Journal of Fisheries International 1 (2-4): 87-91, 2006

Nutrient Utilization and Growth Performance of Clarias Gariepinus Fingerlings Fed Tilapia (*Oreochromis nilotica*) fishmeal

O.A. Oyelese
Department of Wildlife and Fisheries Management University of Ibadan Ibadan. Nigeria

Abstract: The utilization of cheap, abundant, highly prolific whole Tilapia (*Oreochromis nilotica*) for fish meal in Clarias gariepinus fingerlings diets as an alternative to conventional Danish fishmeal is tested in this study. The fish meal was produced and kept for 3 months and the quality was found to be intact,in terms of its proximate composition (crude protein, fat,moisture, crude fibre and nitrogen free extract were the same at the end of the third month). Part of the fish meal was used in compounding six tilapia fishmeal based isonitrogenous diets (0, 20 40, 60, 80 and 100%) of 40% Crude Protein (C.P) to feed *Clarias gariepinus* fry (0.517-0.733 gm), stocked at 30 fry/250 litre bowl for six weeks, with daily changing of water before feeding. The tilapia fish meal (C.P-65.69%) qualities were intact at 3 months and compare favorably with the 72.00% Danish fish meal with which it was supplemented. Significant variations in terms of growth performance and nutrient utilization $p<0.05$ occurred at all levels of diet treatments. The Tilapia fish meal (TFD)-80% (SGR-3.68) was the best having the lowest fish mortality rate of 17.48%, lowest food conversion ratio (F.C.R) of 1.4269% and highest specific growth rate (S.G.R) of 3.68% coupled with highest protein efficiency ratio of 0.2365%. While the TFD–0% (with no tilapia fish meal inclusion) had the least growth performance; with the lowest S.G.R of 1.61% and highest mortality rate of 28.01% along with the TFD -20% diet which also recorded mortality of 28.85%

Key words: Tilapia (*Oreochromis nilotica*) fish meal danish fish meal, isonitrogenous diets, *Clarias gariepinus* fingerlings, growth and nutrient utilization

INTRODUCTION

The need for a cheaper relatively abundant source of fish meal necessitates the search for an alternative source of fish meal production, that the potency will meet or close to the standards of the present stock of imported fish meal available in the market, with crude protein levels ranging from 65%-72%.[1-3].

McBay [4] reported that Tilapia is of a wide variety of the family Cichlidae which is widely distributed throughout the Tropical and sub-tropical regions of Africa, central and North America; they are omnivores with little selectivity in their feeding habits.

Tilapia niloticus (*Oreochromis niloticus*) have several attributes which makes it a prospective species for large-scale aquaculture in the warm water regions of the world. Balarin,[5] The species exhibits fast growth and has the ability to breed under the most diverse conditions all year round. It is remarkably hardy, with a high tolerance to high stocking densities, wide range of salinities and generally degraded water conditions. Although *Oreochromis niloticus* is predominantly herbivorous, it has the ability to utilize various kinds of animal and vegetable wastes and would accept supplementary diets with good food conversion. FAO[6] reported that protected harvest of about eight million tonnes per annum is attainable in Africa alone.

The prolific breeding and overpopulation of tilapia nevertheless constitutes their major disadvantage, especially the resultant stunted growth which leaves a large proportion of the fish population below marketable size (much less than 500 gm weight). It is a low priced fish because it is bony and also for its small size. It is cheap when compared with other fresh/frozen fish sold in the market and hence the proposal for its use in fish meal production.

The importance of fish meal can best be judged by the fact that some 30% of the World catch ends up as fish meal. Fish meal is produced from a number of raw materials which include: skeletal remains of filleted fish, fish Cannery waste, fish offal, whole fish generally regarded as inedible, some varieties of herring, pilchards and many very small fish[7,8].

About 90% of world fish meal production is from only fish species such as mackerel, pilchard, capelin and menhaden. Less that 10% is from white fish offal such as cod and haddock. Only 1% produced from other sources such as shellfish and whales. The majority of fishmeal is "whole' that is, only water and some oil are extracted from the fish FAO[9].

According to FAO[9] fishmeal is used for poultry, pigs, ruminants, farmed fish and for producing animals. It increases productivity and improves the efficiency with which feed is converted to animal protein. It is of special value in diets for young animals, for example in broiler starter diets for early weaned pigs, also for farmed fish and for producing animals.

Fish meal has been shown to be superior to other proteins, especially vegetable proteins, in supplying a balance of amino-acids for farmed fish. Fishmeal is particularly beneficial in situations which are less than ideal, for example, where feed mixing and quality control of ingredients is poor, where husbandry standards are less than ideal and where disease problems are prevalent. Although fishmeal is often traded on a price per unit of protein, the commercial value of fishmeal is determined not only on the basis of protein. Its value is affected by fishmeal supply, price of other fish feed protein sources like, G.N.C (ground nut cake), soyameal etc and of course demand.

This study therefore explored the utility, quality and especially the suitability of *Tilapia (Oreochromis nilotica)* fish meal as an alternative to the conventional Danish fish meal in the diets of *Clarias gariepinus* fry/fingerlings.

The objectives of this study are:

- To produce *Tilapia nilotica* fishmeal and supplement with 72% conventional Danish fish meal in the diet of *Clarias gariepinus* fingerlings.
- To determine the suitability of *Tilapia* fishmeal as an alternative to the conventional fishmeal in the growth performance and nutrient utilization of *Clarias gariepinus*

MATERIALS AND METHODS

Quality assessment of fresh tilapia fish: Twenty kilograms live tilapia fish were bought from Asejire dam and transported straight to the Department of Wildlife and Fisheries Management laboratory Organoleptic assessment of the fresh fish was carried out and the following observations wererecorded.

1	Skin pigmentation	Vivid colour	2
2.	Skin mucus	Transparent	1
3.	Eye tint	Black brilliant pupil	1
4	Eye shape	Bulging	1
5	Gills tint	Brilliant colours	1
6	Gills colour	Sea weedy	1
7	Flesh rigidity	elastic	2
8	Rigidity of the abdominal wall	intact	1
9	State of peritoneum	intact and adherent	2
10	Adherence of back bone	Adherent	1
11	Colour of flesh surrounding back bone	Normal/ same colour as the rest of the flesh	1
12	Odour of cooked flesh	Sea weedy	1
13	Flavour of cooked flesh	Slightly specific	2

N.B - Organoleptic assessment scores • Excellent • Very good • Good • just fair • poor • very poor

Tilapia fish meal preparation: Materials/equipment: fresh *Tilapia (Oreochromis nilotica)* weighing balance/scale, wire gauze, oven, grinder, sieve net/mesh, plant containers, knife.

Procedure:

- 6 kg fresh fish (*Tilapia*) was weighed out gutted and washed.
- The fish was left on wire gauze for a while to allow water drip off
- The fish was loaded into the oven, which was regulated to 75°C till the fish was thoroughly dried.
- The fish was taken to be dried when the pieces begin to crumble between the fingers (This took 34 h)
- The fish was reweighed after drying (The weight of the dried fish was 1. 50 kg)
- The dried fish was ground into fine meal with an electric grinder.

A sample was taken for proximate analysis some were kept and the remaining meal used in compounding diet for the experiment. Scales were not removed from the fish and the drying temperature was between 70-80°C

Experimental fish: Fry of *Clarias gariepinus* of average size range (0.517 gm-0.733 gm) were used for the experiment for the following reasons.Small fish respond faster than large fish to nutritional variables and are more sensitive to diet differences; and also experimental stock can be easily acquired from fish farms around. A total of 180 fry were used and distributed in 6 bowls at the rate of 30 fry/ 250 litre bowl (tagged 0, 20, 40, 60, 80 and 100%).

Feed formulation: In addition to the test fishmeal (Tilapia fishmeal) and the conventional fishmeal, other ingredients used in compounding the diets for the experiment include palm kernel cake (P.K.C.), maize, groundnut cake (G.N.C), oyster shell, salt etc. The feeds were formulated such that

Table 1: Feed formulation (6 isonitrogenous diets of 40% crude protein (C.p%)

	0%		20%		40%		60%		80%		100%		Total
Ingred Content/level	Gm	C.P	Gm	C.P	Gm	C.P	Gm	C.P	Gm	C.P	Gm	C.P	(Gm)
Conventional fish meal	81.81	17.726	65.45	14.180	49.09	10.750	32.72	7.090	16.36	3.545	-	-	245.43
Tilapia fishmeal	-	-	16.36	3.583	32.72	7.090	49.09	10.75	65.45	14.333	81.81	17.916	245.43
Maize	57.12	1.904	57.26	1.909	57.39	1.913	57.62	1.921	57.80	3.468	57.98	1.9333	345.17
Brewery waste	57.12	3.427	57.26	3.435	57.39	3.413	57.62	3.457	57.80	3.468	57.98	3.479	345.17
Blood meal	30.93	8.248	30.84	822.4	30.75	8.200	30.60	8.160	30.48	8.128	30.36	8.096	183.96
G.N.C.	30.93	4.640	30.84	4.626	30.75	4.613	30.60	4.590	30.48	4.572	30.36	4.554	182.96
Soya bean	30.93	4.330	30.84	4.318	30.75	4.305	30.60	4.284	30.48	4.267	30.36	4.250	183.96
Bone meal	4.92	-	4.92	-	4.92	-	4.92	-	4.92	-	4.92	-	29.52
Oyster shell	4.92	-	4.92	-	4.92	-	4.92	-	4.92	-	4.92	-	29.52
Common salt	1.32	-	1.32	-	1.32	-	1.32	-	1.32	-	1.32	-	7.92
Total	300.0	40.274	300.0	40.275	300.0	40.314	300.0	40.250	300.0	40.240	300.0	40.229	1800.00

Table 2: Proximate composition of tilapia fishmeal

	% Moisture	% Crude protein	% Fat	% Crude fribre	%Ash	%N.F.E
Fishmeal	5.60	65.69	10.54	0.99	17.05	0.13

the total crude protein in all the diets were the same. Previous works done on *Clarias gariepinus* put the protein requirement at between 35% to 50% Faturoti depending on the state of development. However 40% Crude Protein (C.P) of 6 isonitrogenous diets (0, 20, 40, 60, 80 and 100%) were formulated and used for this study to feed *Clarias gariepinus* fry for a 6 week experimental period as shown in Table 1.

Weekly weighing and feeding: Seventy five grams each of the 6 diets were weighed into separate containers at the beginning of the experiment and labeled accordingly. The fish in each of the bowls were fed from the measured diets throughout the period of the experiment. The fish were fed to satiation twice daily at the h of 10.00 and 16.00 h.

The fish in each blow and the measured diet used for feeding it were weighed at the end of each week so as to determine the consumption and the corresponding change in body weigh.

Water quality parameters: Water was changed daily in each bowl at least 30 min before daily feeding. Water quality assessment was conducted weekly and the parameters measured include ρH (Alkalinity/acidity), dissolved oxygen, carbon-dioxide and temperature.

Proximate analysis of feed and experimental fish: Proximate analysis of both feed experimental fish were carried out using the A.O.A.C[10] method. The nitrogen content was determined by the microkjeldahl technique of Fel and Veach. And the total protein equivalent was determined by multiplying the nitrogen content by 6.25. crude fat was measured in a soxhet apparatus of lipid by petroleum either (b.ρt 40-60°C extraction).

The fish in each bowl and the measured diet used for feeding it were weighed at the end of each week so as to determine the feed consumption and the corresponding change in body weight.

RESULTS

The proximate composition of the Tilapia fishmeal as shown in Table 2, shows that it has a high crude protein (C.P) content of 65.69%, low moisture of 5.60% and fat of 10.54%. The initial and final proximate composition was determined according to the methods of (AOAC,[10]).

The proximate composition of experimental diets showed the Table 3 six diets compounded (0, 20, 40, 60, 80 and 100%) to be isonitrogenous at 40% C.P with a narrow range of 39.17-41.32% with low moisture ranging from 8.25-9.06%.

The final fat composition of the experimental fish ranging from 4.90-6.35% decreased and were much lower than the initial fat of 8.66%, while the final crude protein content of the 20% (69.90), 40% (67.61), 80% (68.47) and 100% (67.25) were much higher than the initial C.P of 66.83% of the initial fish Table 4. However, moisture content of the final fish increased generally from 0-100% within a range of 11.37-13.06% far more than the moisture content of 9.63% for the initial fish.

ANOVA shows that significant differences ($p<0.05$) exists in the growth and nutrient utilization parameters between the six levels (0, 20, 40, 60, 80 and 100%) of diet treatments, however the 80% level of supplementation of Tilapia fish meal gave the best growth performance especially in terms of highest percentage weight gain 368.01%, Specific Growth Rate (SGR) (3.68) and lowest mortality rate of 17.84% and lowest Food Conversion Ratio (F.C.R) of 1.4269 Table 5.

Table 3: Proximate composition of experimental diets

Diets (Tilapia fish meal supplementation)%	% Moisture	Fat	Ash	Crude protein	Crude fibre	N.F.E
0	8.25	13.30	13.80	41.32	3.00	20.33
20	8.75	10.26	13.40	40.03	2.96	24.60
40	8.31	8.61	13.26	39.17	1.63	29.02
60	8.36	7.26	13.40	41.09	3.00	26.89
80	9.06	5.91	15.20	39.86	2.82	27.75
100	8.45	4.81	14.38	40.95	2.40	29.01

Table 4: initial and final proximate composition of clarias gariepinus

Treatments	% Crude protein	Fat	Crude fibre	Ash	Moisture	N.F.E
Initial	66.83	8.66	0.000	12.63	9.63	2.26
0% (Final)	66.55	6.00	0.000	11.62	12.76	3.07
20% (Final)	69.90	4.90	0.000	9.29	11.37	4.54
40% (Final)	67.61	5.25	0.000	10.88	12.93	3.33
60% (Final)	64.63	6.35	0.000	13.59	13.06	2.37
80% (Final)	68.47	5.80	0.000	15.18	12.46	3.35
100% (Final)	67.25	5.62	0.000	11.92	12.39	2.82

Table 5:Growth and nutrient utilization of *clarias gariepinus* fed different levels of tilapia fish meal diets

Diet (Tilapia fish meal supp--lementation)	Initial mean weight	Final mean weight	Mean weight gain	% wt gain	Mortality rate %	S.G.R	intake	Feed F.C.R	P.E.R	PPV	NNR	(-ve)	Nm NPU	Ranking of diets
0%	0.7087	1.3925	0.6838	96.49	28.01	1.61	51.42	3.5606	0.1108	0.3790	37.90	7.88	8.37	6
20%	0.7333	2.8400	2.1067	287.29	28.85	3.22	22.53	1.9663	0.2338	0.5460	54.61	24.29	17.40	2
40%	0.5660	1.2680	0.7014	123.79	24.79	1.92	22.20	4.1075	0.0797	0.4170	41.67	8.09	6.11	5
60%	0.5173	1.7500	1.2327	238.30	26.95	2.90	19.06	1.9967	0.1618	0.0510	5.13	14.24	11.70	3
80%	0.5833	2.7290	2.1466	368.01	17.84	3.68	22.69	1.4269	0.2365	0.4694	46.94	7.816	5.85	1
100%	0.5833	1.400	0.8147	139.20	25.01	2.08	26.59	6.4462	0.0766	0.2640	26.41	9.39	5.78	4

DISCUSSION

The choice of Tilapia fish meal as a suitable supplement for the conventional Danish fish meal especially because of its high cost(while a kilogram of Danish fish meal presently cost N250 as against N100 for the Tilapia (*Oreochromis nilotica*) fish meal) and the ready availability of Tilapia as a resource for fish meal preparation is further proofed in the six weeks experimentation to monitor growth and nutrient utilization parameters of *Clarias gariepinus* fry this is because the highest mean weight gain (2.1466) percentage weight gain (368.01%), SGR (3.68), PER (0.2365), Nm (- 7.816) and the least mortality rate (17.84%), FCR (1.4269) confirmed 80% Tilapia fish meal diet (80% TFD) as the best diet, while the lowest mean weight gain (0.6838); percentage weight gain (96.49%), SGR (1.61), feed intake (15.42) confirmed 0% Tilapia fish meal diet as the poorest, (0% Tilapia fish meal diet contains 100% conventional fish meal) diet in the experiment as shown in Table 5.

From the foregoing it could be argued that Tilapia fish meal contained a balanced protein/amino acid profile, because the production of the Tilapia fish meal is from the whole fish which included the head, gut, scales, muscle, fins etc. unlike the conventional fish meal which is a product of many sources such as fish waste by catches, shell fish etc. FAO[9].

However, the best level of nutrient utilization was seen in the 20% Tilapia fish diet (20% TFD), which gave the highest values for PPV (0.546), NNR (54.61), NPU (17.40), The 20% TFD was considered as the second best diet which apart from having the best level of nutrient utilization, closely followed the 80% Tilapia fish meal diet (80% TFD) in the growth performance of the experimental fish as shown in Table 5.

Statistical analysis (ANOVA) showed that significant variations $p<0.05$ exists in the growth and nutrient utilization patterns of *Clarias gariepinus* fed Tilapia fish meal supplementation for the conventional fish meal at all levels (0, 20, 40, 60, 80 and 100%) levels of supplementation.

CONCLUSION

The manufacture of quality fish meal s from whole Tilapia fish (*Oreochromis niloticus*) is a viable option to the use of conventional fishmeal.

REFERENCES

1. Tacon, A.G.J. and A.J. Jackson, 1985. Utilization of conventional and unconventional protein sources in practical fish feeds.

2. Connell, J.J., 1979. Advances in fish utilization. J. Sci. Food Agric., pp: 17-329.
3. Cutting, C.L., 1962. Influence of Drying, Salting and Smoking on the Nutritive Value of Fish. Conference of Fish Nutrition. Working papers Washington D.C. United Nations Publication Service, New York.
4. Mcbay, E.G., 1961. The biology of *Tilapia niloticus* Linnaeus. Proceedings from the 15th Annual Conference of South Eastern Association of Game and Fish Commissioners, pp: 21-25.
5. Balarin, J.D., 1979. Tilapia. A guide to their biology and culture in Africa, University of Scotland Publication, pp: 8-174.
6. FAO, 1980. Report on the ad hoc consultation on Aquaculture Res. 3-9 FAO/Fisher. Report, pp: 238.
7. Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated food science and technology for the tropics. Macmillan Publishers.
8. Bossey, S.S. and S.O. Talabi, 1981. Some chemical and organoleptic assessment studies on the storage characteristics of West African long Croaker (*Pseudotolithus typus*). J. Food Chemistry, 7: 169-174.
9. FAO, 1986. Fishery Industries Division. The production of fishmeal and oil. FAO Fish. Technical, pp: 142-1 63.
10. AOAC, 1990. (Association of Official Analytical Chemists). Official methods of analysis of AOAC (W. Hottwithzzed) 13th Edn. A.O.A.C. Washington D.C.