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Blood meal as substitute for fish meal in the diet of *clarias gariepinus* fingerlings: carcass analysis and condition factors

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Abstract
A trial feed was formulated to substitute fish meal with blood meal in the diets of *Clarias gariepinus* fingerlings. Five iso-nitrogenous diets containing crude protein with four replicates in which blood meal was boiled, sundried and mixed with other available materials at varying inclusion levels (10%,15%,20%,25% and 30%) respectively. The analysis of the fish carcass revealed that the diet E with 30% substitution of fish meal with blood meal had the highest protein (52.31%) followed by diet D (blood meal only) 50.43% and finally diet F (control fish meal only) 49.79. In weekly weight increase, diet E with 30% inclusion level had the highest mean weight value of 41.28g followed by diet F (control fish meal only) and diet D with 25% (37.96g), while in weekly increased in length, diet E had the highest increase mean with 8.39cm>diet F 8.13cm > diet D 7.94cm > diet C 6.93cm> diet A 4.95cm. The result therefore are indicative of the fact that the blood meal can serve as fish meal replacers at 30% substitution level without adverse effect on the fish weight, length increase and improve carcass protein.

Keywords: aquaculture, protein, blood meal, carcass composition, condition factor

1. Introduction

Aquacultural practices in the world have grown tremendously and it remains one of the fastest growing agro-industrial activities in Nigeria. Due to increase in human population yearly, the demand for fish food protein has been on a high peak which has made most fish farmers want to engage in large production.

Aquaculture is necessary in a society as Nigeria where anthropogenic activities are carried out on a regular basis as harmful substance are been emitted into the water bodies thereby causing trait to aquatic bio-organisms. Due to this fact there is need for aquatic farming to ensure subsistence and commercial level to meet population demand.

The changing economic, social, political and cultural values of the world have challenged both industrialized and non-industrialized countries to efficiently utilize renewable and non-renewable resources which can be of industrial by products and animals resources.

Feeding is one major problems facing fish farming in Nigeria due to its high cost of feed. Consequently, many local fish farmers use crumbs and other carbohydrate sources to feed fish. The result is poor growth and fish with lots of fat deposits. Researchers and fish nutritionist are seeking for alternative source of protein due to the fact that fish meals are cost effective although it contains Amino acid and other nutritional requirement. There is need to intensity the use of alternative sources of protein (Watanabe 2002) [20].

Protein is a dietary nutrient which affects growth, survival and yield of fish, by providing essential and non-essential amino-acids to synthezise body protein and energy for maintenance. Protein is required in all bio-organisms according to Jena, *et al.,* (2012) [13].

Fish is known to head a high proportion of protein in their diets because they metabolize protein as an energy sources and intensive culture, the cost of feed input is unbearable, primarily because of relatively large percentage of animal protein that has to be incorporated into diets. Abebi *et al.*, (2009). The development of fish feed is essentially based on the information of nutrient digestibility and its conversion rate.

Blood meal is an alternative source of protein for fish meal in diets for many fishes species. Blood meal has a lysine-rich ingredient (6-8% lysine), it is produced using a wide variety of processing techniques. Bareau *et al.,* (1999) and El sayed (1999).

Some researchers have tried mixture of both plant and animal meal such as Martinez Lorens *et al.*, (2008) [16-17] who replaced 10% of fish meal by blood meal with a constant quantity of poultry meal and soya beans meal and obtained better results with a 5% blood meal inclusion. Cowey and sergeant (1979), reported that 10% -20% of lipid in most fresh water fish deits gives optimal growth rates without producing an excessively fatty carcass. On the other hand, Wilson (2000) [21], reported that lipid level in catfish feed should be 5-6%. Also fibre and moisture contents in fish permits better binding and moderate the passages of formulates diets through the alimentary canal. De silva and Anderson (1995) [9], started that fibre content above 8-12% in diets for fish will amount to decrease of the quality of unusable nutrients in the diets. An excessive fibre context results to lower digestibility of nutrients.

Abdulahi (2001), reported that the carcass of *Clarias gariepinus* is composed of moisture (75.00%), ash 10.5%, carbohydrates (10.20%), crude lipid (27.10%) and crude protein 52.20%). The objective of this research is to determine the condition factor weekly increase in length and weight of *Clarias gariepinus* during the experimental period and to evaluate the carcass composition of *Clarias gariepinus* resulting from the various diets.

Materials and Methods

The research was carried out at the hydrobiology/fisheries experimental site in Ignatius Ajuru University of Education, Rumuolumeni Port Harcourt, Rivers State, where necessary apparatus and methods were used in stocking, formulating of feed meal, feeding, measuring and weighing of the fingerlings within a period of eight weeks (56 days).

The water used for the experimental studies was obtained from the Biology Old Lab 1 into the site through borehole water using a pipe and clean host in the farm to supply water into each experimental units to ensure good water quality and oxygen buoyancy in each units. Three hundred (300) *Clarias gariepinus* fingerlings were obtained from Mike Modies Farm, Plot 4 Prince Victor Close by Elioparanwo Road. The fingerlings were transported in 50 liters open plastic rubber half filled with water to the experimental site. This was done in the early hours of the morning to avoid stress in the fingerlings.

The fish was distributed into 24 outdoor tanks, 12 fishes in each tank and allowed to acclimatize for 2 days. During this period, the fishes weren't fed. The initial weight of the experimental fish was weighed using filter paper and chemical weighing balance. The fingerlings were manually fed 5% of their body weight in two portions per day at 9:00am and 16:00pm for 56 days.

The experimental units were cleaned after two days while weekly weight gain was monitored weekly for 56 days. The experimental design consists of six (6) dietary treatment of different inclusion with four (4) replicates each. Diet (A) 10% Bm, Diet (B) 15% Bm, Diet (C) 20%Bm, Diet (D) 25% Bm, Diet (E) 30% Bm and Diet (F) which serves as control feed. The blood meal was gotten from an abattoir at Iwofe slaughter behind the Ignatius Ajuru University of Education, Rivers State, Port Harcourt. The blood was boiled till it loosed it water content after that, the wet boiled blood was sundried to avoid denaturing the protein content for some weeks. The dried blood was grounded finely into tiny particles before it was finally used to compound the feed.

Table 1: Gross Composition of the Experimental Feed

Ingredients	Diet A	Diet B	Diet C	Diet D	Diet E
Blood meal	10	15	20	25	30
Yellow maize	48	48	48	48	49
Garri (binder)	2.0	2.0	2.0	2.0	2.0
Palm oil	1.0	1.0	1.0	1.0	1.0
Vitamin premix	2.5	2.5	2.5	2.5	2.5
Methionine	0.3	0.3	0.3	0.3	0.3
Common salt	0.3	0.3	0.3	0.3	0.3
Wheat brown	35	29.6	24.6	19.6	13.6
Bone meal	1.2	1.3	1.3	1.3	1.3
Total	100	100	100	100	100

Vitamin Premix

Vitamin A	=	15,000.00IP
Vitamin D	=	3,500.00I0
Vitamin E	=	30,000.00mg
Vitamin K_3	=	1,000mg
Folic acid	=	1,000mg
Niacin	=	10,000mg
Vitamin B_{12}	=	8,000mg
Vitamin B_6	=	4,000mg
Biotin	=	30mg
Antioxidant	=	125,000mg
Vitamin K_3	=	3,000mg
Cobalt	=	146mg
Selenium	=	300mg
Iodine	=	1400mg
Iron	=	40,000mg
Manganese	=	96,000mg
Copper	=	16,000mg
Zinc	=	80,000mg
Choline Chloride	=	5000, 00mg

Chemical Analysis

Various diets of blood meal and the experimental fish (initial and final carcass) were analyzed for their proximate composition which includes their moisture content, nitrogen, crude fibre, Nitrogen Free Extract (NFE) according to the procedures of Association of Official Analytical Chemists (AOAC, 2000).

Growth and Feed Utilization Paremeters

Growth and nutrient utilization parameter was calculated as follows;

Mean Weight Gain (MWG) = $(W_2 - W_1)$ g

Where: W_1=Initial Mean Weight (g)
W_2=Final Mean Weight (g)

Nitrogen Metabolism (NM) = $\frac{(0.549)(b-a)h}{2}$

Where: a = Initial Wt of fish
b = Final Wt of fish
h = Exp. period in days
0.549 = Exp. constraint

Percentage Weight Gain (PWG)% = $\frac{\text{Mean Weight Gain}}{\text{Mean Fish Weight}} \times \frac{100}{1}$

Determination of Protein

Kejal method was used to find the percentage of nitrogen content which is calculated by:

% Nitrogen Content =

$$\frac{\text{ml of standard acid} - \text{ml of blank}) \times \text{N of acid} \times 1.4007}{\text{Weight of sample in grams}}$$

Nitrogen is finally converted to crude protein by multiplying by 6.25

Determination of Moisture Content
Moisture content was determined by weighing the samples in a porcelain crucible.

$$\% \text{ Moisture Content} = \frac{\text{Weight of moisture obtained (gm)} \times 100}{\text{Weight of sample (gm)}}$$

Determination of Ash Content
Ash content was determined following the method of A.O.A. C (2000)

$$\% \text{ Ash Content} = \frac{\text{Weight of ash obtained (gm)}}{\text{Weight of sample (gm)} \times 100}$$

Crude Fibre
The crude fibre was calculated by difference. This was done by subtracting the sums of protein, carbohydrate, lipid and ash from a 100.

Crude Lipid
Weight accurately 3 – 4gms of well mixed sample into a dry filter paper, roll and insert in an extraction thimble and extract fat.

$$\%\text{fat} = \frac{\text{Weight of fat/lipid obtained (gm)} \times 100}{\text{Weight of sample (gm)}}$$

Area Analysis
The fish samples (whole body) before and after the experiment and six diets were analyzed for the gross and proximate composition as described by (AOAC, 2000).

Statistical Analysis
Data (Mean Weight Gain, Nitrogen Metabolism, Percentage Weight Gain) the experiment will be subjected to analysis of variance (ANOVA) using completely randomized design.

Results
The increase in length with time of *Clarias gariepinus* under different treatments sample during the period of experimental study is shown in Table 2: the length increase from I.L.V. of 4.12cm to F.L.V 6.50cm with its M.L.V. of 4.95cm in Diet A; I.L.V 4.00cm to F.L.V 8.19cm with its M.L.V 0f 5.54cm in Diet B; I.L.V. of 4.49cm to F.L.V. 9.12cm with M.L.V. of 6.93cm in Diet C; I.L.V. 5.38cm to F.L.V. 10.45cm with M.L.V. of 7.94cm in Diet D; I.L.V. 4.60cm to F.L.V. 11.83cm with M.L.V. 8.39cm in Diet E; in Diet F (control), I.L.V. 5.45cm to F.L.V. 10.71cm with M.L.V of 8.13cm.
Mean Length Value in the test conditions were significantly better at P>0.05 levels than the control. ANOVA test at P>0.05 revealed that Diet E was significantly different from others.

Table 2: Weekly Increase in lenght of *C. gariepinus* (cm) during the experimental period.

Weeks	Experimental Diet (Sample Identity)					
	A	B	C	D	E	F (Control)
1	4.12	4.00	4.49	5.38	4.60	5.45
2	4.09	4.07	5.00	6.65	5.49	6.01
3	4.18	4.19	5.47	7.00	7.50	7.41
4	4.27	4.48	6.89	7.49	8.84	8.00
5	5.01	5.13	7.69	8.01	9.00	8.88
6	5.46	6.78	8.00	8.64	9.85	9.00
7	6.00	7.50	8.79	9.88	10.01	9.61
8	6.50	8.19	9.12	10.45	11.83	10.71
Mean	4.95	5.54	6.93	7.94	8.39	8.13

* M.L.V = Mean Length Value,
I.L.V. = Initial Length Value
F.L.V. = Final Length Value

The result of the application of different feeds formulation on the weight of *C. gariepinus* as shown in table 3. The result indicated that the weekly increase in weight of *C. gariepinus* during the experimental period fish feed with diet E have the highest mean weight (41.28g) followed by fish feed by control diet (38.66g), diet D (37.96g), diet A (33.98g), diet C. (33.31g) and diet (32.18g). Analysis revealed on the weekly increase in weight of *C gariepinus* during the experimental period that Diet A, B, C when compared to Diet F (control feed) are significant at 0.05 level using ANOVA when subjected to Dunnett test.

Table 3: Weekly Increase in weight of *C. gariepinus* (g) during the experimental period

Weeks	Experimental Diet (Sample Identity)					
	A	B	C	D	E	F (Control)
1	23.33	23.30	24.20	21.96	22.92	23.16
2	29.83	30.10	29.20	30.98	29.63	29.96
3	34.89	33.83	32.97	36.14	34.07	33.44

4	34.19	33.96	34.37	36.09	43.33	35.30
5	34.49	29.38	35.62	39.92	43.79	43.25
6	36.07	32.70	33.63	42.28	46.48	45.08
7	39.06	35.66	37.51	45.38	53.08	48.92
8	39.99	38.52	39.01	50.91	56.91	53.15
Mean	33.98	32.18	33.31	37.96	41.28	38.66

* M.W.V = Mean Weight Value.

The proximate analysis of fish carcass in Table 4, before and at the end of experimental period indicated that the protein content in the initial fish carcass is (40.21) g/100g while that of the final carcass at the end of the experiment ranges from sample identity A to F. showing that diet E (52.31)> diet F (49.79)> diet D (50.43) > diet B (47.55)> diet C (47.20)> diet A (44.32). Based on the analyzed data on the proximate analysis of fish carcass before and at the end of experimental period result revealed that all the feed type A, B, C, D, E and F (control) are not significant at 0.05 level when subjected to ANOVA statistics using Dunnet test.

Table 4: Proximate Analysis of fish carcass before and at the end of experimental period

Nutrient Parameter	Sample Identity (Feed type)						
	Initial	**A**	**B**	**C**	**D**	**E**	**F**
Protein (g/100g)	40.21	44.32	47.55	47.20	50.43	52.31	49.79
CHO (g/100g)	5.33	4.04	1.69	3.88	1.94	2.76	1.53
Lipid (g/100g)	14.87	17.93	20.23	15.12	19.66	20.14	27.51
Ash (g/100g)	15.04	12.12	13.95	10.24	10.05	11.35	9.63
Fibre (g/100g)	22.21	17.58	12.63	20.53	12.48	8.70	6.47
Moisture (g/100g)	2.34	4.01	3.95	3.03	5.14	4.74	5.07

Initial = (before experiment)
A – F = Final (at the end of experiment)

Discussion

The mineral and chemical composition of the experimental diets across the dietary treatments did not differ much. The content of the experimental diets is a reflection of the nutritive value of the materials present. The proximate composition of the experimental diets in table 4, fell within the range expected to support growth of fish (Li *et al.,* 2014) [15]. Therefore 10-12% lipid is fish gives an obtimum growth rate without producing an excessive fatty Carcass (Tibbetts and Lau, 2013).

The lipid content (14.87-20.14) fell within the range. Ash and fibre contents (not more than 8-12 percent) is needed for optimal fish growth (Condey, 2002) [7] and the value of this study gives (11.35 Ash and 8.70 fibre) fell within this range. In the diet of E Constituting 30% of blood meal and protein of 52.31% compare to species of *Clarias gariepinus* feed with conventional fish meal.

A higher fiber and ash content generally reduces in the digestibility of other feed ingredients in the diets resulting in high waste output which may cause pollution and poor growth performance of the fish species. Ash supply minerals of both macro arid micro content to the fish while fibre acts as a fitter and when added in the correct level assist in digestion but when in excess reduces the absorption of iron, zinc, and other minerals (Crawford and Allen, 2007) [8]

The values of protein content across the dietary groups (40.21%- 52.31%) also fell within the acceptable range (28-39 percent) for catfish and is in agreement with research of Bob-Manuel and Edoghotu, (2017) [5] on wheat bran grown Brewery yeast as feed for *Clarias gariepinus* with protein ranging 39.26-50.91 percent. Moisture content is very important because, when it is added accurately, the feed formulation, it helps to improve the quality of pellets in terms of its hardness, durability and storage condition. It helps to maintain weight of pelleted fish feed (Fuller, 1999) [12]. From this research work, moisture content ranges from 2.34-5.04%. This is in contrast with the findings of Bob-Manuel 2017 (1.09-8.42 percent).

The results from the analysis of the length/weight relationship of *Clarias gariepinus* fingerlings under the study condition of feeding trial on blood meal in varying level of inclusions are shown in table 2 and 3; indicated that Diet E such as M.L.V 8.39cm and M.W.V 41.28g is greater than Diet F control with M.L.V. of 8.13cm and M,W,V. of 38.66g.

Diet E gives a positive allometric because fish becomes heavier with increase in length and weight. Fasakin *et al.,* 2003; Ajani *et al.,* 2004 [3] and Sogbesan 1998 [19], stated that fingerlings are always able to convert the protein components in Natural meals more efficiently than those found in artificial feeds. This is in agreement, because Diet E utilize proper nutrient and from the feed better than Diet F control.

Also, Kibria *et al.,* (1997) [14], reported that fishes feed with natural feeding ingredients tends to possess fatness at a particular length and in a better condition. This findings are in agreement since Diet D gives a betters positive allometric because fish becomes heavier with increase in length and weight. Although from the results above Diet D with M.L.V of 7.94cm and M.W.V. of 37.96g > Diet C (M.L.V. 6.93cm, M.W.V. 33.31g) > Diet B (M.L.V. 5.34cm, M.W.V. 32.18g) and Diet A (M.L.V. 4.95cm, M.W.V. 33.98g). This values are lower when compared to those recorded by Bob-Manuel (2013,a) [6] using commercial cat fish feeds for *C gariepinus* fingerlings which ranges between 24.43-57.30g.

The different diets shows positive condition factors and response except for Diet A with inclusion level of 10% which shows a poor performance in length and weight. This fact disagrees with the findings of Otubunsi (2000), reported that replacement of fish meal with 10% blood meal in pelleted feed was adequate for *Orechromis niloticus* production in floating bamboo net cages.

The present study revealed that Diet E proved to be most conducive for rearing *Clarias gariepinus* fingerlings. And it was the best alternative in comparison with Diet F control because it gave rise to the best growth rate and size increase.

Conclusion

The results obtained from this study shows that blood meal can be affectively at 30% substitution as an alternative source for total replacement of commercial feed in the culture of *C. gariepinus* fingerlings. From this study the diet of 30% gives the best mean weight value of 41.28g and mean length value of 8.39cm to other experimental diets.

Recommendation

Although blood meal at 30% has proven to be effective substitutes and secondary protein source to fish meal in aquacultural practice, its role should be addressed in the light of new information and public confidence in commercial animal based feeds. This is hoped to bring down the cost of aquafeed production by utilizing less of the expensive fishmeal for sustainable aquaculture.

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