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Full Length Research Paper

Utilization of blood meal as a protein ingredient from animal waste product in the diet of *Oreochromis niloticus*

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Three iso-nitrogenous diet of 35% crude protein were prepared with blood meal at various inclusion level of 0, 50 and 100%. These were coded Treatment 1 (T1), Treatment 2 (T2), and Treatment 3 (T3) respectively. The diet with 0% blood meal was used as control. *Oreochromis niloticus* average initial weight of 6.20±0.02 g were randomly allocated to three treatment diets, 20 fingerlings per unit net-hapa, for a period of twelve weeks (84 days). The three treatment diets (T1, T2 and T3) were replicated in three net-hapas each of dimension 1 × 1 × 1 m, stacked in concrete tanks. Each dietary treatment was tested in triplicate group of 20 fingerlings per unit hapa. The experimental fish were fed twice daily at 5% of biomass for a period of twelve weeks. Final average weight gain, specific growth rate, protein efficiency ratio, protein intake, were highest in the fish fed with 100% BM (T3) inclusion. The analysis of variance showed significant difference P<0.05) in the feed treatments on the growth of (*O. niloticus*). There were no significant difference (p >0.05) in growth performance among fish fed diets. However, fish fed diet 100% BM (T5) had higher (p<0.05) growth than those fed with 0% (T1) and 50% (T3) BM respectively. There was no mortality recorded during the period of the experiment. The results showed that blood-meal performed very well as a feedstuff and inclusion of rate of 100% could replace fishmeal in Tilapia diet with no adverse effect on growth and survival of *O. niloticus* fingerlings.

Key words: Blood meal, fishmeal, protein, diet, *Oreochromis niloticus*, substitution.

INTRODUCTION

Fish are known to need a high proportion of protein in their diet because they metabolize protein as an energy source. Fish meal is the conventional source of animal protein in fish diet and it has been valued for its balanced amino acids, vitamin contents, palatability and growth factors (Tacon, 1993). Fagbenro (1999) reported that feed cost is the major constraint in aquaculture. Fish feed forms an integral part of aquaculture and one of the most important factors to its development, considering that feed form as much as 60% of the operational cost in fish farming (Ayinla and Bekibele, 1991). According to Fagbenro (1999), to reduce the price of a complete feed, locally available feed stuff should be included in the feed, especially agricultural by-products.

The success of fish farming invariably depends on the provision of suitable and economical fish feed (Delgedo and Minot, 2003). He further reported that Agriculture is likely to grow over the next 20 years and some experts are concerned that rising demand for fish meal and fish oil could place heavier fishing pressure on already

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Table 1. Percentages composition of experimental diets.

Ingredients (kg)	Treatments		
	T1	T2	T3
Maize	16.02	16.02	16.02
FM	54.6	27.3	0
BM	0	27.3	54.6
PKC	27.3	27.3	27.3
P/Oil,Vit Pre,Cal.Phos	2.0	2.0	2.0
	0%	**50%**	**100%**

threatened stocks of fish which will invariably increase the cost of fish meal in the world market. Many scientists have reported the possible use of some alternative animal protein feedstuffs to fish meal. The high cost and scarcity of fish meal in formulated feeds has led to the use of other protein source such as earthworm, insects, snails, maggots, and frogs (Tacon et al., 1983; Lim and Dommy, 1989; Fagbenro, 1993). Blood meal which is an animal waste product and readily available in abattoirs is an alternative cheaper protein source. The development of a more sustainable aquaculture feed production will depend on identifying and establishing alternative feedstuffs to fishmeal (Olukayode and Emmanuel, 2012).

The objective of this study is to determine the rate of growth and nutrient utilization of *Oreochromis niloticus* fed with various inclusion of blood-meal, and also the economic viability of feeding *O. niloticus* with various inclusion level of blood-meal.

MATERIALS AND METHODS

The experiment was carried out for a period of 12 weeks. Ten hapas, each of dimensions 1 × 1 × 1 m used were arranged in concrete ponds with surface area of 100 m^2 (10 × 10 m). The fish used for the experiment were acclimatized for 24 h before they were used for the experiment. One hundred and eighty fingerlings of *O. niloticus* weight range (6.01 to 6.26 g), and mean (6.20 to 0.002 g) were randomly assigned to the hapas at a stocking density of twenty per hapa, to each of the dietary treatments. The experimental fish were fed twice daily at 5% body weight. The quantities of feed were then adjusted weekly in accordance with weight gain of fish.

The cow blood used was collected from abattoir. It was clear free of hair, intestines etc and it was oven dried at 60°C to produce the blood meal. Three diets were formulated to contain 0, 50 and 100% blood meal in replacement of fish meal. The control diet is the one containing 100% fish meal without blood meal .The formulation is shown in Table 1.

Growth and feed utilization were calculated using the following parameters

The total weight gain (TWG), relative growth rate (RGR) (%), specific growth rate (SGR) (%/day), total feed intake (TFI), feed conversion ratio (FCR), protein intake (PI), protein efficiency ratio (PER) and survival (%) were determined according to the methods of Sogbesan et al. (2005).

Water quality parameters

Temperature, dissolved oxygen (DO), pH and salinity were monitored twice a day using Horriba Water Quality Checker U22XD.

Statistical analysis

Significant differences among the means of the above parameters were determined through one way analysis of variance at 5% and Duncan's new multiple range tests using the SPSS Statistical Package (SPSS, 1996).

RESULTS

The inclusion of blood meal in the experimental diet positively affected the growth of fish in the study as shown in Figure 1. There were steady increase in the specific growth rate, weight gained, biweekly growth rate, protein retention, and food conversion ratio from the beginning of feeding trail in T1 (O inclusion), T2 (50% inclusion) and T3 (100% inclusion) to the end of the feeding trial respectively. A summary of the mean weight gain of *O. niloticus* forth nightly are shown in Table 2. Fish fed with 100% blood meal had the highest meal weight of 69.0 g/fish while lowest value 36.60 g/fish was recorded in fish fed 0% blood meal (Table 3). The lowest specific growth rate was also recorded in 0% blood meal diet. Survival was high in all the diets (Table 4).

Cost implication of the replacement was analysed (Table 5). The cost analysis of the three diet treatments shows that diet T3 (100% blood meal) was the cheapest among the three dietary treatments (N101.43) followed by diet T2 (N115.26) and finally diet T1 (N129.00). The oil and mineral/vitamin premix in each of the dietary treatment are of the same quantity. It is therefore negligible in the cost analysis of the three treatment diets.

DISCUSSION

Mammalian blood meal had frequently been used as a

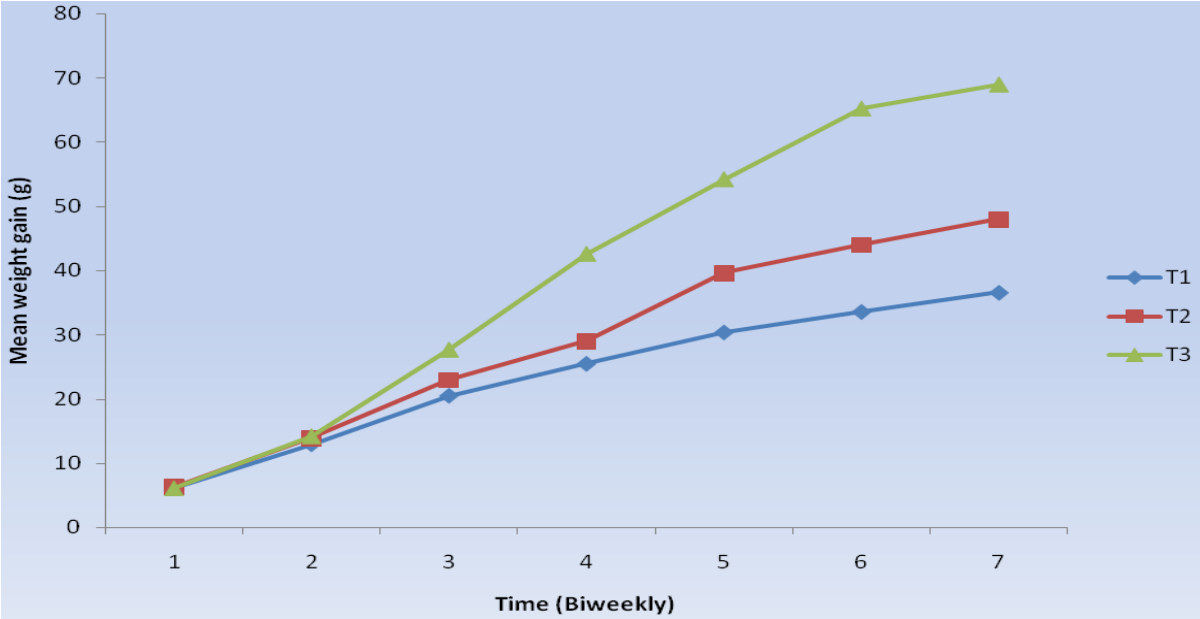

Figure 1. Bi Weekly growth pattern of *Oreochromis niloticus* fed different blood meal inclusion diets.

Table 2. Proximate composition of experimental diets.

Parameter (%)	Treatment diets		
	T1	T2	T3
Crude protein	34.35	35.14	37.49
Ether extract	1.49	1.50	1.97
Fibre	9.85	7.43	7.43
Ash	9.00	9.00	8.00
Moisture	9.50	10.25	10.00
N.F.E.	35.85	36.68	35.11

Table 3. Growth and feed utilization of Tilapia (*Oreochromis niloticus*) fed with different level inclusions of blood meal.

Parameter	Treatment 1	Treatment 2	Treatment 3
Experimental days	84	84	84
No of fish stocked	20	20	20
Initial average weight (g)	6.20	6.26	6.15
Final average weight (g)	36.60	48.00	69.00
Average weight gain (g)	24.20	41.74	62.85
Mean weight gain/day (g)	0.29	0.50	0.75
Average weight gain/weekly	2.02	3.48	5.24
Mean weight gain/biweekly	4.40	6.96	10.47
Total (Relative) weight gain (%)	390.00	666.77	1021.79
Specific growth rate	0.93	1.06	1.27
Total feed intake (g)	8.30	10.14	13.96
Feed conversion ratio	0.34	0.24	0.22
Protein intake	2.92	3.49	5.2
Protein efficiency ratio	56.76	58.38	53.40
Survival (%)	100	100	100

Table 4. Water quality parameter.

Parameter	Range
Dissolved oxygen (mg/L)	5.5 -5.5
Temperature (°C)	28-30
pH	6.45 -6.60
Salinty (ppt)	0.20 -0.21

Table 5. Cost implication of utilizing the experimental diets.

Ingredients (kg)	Prices (N/kg; $/kg; £/kg)	T1 (N; $; £)	T2 (N; $; £)	T3 (N; $; £)
Maize	N67; $101.84; £16013	N1.07; $1.63; £3829.78	N1.07; $1.63; £3829.78	N1.07; $1.63; £3829.78
Fish meal	N400; $60800; £95600	N21.84; $3319.68; £13049.0	N10.32; $165.98; £3828.78	N0; $0; £0
Blood meal	N40; $6080; £9560	N0; $0	N1.09, $1659.84	N2.18; $330.14
Palm kernel cake	N25; $3800; £5975	N.6825; $103.74; £6524.7	N.6825; $103.74; £3828.78	N.6825; $103.74; £3828.78
Palm oil, Vit.premix, Cal.phos	Negligible	Negligible	Negligible	Negligible
Total cost	1 kg (N532; $70781.84; £127148)	1 kg(N23.5925; $342.05; £ 23403.48)	1 kg(N13.1625; $272.35; £11487.34)	1 kg (N3.9325; $435.51; £7658.56

high quality protein source in Salmonid feed. Dominy and Ako (1988) reported that blood meal products can replace marine proteins in grow-out rations for medium sized (3.4 g) *Pannaeus vannamei*. The result also indicated that the blood meal product containing covalently attached methionine may be a potentially useful way to supplement limiting amino acids in shrimp diet.

Davies et al. (1989) reported that optimum meal and bone meal with blood meal could effectively replace up to 75% of the fish meal in the diets fed to Mozambique tilapia *O. mossambicus* fry over in seven week period. Viola and Zohar (1984) in support of experiment carried out by Otubisin (1987) reported that up to 50% of fish meal could be successfully replaced within tilapia feeds by poultry by products. In the long term feeding trials (120 days) of Otubisin (1987) with caged reared *O. niloticus* fingerlings (3 initial body weight) using blood meal as a fish meal replacer found that dietary blood meal inclusion levels above 50% of the fish meal protein significantly reduced fish performance. In this experiment opposite is the case, some other factors such as feeding rates and frequency, rearing condition and other environmental factors might have contributed to this, suggesting that blood meal can either completely or partially replace fish meal in the diet of *O. niloticus* fingerlings. Agbebi et al. (2009) reported that fish meal can be replaced completely (100%) by blood meal with no adverse effect on growth, survival and feed conversion of *Clarias gariepinus* juvenile. Their result corroborate with this research work which shows that fish meal can be substituted completely (100%) by blood meal with adverse effect on growth, survival and feed conversion ratio in Tilapia (*O. niloticus).*

Research work on replacement of Fish meal with blood meal in the diet of fish, will have to be intensified in order to formulate least cost fish feed for better fish growth, so as to reduce the cost of fish production in aquaculture sector.

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