African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 3, Issue 3, 2020 (pp. 21-28) www.abjournals.org

SUBSTITUTION OF FISHMEAL WITH BLOOD MEAL IN THE DIETS OF CLARIID CATFISH *HETEROBRANCHUS BIDORSALIS* FINGERLINGS

Aliu B.S. and Ademiluyi A.G.

Department of Aquaculture and Fisheries Management, Faculty of Agriculture, University of Benin, P.M.B. 1154, Benin City, Nigeria. Tel: +2348055314843

ABSTRACT: *This study was carried out to examine the effect of the substitution of fishmeal with blood meal (BM) in the Practical diets of Heterobranchus bidorsalis fingerlings for a period of 70 days (10 weeks). Five iso-nitrogenous diets containing varying levels of blood meal were formulated. Diet 1 (10%BM) Diet 2 (25%BM), Diet 3 (50%BM), Diet 4 (75%BM), Diet 5 (100%BM) as substitution for fishmeal were fed to three replicate of Heterobranchus bidorsalis with an initial mean weight of 11.02±0.01g, the feed were fed to satiation twice daily and water quality monitored. At the end of the experimenal period Diet 2, (25%BM)recorded the best mean growth rate of 2.019g but was not significantly different from other treatments (P>0.05), Diet 2 was also a better performer among all the other treatments with a feed intake valur of (2.112), feed conversion ratio of (2.119), relative weight gain of (13.58) and specific growth rate of (9.010). It is therefore recommended that blood meal can substitute fishmeal but will be best at 25% substitution in diets for Heterobranchus bidorsalis without compromising the growth and carcass composition.*

KEYWORDS: Fishmeal, Bloodmeal, *Heterobranchus Bidorsalis*, Fish Nutrition

INTRODUCTION

Nutrition is one of the most important factors to consider in fish farming, because it contributes up to 50% of fish production costs (Omoruwou and Edema 2011). Nowadays, it is necessary to increase fish production for satisfying the increasingly growing demand of protein. Therefore, fish breeding has been found necessary to increase fish production in order to make fish/protein available to the population. However, one of major constraints facing aquaculture is feeding. The prominence of fish meal in the production of animal feeds cannot be disputed but constitute the highest cost, thereby making the price of the feed to rise exponentially (Olaniyi and Salau 2013).

Aquaculture requires optimization of nutrition to efficiently raise fish for the purpose of food production. Nutrition plays a critical role in intensive aquaculture as it influences not only the production cost but also fish growth, health and waste production and waste management. Fish nutrition is the study of nutrients and energy sources essential for fish health, growth and reproduction (Hixson, 2014). For promoting normal growth of fish, proper nutrition plays a key role. Fish require a lot of protein, especially catfish species, which incidentally are increasingly farmed in Nigeria (Falayi, 2009). They also require a source of carbohydrates and fibre, Vitamin, minerals, Fats and oil. Out of the 10 Essential Amino Acids (EAA) required for optimum fish growth only three have been exhaustively studied (methionine, lysine and arginine) (Macarthney, 1996). Fish requires high quality nutritionally balanced

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 3, Issue 3, 2020 (pp. 21-28)
www.abjournals.org

diet for growth and attainment of market size within the shortest possible time (Gabriel *et al.*, 2007). Given that fish feed is one of the highest operating costs of an aquaculture system (FAO 2006), it is necessary to maximize the feed conversion ratio and use costly feed ingredients judiciously. The objective of this study is to evaluate the effect and nutritive value of blood meal in the diet of the catfish *Heterobranchus bidorsalis* fingerlings.

Materials and Methods

Preparation of Blood Meal

The blood from the Ox was collected from the Slaughter Unit of the University of Benin Farm Project in Benin-City, Edo State. It was boiled for 30 minutes to get rid of micro-organisms that may cause certain effects like dropsy (bloated belly), and also to coagulate the blood. It was then dried in the Altona Smoking kiln for 12 hours at a temperature of 105^{o}C. The dried blood was then ground finely.

Preparation of the Experimental Diets

The feed ingredients; fish crumbs, soybean cake, maize, bone meal, palm oil and vitamin premix which was used in the production of the feed were procured at Uselu market, Benin. The blood meal was obtained from the Slaughter Unit of the University of Benin Farm Project.

Five isonitrogenous diets were formulated. The feed ingredients including the blood meal were milled, mixed, using the gelatinized maize as binder, then pelleted and stored in a cool, dry place. The ingredients and their inclusion levels by weight are shown in Table 1 below:

Table 1: Composition of the Experimental Diets

INGREDIENTS	DIET 1	DIET 2	DIET 3	DIET 4	DIET 5
Fish meal (65.5%)	28	21	14	7	0
Blood meal (80% CP)	0	7	14	21	28
Soya bean cake (48.0% CP)	44.36	44.36	44.36	44.36	44.36
Yellow maize (7.5% CP)	15	15	15	15	15
Palm oil	8	8	8	8	8
Bone meal	4	4	4	4	4
Vitamin premix	0.6	0.6	0.6	0.6	0.6
Vitamin E gel	0.04	0.04	0.04	0.04	0.04
TOTAL	100	100	100	100	100

The various ingredients were measured accurately to their required quantity, after which they were homogenously mixed, finely pelleted and dried at the departmental fish farm. *Heterobranchus bidorsalis* fingerlings with mean weight of 1.37±0.01g was obtained from the nursery pond of the department.

Feeding Trial: The study was conducted in the wet laboratory of Department of Aquaculture and Fisheries Management, University of Benin, Benin City. Fifteen (15) rectangular plastic tanks, five (5) treatments in three (3) replicates measuring (30cm×36cm×52cm) were used. Each tank was filled up to 2/3 of its volume with bore-hole water attached to the laboratory. The fishes were weighed in batches of five into each of the experimental units replicated thrice for each treatment. They were fed twice daily to satiation to ensure maximum growth between 08:00hrs and 16:00hrs. Feeding was monitored for each unit to ensure that fishes were not underfed or overfed. The experimental units were cleaned by total changing of the water daily. All fishes' tanks were weighed and counted weekly to determine growth and survival, also the weekly weighing of feed was also carried out. The data obtained from the feeding trials were tested for significant differences using one-way Analysis of Variance (ANOVA) test and the means were separated using Duncan's Multiple Range Test, all at 5% level of significance.

Parameters Monitored: Data on feed consumed and weight gain were collected weekly for each unit from which the following performance parameters were evaluated.

1. Weight gain (WG) = $W_2 - W_{1\,(g)}$ Where; W_1 = initial weight

   W_2 = final weight

2. Feed intake = Initial weight of feed – Final weight of feed

3. Specific growth rate per day (SGR) % = $\frac{\text{Loge W2} - \text{loge W1}}{\text{T2} - \text{T1}} \text{ X } 100$

   Where: T_1 and T_2 are time of experiment in days.

   W_2 = final weight at T_2

   W_1 = initial weight at T_1

   Loge = natural logarithm.

4. Relative weight gain (PWG) % = $\frac{\text{Weight Gain}}{\text{Initial Weight}} \text{ X } 100$

5. Food conversion ratio (FCR) = $\frac{\text{Feed Intake(g)}}{\text{Wet Weight Gain(g)}} \text{ X } 100$

6. Protein efficiency ratio (PER) = $\frac{\text{Weight Gain (g)}}{\text{Protein Intake}} \text{ X } 100$

7. Survival rate % = $\frac{\text{Initial stocked} - \text{mortality}}{\text{Initial stocked}} \text{ X } 100$

RESULTS

Proximate Composition of the Experimental Diet

The proximate composition of experimental diet (Table 2) shows that moisture was highest in Diet 2 (5.64%) and lowest in Diet 1 (5.29%). Ash content was highest in Diet 4 (8.31%) and lowest in Diet 5 which was 6.39%. The ether extract (crude fat) level in the diets were irregular with Diet 4 having the highest at 14.00% and Diet 1 being the lowest at 10.09%. The crude fibre level was highest in Diet 4 (4.68%) and lowest in Diet 1 (3.45%). The crude protein was highest in Diet 4 (59.87%) and lowest in Diet 1 (48.79%). Nitrogen free extract (NFE) was highest in Diet 1 (23.72%) and lowest in Diet 4 which was 7.71%.

Proximate composition of experimental fish (Table 3) shows that crude protein level was highest in fish fed Diet 5 (67.21%) and lowest in Diet 1 with 58.48%. The fat content was highest in fish fed Diet 3 (15.56%) and lowest in Diet 5 (9.45%). Ash content of test fish was highest in fish fed with Diet 2 at 13.10% and lowest in fish fed Diet 5 (6.14%). The moisture content was highest in fish fed with Diet 3 (5.11%) and lowest in fish fed with Diet 4 at 4.89%. Carcass fed with Diet 5 had the highest nitrogen free extract (17.42%) and carcass fed with Diet 2 (6.77%) had the lowest value.

Growth and Feed Utilization Parameters

Results from the growth performance and feed utilization of *Heterobranchus bidorsalis* as shown in table 4 showed that Weight gained in Diet 1, 2, 3, 4 and 5 was not significantly different (P>0.05) from each other. However, Diet 4 had the highest weight gain of 2.049g and the lowest weight gain was recorded in Diet 3 (1.02g).

The feed conversion ratio in Diet 1 (1.102) and Diet 4 (1.00) showed no significant difference (P>0.05) from each other as well as Diet 3 (1.873) and Diet 5 (1.542) that showed no significant differences (P>0.05) also. The feed conversion ratio for Diet 2 (2.119) was significantly different (P<0.05) than all other treatments.

Feed intake in Diet 3 (1.843) and Diet 4 (1.950) was not significantly different (P>0.05) from each other. Diet 2 had the highest feed intake of 2.112g and the lowest feed consumption was recorded in Diet 1 (1.562g). This result indicates that the best intake of feed containing blood meal was at 25% inclusion level and that with the combination of both blood meal and fish meal (75%) was more than

The Relative Weight gain of fish feed in Diet 2 (13.58) and Diet (14.53) were not significantly different (P>0.05) from each other, and also, Diet 1 (9.99) and Diet 3 (10.95) were not significantly different. The Relative Weight gain for Diet 5 (11.23) was significantly different (P<0.05) from all other treatments.

The Specific Growth rate for Diet 3 and Diet 4 showed no significant difference (P>0.05) between each other, with Diet 2 (9.010) having the highest Specific growth rate

Net protein unit for Diet 2, 4 and 5 showed no significant difference (P>0.05) from each other while Diet 1 (38.61) showed significant difference (P<0.05) from Diet 3. The net protein unit in Diet 3 (40.78) is significantly different to all the other treatments.

Table 2 Proximate Composition (%) of the Experimental Diets.

DIETS	Moisture	Ash	Fat	fibre	Crude Protein	NFE
Diet 1	5.29	7.34	11.41	3.45	48.79	23.72
Diet 2	5.64	6.82	10.09	4.10	54.92	18.43
Diet 3	5.62	7.54	13.70	3.36	51.14	18.54
Diet 4	5.43	8.31	14.00	4.68	59.87	7.71
Diet 5	5.66	6.39	11.47	3.92	57.92	14.64

NFE= nitrogen-free extract. It was determined by subtracting the summation of the values of crude protein, fat, fibre, ash and moisture from 100%

Table 3 Carcass Composition (%) of *Hetebranchus bidorsalis*fingerlings fed varying levels of bloodmeal based diets for 70 days.

DIETS	Crude protein	Fat	Ash	MC	NFE
Fish (initial) carcass	73.50	15.75	8.37	5.43	4.14
TSF 1	58.48	13.11	12.10	4.96	11.37
TSF 2	63.81	11.32	13.10	5.00	6.77
TSF 3	60.10	15.56	11.88	5.11	7.35
TSF 4	67.21	10.90	9.68	4.89	7.32
TSF 5	62.09	9.45	6.14	4.90	17.42

MC= moisture content, NFE= nitrogen-free extract, TSF= Test fish carcass composition

Table 4 Growth Performance and Feed Utilization of Fingerlings Fed Blood Meal Based Diets.

PARAMETERS	T_1 (0%BM)	T_2 (25%BM)	T_3 (50%BM)	T_4 (75%BM)	T_5 (100%BM)	SEM
Weight Gain(g)	1.485^a	2.019^a	1.205^a	2.049^a	1.482^a	0.411
Specific Growth Rate (%/day)	8.662^{ab}	9.010^a	5.232^c	5.761^c	7.661^b	1.984
Relative Weight Gain (%)	9.99^c	13.58^a	10.95^c	14.53^a	11.23^b	0.57
Protein Efficiency Ratio	3.538^b	4.808^c	2.869^a	6.027^d	3.527^b	1.167
Feed Intake(g)	1.562^c	2.112^a	1.843^b	1.950^b	1.669^c	0.421
Feed Conversion Ratio	1.102^a	2.119^c	1.873^b	1.00^a	1.542^b	0.603

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

DISCUSSION

Weight Gain

This study revealed a significant response in the growth of *Heterobranchus* to the use of blood meal as replacement for fishmeal in the formulation of the fish feed.

The weight gain was not significantly different from other diets ($p>0.05$) but was highest in those fed 25% and 75% blood meal, lower weight gain was recorded in those fed with 0%, 50% and 100% blood meal.This finding indicates that fishmeal in the diet of *Heterobranchus bidorsalis* can only be efficiently replaced with either 25% or 75% blood meal and this observation agrees with Agbebi *et al.,* (2009) who reported that a 25% blood meal substitution of fishmeal in diets gave the best growth performance.

Specific Growth Rate

The specific growth rate and feed conversion ratio was significantly higher in treatment 2; this result agrees with 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 fed with the control diet and the treatment diet with inclusion level of 25% bovine blood and ruminant digest meal. The results obtained from this study showed that fish meal can be replaced with blood meal at 25% inclusion level with no adverse effects on the growth, mortality and feed conversion ratio of *Heterobranchus bidorsalis* fingerlings, although this differs from that 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. Furthermore, the result also revealed that not all feed treatments especially treatment 3 and treatment 4 were accepted by the fish which is similar to the report given by Olukunle *et al.,* (2012) who stated that blood meal can be harmful to fish after 15% inclusion.

Relative Weight Gain (%)

The relative weight gain varied with the different inclusion level of blood meal; it was highest in treatment 4 (14.53%). This variation in growth rate that was highest in diet 4 can be attributed to the use of bloodmeal as the major animal protein source. In the long term feeding trials (120 days) of Otubisin (1987) with caged reared *Oreochromis niloticus* fingerlings also, using blood meal as a fish meal replacer found out that dietary blood meal inclusion levels above 50% of the fish meal protein significantly reduced fish performance.These observed differences in this study could also probably be as a result of the method used to process the blood meal (cooking for about 30minutes) which may have also denatured the amino acid leading to a low growth rate in the fish (Bureau *et al.,* 1999).

Protein Efficiency Ratio

From this study, the protein efficiency ratio (PER) decreased with increased dietary protein levels. The highest value was recorded in treatment 3 where the fish were fed 60.10% CP. The protein content of fish fed the highest CP level was higher and different from the body protein content of fish fed the lowest CP levels. This is in accordance with similar studies with different fish species where body protein level increased with increased dietary protein levels (De Borba *et al.,* 2003, Siddiqui and Khan 2009).

Feed Intake (g)

In general, performance of the fish was increased as the level of fish meal was decreased. The replacement of the fishmeal with blood meal not only changed the nutritional profile of the diet but it also affected the palatability.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 increased as fish meal was removed. The acceptability of the blood meal-based diets was very high and this also resulted to the growth rate.

Feed Conversion Ratio

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 Diet containing the highest blood meal level. The highest value was recorded from treatment 2(2.119%).

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 blood meal. 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 *Clariasgariepinus*diet. *European Journal of Scientific Research.* **83**: 167-172.

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 *Clarias gariepinus* culture in net cages. *European Journal of Scientific Research*. **31**(1): 6-10

Bureau, D.P., Harris,A.M., Cho, C.Y., (1999). Apparent digestibility of rendered animal protein ingredients for rainbow trout (*Oncorhynchus mykiss*). *Aquaculture.***180**: 345-358.

De Borba, M.R., Fracalossi, D.M., Pezzato, L.E., Menoyo, D. and Bautista, J.M. (2003). Growth, lipogenesis and body composition of piracanjuba (*Bryconorbignyanus*) fingerlings fed different dietary protein and lipid concentrations. *Aquatic Living Resources.***16**: 362-369.

Falayi, B.A. (2009). Tropical feedstuff composition tables and some biological catalogues in fish and livestock production. A guide in nutrition technology (1-4). National Institute for Freshwater Fisheries Research (NIFFR), New Bussa, Nigeria. Pp 77.

Food and Agriculture Organization (FAO), (2006). State of world aquaculture. FAO Fisheries Technical Paper. 500: 134.

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

Hixson, S.M. (2014). Fish Nutrition and Current Issues in Aquaculture: The Balance in Providing Safe and Nutritious Seafood, in an Environmentally Sustainable Manner. *Journal of Aquaculture Research and Development*. **5**(3): 2-10.

Macartney, A. (1996). Ornamental fish nutrition and feeding. In: Kelly, N. C., Wills, J.M., (Eds), Manual of Companion Animal Nutrition and Feeding. British Small Animal Vertinary Association, Gloucestershire. UK; 244-251.

Olaniyi, C.O. and Salau, B.A. (2013). The Effect of Pawpaw (*Carica papaya*) Leave meal on the Growth Performance and Blood Profile of African Catfish. *Transnational Journal of Science and Technology*.**3**(7): 3-9.

Olukunle, J.O., Abatan, M.O., Adenubi, O.T., Oyebanji, O.O., Ogbole, O.O. (2012). Anti-inflammatory and anti-nociceptive effects of extract and fractions of *Morinda morindoides* root. *International Research Journal of Pharmacy and Pharmacology*. **2**(6): 118-125.

Omoruwon, K.R. and Edema, U.B. (2011). Influence of rate of feeding on body composition and protein metabolism in sunfish. *Physiology*.**28**:267-282.

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

Siddiqui, T.Q. and Khan, M.A. (2009). Effects of dietary protein levels on growth, feed utilization,protein retention efficiency and body composition of young *Heteropneustesfossilis* (Bloch). *Fish Physiology and Biochemistry***35**: 479-488.