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The Comparative Effect of Fish and Blood Meal Based Diets on the Growth and Survival of Juvenile Tilapia (*Oreochromis niloticus*) in Concrete Tank

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ABSTRACT

Protein is the most important nutrient in fish diet. The protein in the ingredients must not only be chemically available but it must also be biologically available for the fish to utilize it. An experiment was carried out to find out the comparative effect of imported fish meal, blood meal and local fish waste based diets on the growth and survival of juvenile tilapia (*O. niloticus*) in concrete tank. Four diets consisting of Nigerian Institute for Oceanography and Marine Research (NIOMR) pelleted feed (40% CP) (treatment 1 and control), fresh boiled cattle blood (30% CP) (treatment 2), fresh cattle blood (30% CP) (treatment 3) and local fish waste meal (30% CP) (treatment 4) were fed to juvenile tilapia. The average initial weight of the fish was 55.24 g. The experiment was a completely randomized design in four replicates. There was no significant difference ($p<0.05$) in the body weight gain, average daily weight gain and average body length between the treatments. However, the relative weight gain of treatments 1 (93.69%) and 2 (80.21%) were significantly higher ($p<0.05$) than treatments 3 (62.37%) and 4 (64.85%). The survival was 100% in all treatments. Treatment 2 was more cost effective at ₦539.06 kg^{-1} fish, followed by 1 with ₦667.52. Treatments 3 and 4 had the highest at ₦698.20 and ₦718.60 kg^{-1} fish. The trial showed that tilapia feed processed with fresh cattle blood performed as well as imported fish meal, boiled blood and local fish waste and in addition was more cost effective.

Key words: Non-conventional feed, protein, growth parameters, nutrient utilization, survival rate, tilapia

INTRODUCTION

Protein provides the major basis for growth, development and reproduction etc., in fish (Steffens, 1989; Kaushik, 1995). The protein source is the major indicator of the quality of protein with fish meal excelling all other alternatives in fish feeding (De Silva and Anderson, 1995). The nutritional practice is to combine animal and plant protein concentrates. The available nutrient in one complements the deficiency in the other (Jackson and Capper, 1982; Tacon and Jackson, 1985). The availability of fish meal for large scale production of fish feed is highly suspected (Naylor *et al*., 2000). Its use in Nigeria, is dependent on importation with resultant high cost and waste of foreign exchange. Cattle blood available in most abattoirs in Nigeria is currently not

efficiently used. Harris (1980) asserted that the combined deficiency of cystine and methionine in blood meal could be remedied by fortifying with pure synthetic methionine which is available as a feed supplement. Ogunji and Wirth (2001) in their study on alternative protein sources as substitute for fish meal in the diet of young tilapia (*O. niloticus)* observed that a proper combination of soya beans, blood meal (not more than 6% level), groundnut cake and wheat bran could provide the 42-45% protein needed by the fish. Such combination could provide the low cost feed required for low cost of production (Webster *et al*., 1992; Tacon and Jackson, 1985) which is needed for tilapia production. This work was thus effected to find out the comparative effect of cattle blood made into feed in the fresh liquid state, boiled state, imported fish meal and local fish waste meal based diets on the growth and survival of tilapia and the resultant cost benefit effect on stagnant concrete tank, the system mostly used by farmers in Nigeria.

MATERIALS AND METHODS

Feed for the trial-Pelleted commercial feed (6 mm size) obtained from NIOMR Lagos, containing 40% cp and made up of imported fish meal, defatted soya bean meal and groundnut cake as crude protein sources and corn and wheat bran as carbohydrate sources, served as the control. Three other diets were formulated at 30% Cp with 8.5% CP contributed by fresh, boiled blood and local fish meal, respectively as animal protein sources with soybean cake as plant protein source and wheat bran and garri as carbohydrate sources. The formulae are as shown in Table 1. The materials were scaled out according to the formulae, ground, mixed and pelleted with a 6 mm die. The nutrient composition in all the diets were calculated as shown in Table 1.

Feeding trial: The four diets were allotted to 1 m^3 concrete tanks in the family testing unit at the African Regional Aquaculture Centre (ARAC) Aluu, Port Harcourt, as four treatments each with 4 replicates in a completely randomized design.

Table 1: Ingredient and calculated proximate composition of experimental diets

Ingredients	Diet 1 (control diet)	Diet 2 (fresh blood)	Diet 3 (boiled blood)	Diet 4 (local fish meal)
Wheat bran	10.80	46.40	46.40	41.92
Corn	10.80	-	-	-
Soya bean	32.40	33.01	33.01	34.75
Fish meal	18.40	-	-	13.33
Blood meal	-	10.00	10.00	-
Groundnut cake	34.60	-	-	-
Garri	-	5.00	5.00	5.00
Vegetable oil	0.70	5.00	5.00	5.00
Vitamin/trace mineral premix	0.25	0.25	0.25	0.25
Methionine	-	0.35	0.35	-
Vitamin C	0.10	0.10	0.10	0.10
Total (%)	100.00	100.00	100.00	100.00
Proximate composition:				
Crude protein	44.38	30.44	30.44	30.50
Ether extract	5.23	8.14	8.14	8.60
Crude fiber	5.60	5.46	5.46	5.25
Ash	4.33	4.54	4.54	6.87
Moisture	11.60	12.54	11.54	12.12
NFE: nitrogen free extracts	28.86	38.88	39.88	36.16

Eleven juvenile tilapia were stocked per tank at an average initial weight of 55.24 g. Borehole water was supplied from a concrete reservoir. Water quality parameters such as PH, temperature and DO were measured using the pencil type pH meter with temperature display and LaMotte fresh water aquaculture test kit (Model AQ-2, code 3633-03) for DO every week.

At the beginning of the third month, electricity failure and damage to the borehole pump led to acute water shortage with resultant effect on water quality. Remediation measures included the agitation of the water in all the tanks to raise the DO level.

Sampling was done every month and new weights and lengths determined. The new feeding rate was worked out based on the new biomass. At the end of the trial in 4 months, final weights and length were determined.

Statistical analysis: The means of growth performance, nutrient utilization and survival parameters were subjected to Analysis of Variance (ANOVA). Where differences occurred, they were separated by Duncan Multiple range test.

RESULTS AND DISCUSSION

Physicochemical parameters: The result of water quality as shown on Table 2 indicated fair pH value of 7.07 for borehole water and 6.87, 6.75, 6.86 and 6.87 for months 1, 2, 3 and 4 averages for tank water and temperature values of 28.9, 28.1, 30, 28.4 and 28.6°C, respectively. Dissolved oxygen values were low at 2.35, 1.53 and 1.85 mg L^{-1}. The values rose again to 2.89 mg L^{-1} following remediation action. All the diets had similar effect on the quality of tank water.

Growth performance: There was gradual increase in body weight within the first two months of the trial in all treatments (Table 3), followed by a drop in the third month due to very low DO. This agrees with the finding of Okaeme (1990) that low DO retards the growth of juvenile fish. A rise occurred again with remediation action in the 4th month. Condition factors (Table 4) improved in all the treatments for the first two months, dropping in the third till the end. Average final body

Table 2: Physicochemical parameters of borehole and tank water

		Experimental tank water			
Parameters	Borehole	Month 1	Month 2	Month 3	Month 4
pH	7.07	6.87	6.75	6.86	6.87
Temperature (°C)	28.90	28.10	30.00	28.40	28.60
DO_2 (mg L^{-1})	2.35	1.53	1.85	0.85	2.89

Table 3: Average monthly body weight of juvenile tilapia (g)

Treatments	Initial	Month 1	Month 2	Month 3	Month 4
1	52.50	81.00	110.83	91.98	100.83
2	53.85	79.58	105.12	89.26	96.54
3	61.45	83.46	103.19	92.61	98.40
4	53.17	71.40	95.91	78.75	86.82

Table 4: Average monthly condition factor

Treatments	Initial	Month 1	Month 2	Month 3	Mount 4
1	1.36	1.99	2.28	1.68	1.60
2	1.36	1.72	2.14	1.65	1.61
3	1.51	1.73	2.04	1.60	1.57
4	1.38	1.80	2.06	1.61	1.45

Table 5: Growth performance, nutrient utilization and survival of juvenile tilapia fed the experimental diet

Parameters	Diet 1 (control)	Diet 2 (fresh blood)	Diet 3 (boiled blood)	Diet 4 (local fishmeal)
Growth performance				
Av. initial body weight (g)	52.50	53.85	61.45	53.17
Av. initial length (cm)	15.67	15.82	15.98	15.66
Av. final body weight (g)	100.83	96.54	98.40	86.82
Av. final length (cm)	18.47	18.16	18.45	18.14
Av. weight gain (g)	48.34[a]	42.68[a]	36.95[a]	33.65[a]
Av. daily weight gain (g)	0.41[a]	0.36[a]	0.31[a]	0.28[a]
Av. relative weight gain (%)	93.69[a]	80.21[a]	62.37[b]	64.85[b]

[a,b]:Means of the same suffix not significantly different ($p>0.05$)

weight of 100.83, 96.4 and 86.82 g and average body length of 18.47, 18.16, 18.45 and 18.14 cm for treatments 1 (control), 2 (fresh blood), 3 (boiled blood) and 4 (local fish waste meal based diet), respectively, Showed no significant difference ($p>0.05$) (Table 5).

Average weight gain of 48.34, 42.68, 36.95 and 33.65 g for treatments 1-4, respectively, also showed no significant difference ($p>0.05$). The same was true for average daily weight gain of 0.41, 0.36, 0.31 and 0.28 g. However relative weight gain (Table 5) was higher in treatments 1 and 2 at 93.69 and 80.21 than in treatments 3 and 4 at 62.37 and 64.85%, respectively ($p<0.05$). This result contradicts the findings of Ogunji and Wirth (2001) who observed that blood meal inclusion rate not exceeding 6% may be recommended for *O. niloticus* and that beyond this level poor performance of fish was noticed and increased mortality. The level used was 10% and compared effectively with the fish meal based diet. The fresh blood type more so. The reason for this may not be unconnected with the fact that absorbing fresh blood in wheat bran and other materials and pelleting before sun drying ensures that nutrients which could be destroyed by heat in the conventional method of processing blood meal are saved as observed by Sonaiya (1988). The combination also improves the ratio of leucine: Isoleucine and removes the antagonism between the two observed by Taylor *et al.* (1977) and fortification with methionine takes care of the deficiency in blood meal and soybean meal as stated by Harris (1980). The relatively poor growth rate in all the treatments was due to the low DO level particularly after the second month.

Survival: Survival was 100%, showing that tilapia could survive even beyond 6% level of blood inclusion, contrary to the observation of Ogunji and Wirth (2001).

Cost effectiveness: Diet 2 (fresh blood diet) produced 1 kg of tilapia at the lowest cost of ₦539.06 (Table 6), followed by diet 1 (control) with ₦667.52. Diets 3 and 4, the boiled blood

Table 6: Estimation of cost effectiveness

		Diet 1		Diet 2		Diet 3		Diet 4	
Ingredients	Cost kg^{-1} ing. (n)	kg ing. /100 kg^{-1} diet	Cost/100 kg^{-1} diet (n)	kg ing. /100 kg^{-1} diet	Cost/100 kg^{-1} diet (n)	kg ing. /100 kg^{-1} diet	Cost/ 100 kg^{-1} diet (n)	kg ing. /100 kg^{-1} diet	Cost/ 100 kg^{-1} diet (n)
Wheat bran	36	10.80	388.80	46.40	1670.40	46.40	1670.40	41.92	1509.12
Corn	60	10.80	648.00	-	-	-	-	-	-
Soya bean	140	32.40	4536.00	33.01	4621.40	33.01	4621.40	34.75	4865.00
Imported fishmeal	350	18.40	6449.00	-	-	-	-	-	-
Blood meal	120	-	-	10.00	1200.00	10.00	1200.00	-	-
Garri	145	-	-	5.00	725.00	5.00	725.00	5.00	725.00
Local fishmeal	250	-	-	-	-	-	-	13.33	3332.50
Vegetable oil	350	0.70	245.00	5.00	1750.00	5.00	1750.00	5.00	1750.00
Premix	1000	0.25	250.00	0.25	250.00	0.25	250.00	0.25	250.00
Methionine	1400	-		0.35	490.00	0.35	490.00	-	-
Vitamin C	5000	0.10	500.00	0.10	500.00	0.10	500.00	0.10	500.00
GNC	110	34.60	3806.00	-	-	-	-	-	-
Total		100.00	16,813.80	100.00	11,206.8	100.00	11,206.80	100.00	12,937.62
Cost effectiveness:									
1. Cost kg^{-1} diet (n)			168.14		112.07		112.07		129.38
2. Amount of feed required to produce 1 kg^{-1} fish (FCR)		3.97		4.81		6.23		5.55	
3. Cost effectiveness (1)×(2)			667.52		539.06		698.20		718.06

and local fish meal based diets had the highest cost at ₦698.20 and ₦718.06, respectively for every 1 kg^{-1} of the fish produced. The high cost was due to the poor growth in all the treatments.

CONCLUSION

The study showed that blood meal compares favourably with fish meal particularly when used fresh in processing the feed for juvenile tilapia. It is also more cost effective.

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