 1995; Meilahn *et al.,* 1996). Palatability is defined as the degree of acceptability of feed materials by a particular animal. Based on visual observations of the fish in this experiment as well as subjective ranking of the quantity of feed remaining in the tanks after feeding, it was clear that palatability was reduced as fish meal was reduced. The acceptability of the bloodmeal based diets was very low and this also resulted to low growth rate.

The lower the FCR of a feed, the higher the efficiency of the feed and vice versa. The lowest FCR in this study was recorded from the fish fed 10% bloodmeal. This is in accordance with MacDonald *et al.* (1994) who reported an increase in feed conversion ratio of fish as the inclusion level of LabLab bean meal increased across the treatment.

Conclusion

The results of this present study showed that fish fed on diet with high inclusion level of fishmeal performed better in terms of growth than those fed on feed with high inclusion level of bloodmeal. However, although blood meal cannot compete with fishmeal in terms of growth performance, the economics of using it to replace fish meal is positive in the long run.

References

Adejoke, A. A. (2012) Bovine blood and ruminant digesta in Catfish *Clarias gariepinus* diet. *European Journal of Scientific Research.***83**: 167-172.

Adekoya, B.B.,Ayansawo, T.O.,Idowu, A.A.,KudoroO.A. and Salisu A.A. (2006). In "Directory of fish hatcheries in Ogun State" Ogun State Agricultural Development Programme (OGADEP), Abeokuta, 18 pp.

Adikwu, I.A.(1991). The development of complete diet from local feedstuffs and industrial wastes for the culture of Tilapia: *Oreochromis niloticus* in Nigeria. *Technical Report for the International Foundation for Science.***2**: 005 – 114

Agbebi, O.T., Otubusin, S.O. and Ogunleye, F.O. (2009).Effect of different levels of substitution of fish meal with blood meal in pelleted feeds on catfish *Clariasgariepinus*culture in net cages.*European Journal of Scientific Research*. Vol. **31**(1):6-10

Aliu, B.S. and Esume A.C. (2016). Replacement of Fishmeal with Poultry/ Hatchery Waste Meal supplemented with Bloodmeal in the diet of Clariid catfish (*Heterobranchus bidorsalis*) Fingerlings. *Journal of Scientific and Engineering Research* 3(6):125-130

Davis, D. A., Jirsa D. and Arnold C. R. (1995). Evaluation of soybean proteins as replacements for menhaden fi sh meal in practical diets for the red drum *Sciaenopsocellatus*. *Journal of the World Aquaculture Society*.**26**:48–58.

Eyo A. A.(1985). Studies on Dietary Protein Requirement of *Heterobranchusbidorsalis* Fingerlings.National Institute for Freshwater Research, Annual Report.

F.A.O. of the United Nations(2006).Report of the expert consultation on Global Forest Resources Assessment: Towards FRA 2010.

Faruque, M.M., Ahmed, M.K. and Quddus, M.M. (2010) Use of live food and artificial diet supply for the growth and survival of African Catfish (*Clariasgariepinus*) larvae. *World Journal of Zoology*.Vol. **5**(2):82-89

Fasakin, E. A., Serwata, and Davies, S. J. (2005). Comparative utilization of rendered animal derived products with or without composite mixture of soybean meal in hybrid tilapia (*Oreochromisniloticus* × *Oreochromismossambicus*) diets. *Aquaculture*.**249**:335-338.

Gabriel, U. U., Akinrotimi, O. A., Bekibele, D. O., Onunkwo, D. N. andAnyanwu, P. E. (2007). Locally produced fish feed: Potentials for aquaculture development in sub Saharan Africa. *African Journal of Agricultural Research.***2**(7): 287-295.

Hardy, R. W. and Tacon, A. G. J. (2002). Fish meal: Historical uses, production trends and future outlook for sustainable supplies. In R. R. Stickney & P. MacVey (Ed.), Responsible Marines Aquaculture. Pp. 311-325.

Kirimi, J. G., Musalia, L. M. andMunguti, J. M. (2016).Effect of replacing fish meal with blood meal on chemical composition of supplement for Nile tilapia (*Oreochromisniloticus*).*East African Agricultural and Forestry Journal*.**1**: 1-9.

MacDonald, P., Edwards, R.A. and Greenhaigh, J. F.D. *Animal Nutrition*. 5th Edition Longman, Singapore.

Meilahn, C. W., DavisD. A. and Arnold C. R. (1996). Effects of commercial fish meal analog and menhaden fi sh meal on growth of red drum fed isonitrogenous diets. *Progressive Fish-Culturist.***58**:111–116.

Okanlawon, S.S. and Oladipupo, S.A. (2010) Nutritional Evaluation of Snail Offal Meal as Animal Protein Supplement in the Diet of *Clariasgariepinus* fingerlings.*World Journal of Fish and Marine Sciences* Vol. **2**(2):103-108

Olukayode A.M., and Emmanuel B.S. (2012). The potential of two vegetable- carried blood meals as protein sources in African catfish (*Clariasgariepinus*) juvenile diet. *Journal of Animal Science***2**(1):15-18.

Olvera-Nora M.A.(1996). The dietary protein requirement of *Cichlasmasynspillum* fry.*Aquaculture Research.***27**: 167-173

Otubusin S.O. (1987). Effects of different levels of blood meal in pelleted feeds on tilapia *Oreochromis niloticus*, production in floating bamboo net-cages.*Aquaculture***65**(3-4):263-266.

Otubusin S.O. (2001) Economics of small scale table size Tilapia production in net- cages. ASSET Series A**1**: 83-90.

Otubusin, S.D., Ogunleye, F.O. and Agbebi, O.T. (2009) Feeding trials using local protein sources to replace fish meal in pelleted feeds in catfish (*Clariasgariepinus*) culture.*European Journal of Scientific Research* Vol. **31**(1):142- 147