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Effect of Fish Meal Replacement with Blood Meal on the Growth Response and Utilization of Hybrid (*Clarias gariepinus* ♀ X *Heterobranchus bidosarlis* ♂) Fingerlings

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Authors' contributions

This work was carried out in collaboration between both authors. Author BSA designed the study, performed the statistical analysis and wrote the protocol. Author MQD wrote the first draft of the manuscript, managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

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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±0.01 g. 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.

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Keywords: Catfish diet; Heteroclarias; blood meal and fingerlings.

1. 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 [1]. The development of a more sustainable aquaculture feed production will depend on identifying and establishing alternative feedstuffs to fishmeal [2]. Research has shown that most imported feedstuff (fishmeal) can be replaced by locally available feedstuff [3,4,5,6,7]. This, therefore, entails the production of fish feed from locally available materials using local technology in order to reduce the cost and improve the availability of feed to farms.

Catfishes of the family Clariidae comprise the most commonly cultured fishes in Nigeria [8]. Heteroclarias is a hybrid from two African Catfishes. It has been reported to be the most widespread and accepted hybrid fish in Africa especially in Nigeria [9]. 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 [10]. 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 [11]. Although blood meal was found to be a good substitute of fish meal [12] regarding 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.

2. 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±0.01 g) 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 the University of Benin in the laboratory. The 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 30 minutes 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$^{°}$C. The dried blood was then ground finely before it was used in compounding the feed.

2.1 Chemical Analysis

The various diets, bloodmeal and the experimental fish (initial and final carcass) were

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

analyzed for their proximate composition which includes 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.

2.2 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.

2.3 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.

3. RESULTS

The 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 was consumed at different levels within each treatment. Diet 1 had the highest feed intake value of 2.53 g while the lowest feed intake value was recorded in Diet 5 (1.02 g).

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

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.

4. 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 indicates that fishmeal in the diet of *Heteroclarias* can only be efficiently replaced with 10% blood meal and this observation agree with the result of [13] 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 [3] 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 [14] 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 the 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 [3] who stated that fish meal could be replaced entirely 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 a balanced amino acid profile, high digestibility, and palatability which promote good growth of fish [15]. The poor performance of the high blood meal based diets on the fishes agrees with the study carried out by [16] in which the feed containing the highest amount of bloodmeal gave the poorest performance regarding growth and feed conversion ratio. This could be due to the imbalanced nature of the essential amino acid composition in the bloodmeal which was translated into the diet [17,18].

In general, the 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 [19,20] 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 a 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 [21] who reported an increase in feed conversion ratio of fish as the inclusion level of LabLab bean meal increased across the treatment.

5. 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 regarding growth performance, the economics of using it to replace fish meal is positive in the long run.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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