Growth Performance And Survival Of *Clarias* Gariepinus Fingerlings Fed Local Smoked Fish Discarded Meal Based Diets

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Abstract: An experiment was conducted to examine the use of local smoked fish discarded meal (LSFDM) as substitute for imported fish meal (IFM) in practical diet of Clarias gariepinus fingerlings. Five (5) diets of 40% crude protein containing smoked fish discarded meal varied at 0%, 25%, 50%, 75%, 100% inclusion level were formulated. The Clarias gariepinus fingerlings with mean weight of 38.83±0.55g were fed at 5% body weight twice per day for 56 days. It was observed at the end of the feeding trial that 100% inclusion level of local smoked fish discarded meal gave the highest mean weight gain (MWG), mean final weight gain (FWG), and specific growth rate (SGR), 318g, 357.27g and 3.94g/day respectively. The feed conversion ratio of 0.96 was the best in diet 5 compared to other diets. There was significance difference ($P<0.05$) between the mean weight gain and the feed conversion ratio of fish fed local smoked fish discarded meal based diets. Based on the result, it could be concluded that 100% inclusion level of local smoked fish discarded meal based diet is feasible for Clarias gariepinus production.
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Introduction

Aquaculture sector is growing fast worldwide. This rapid development largely depends upon fish meal (FM), which is considered the most desirable animal protein ingredient in aquaculture feeds because of its high protein content, balanced amino acid profile, high digestibility and palatability, and as a source of essential n-3 polyenoic fatty acids (Hardy and Tacon,2002). Global fish meal (FM) production is approximately 6-7 million tonnes per year. The continuous increasing demand for fish meal used in animal feed especially in aqua feed has resulted in fish meal becoming difficult to obtain and very expensive. Therefore, the search for alternatives to fish meal is a global research priority (Chamberlain, 1993; Hardy and Kissil, 1997; Abdelghany, 2003; Abdelghany *et al*., 2005; Ahmad, 2008).

The increase cost of fish meal (FM) and concerns regarding its future availability have made it imperative for the aquaculture industry to reduce or eliminate fish meal (FM) from fish diets where possible. So many studies have tried to partially or totally substitute fish meal (FM) with less expensive animal and/or plant protein sources.

Despite the fact that large amounts of fishery by-products and by-catch are produced annually in the world, little attention has been paid to the commercial use of these by-products for *Clarias gariepinus* culture (El-sayed, 2004). Fish smoking industry produce a huge waste that is rich in protein source which may be used as a replacement of fish meal in fish diets.

African mud catfish, *Clarias gariepinus* was used for this study because of its omnivorous feeding habit and its market value which currently makes it the most cultured fish species in Nigeria.

The objective of this experiment was to examine the use of local smoked fish discarded meal (LSFDM) as a substitute for imported fish meal (IFM) in practical diet for catfish, *Clarias gariepinus* fingerlings and its relation to fish growth and feed utilization.

Materials and Methods

The experiment was conducted at the Feedmill Unit of the Federal College of Freshwater Fisheries Technology, New Bussa, Nigeria. Two hundred and twenty-five (225) fingerlings of *Clarias gariepinus* of initial average weight of 38.70±0.55g was obtained from Kofo Fish Farm in New Bussa, Nigeria. They were acclimatized for five (5) days before the start of the experiment.

The experiment had five (5) treatments of fifteen (15) fingerlings each with three (3) replicates. Each treatment was fed with 40% crude protein diet formulated from practical ingredients with 0, 25, 50, 75 and 100% by weight of local smoked fish discarded meal (LSFDM) used to replace imported fish meal (IFM) in a completely randomized design (CRD).

Experimental fishes were fed in 35litre-capacity cylindrical plastic bowls with aeration.

2.1 Experimental diets preparation

Local smoked fish discarded meal (LSFDM) was prepared by grinding broken smoked fish parts during smoking, packaging and transportation of fish into powder form and properly sieved. Five (5) experimental diets containing 40% crude protein diets were formulated as follows: Diet 1, 100% IFM: 0% LSFDM as control feed; Diet 2, 75% IFM: 25% LSFDM; Diet 3, 50% IFM: 50% LSFDM; Diet 4, 25% IFM: 75% LSFDM and Diet 5, 0% IFM: 100% LSFDM. They were mixed with other feed ingredients in homogenous mixture, and then additives such as vegetable oil, vitamin premix, methionine, lysine and salt were added. Subsequently, water of about 30% was added to the dry mixture and blended until it became dough- like paste. Moisten feed mixture were passed through a mechanical pelleting machine with die size of 2mm and dried in open air. Dried pelleted diets were stored in airtight plastic bags at -4^{o}C. The formulation of experimental diets is shown in Table 2.

2.2 Experimental fish culture

The catfish (*Clarias gariepinus)* fingerlings with initial average weight of 38.70±0.48g were acclimatized for five (5) days before the start of the feeding trial. Fifteen (15) fishes were randomly sampled and stocked in 35litre-capacity cylindrical plastic bowl and aerated. Fish fingerlings were fed gradually twice daily at 7.00am and 6.00pm. Leftover diets were collected by siphonation weekly during sampling. The fishes were not fed on the morning of sampling days. Monitoring of water quality in the plastic bowls was conducted daily. Temperature, dissolved oxygen (DO), pH and conductivity were determined using (. APHA AWWA WPCF, 1999).

2.3 Nutrition analysis of experimental diets

Diets were randomly sampled, dried and blended into size that passed 200micron mesh sieve. They were subsequently homogenized and then stored in airtight containers at -18^{o}C until analysis using (AOAC,1995). The crude protein was determined by micro Kheldahl method, crude lipid by Ether Extraction, total ash by Muffle Furnace Combustion, crude fibre by Weede Method, carbohydrate by % NFE equation: % NFE = 100 – (% protein + % lipid + % fibre + % ash + moisture) and Gross Energy (GE): GE = (% NFE x 4.11) + (% protein x 5.64) + (% lipid x 9.44).

2.4 Growth parameters

Fish growth and feed utilization efficiency in this experiment were measured weekly and at the end of the experiment using the methods of Somsueb and Boonyaratpalin(2001); Jantrarotai *et al.*(1996); Chuapoehuk, (1999) and Tinnungwatana and Viputhanumas, (2000).

$$\text{Percentage weight gain (\%)} = \frac{(\text{Mean final weight} - \text{Mean initial weight})}{\text{Mean initial weight}} \times 100$$

$$\text{Growth rate per fish per day (g/day)} = \frac{(\text{Mean final weight} - \text{Mean initial weight})}{\text{Culture period (day)}}$$

$$\text{Specific growth rate (SGR)} = \frac{(\text{InWf-InWi})}{\text{Time}} \times \frac{100}{1}$$

$$\text{Feed conversion ratio (FCR)} = \text{Total feed consumed/Increased mass of fish}$$

$$\text{Total fish production (Kg/m3)} = \frac{\text{Final weight (g)} \times \text{Survival rate}}{100\ (g)}$$

$$\text{Survival rate (\%)} = (\text{Final number of fish/Initial number of fish}) \times 100$$

2.5 Statistical Analysis

The obtained data of fish growth, feed utilization and survival rate were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncan test. All the statistical analysis were done using SPSS program version 10 (SPSS, Richmond, VI, USA) as described by Dytham, (1999).

Results

Table 1 shows the proximate composition of the ingredients used in the experimental diet while the formulation for the experimental diet is shown in Table 2.

Table 1: Proximate composition of the ingredients used in the fish diets

Chemical analysis	Local smoked fish discarded meal	Imported fish meal	Yellow maize
Moisture content	6.09	7.50	5.52
Crude protein	68.73	72.26	11.83
Crude fat	9.57	14.18	5.47
Ash	16.85	11.05	1.48
Crude fibre	0.68	2.17	15.14
NFE*	4.83	0.34	66.08
GE/100g diet**	544.12	543.66	389.46

*Nitrogen-Free Extract (calculated by difference) = 100 – (protein + lipid + ash + fibre).
**Gross energy (GE) was calculated from (NRC, 1993) as 5.65, 9.45, and 4.1kcal/g for protein, lipid, and carbohydrates, respectively.

Table 2: Experimental diet formula of African catfish (*Clarias gariepinus*)

Ingredients	DT1, 0%LSFDM	DT2, 25%LSFDM	DT3, 50%LSFDM	DT4, 75%LSFDM	DT5, 100%LSFDM
Local smoked fish discarded meal	0.00	12.17	24.05	37.50	50.75
Imported fish meal	48.00	36.50	24	12	0
Yellow maize	46.00	46.00	46.00	46.00	46.00
Vegetable oil	3.00	3.00	3.00	3.00	3.00
Vitamin premix*	1.0	1.0	1.0	1.0	1.0
Methionine	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Dicalcium sulphate	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00

*Hi-Nutrients Vitamins/Minerals premix supplies 100g Diet. Palmat A; 1000IU; Cholccalceferol (D); 1000IU; G-Tocopherolacetate (E): 1.1mg; Menacilione (K): 0.02mg; Thiamine B1: 0.63mg; Riboflavin (B12): 0.001mg; Nicotinic Acid: 3.0mg; Folic Acid: 0.1mg; Choline: 31.3mg; Ascobic Acid: 0.1mg; Iron (Fe): 0.05mg; Cu: 0.25mg; Mn: 6.00mg; Co: 0.5mg, Zn: 5.0mg; Sn: 0.02mg.

Table 3 shows the proximate composition of the experimental diet.

Table 3: Proximate composition (%) of the diets fed to *Clarias gariepinus* for 56days

Chemical analysis	DT1, 0%LSFDM	DT2, 25%LSFDM	DT3, 50%LSFDM	DT4, 75%LSFDM	DT5, 100%LSFDM
Moisture content	7.25	6.50	8.11	9.62	7.76
Crude protein	40.78	38.78	39.22	39.49	40.83
Crude fat	6.55	5.60	7.00	6.48	6.80
Ash	12.87	18.00	18.00	16.00	17.00
Crude fibre	3.50	4.00	4.20	4.00	3.85
NFE*	34.08	30.12	33.47	35.41	31.68
GE/100g diet**	500.87	525.89	526.93	513.83	521.99

*Nitrogen-Free Extract (calculated by difference) = 100 – (protein + lipid + ash + fibre).
**Gross energy (GE) was calculated from (NRC, 1993) as 5.65, 9.45, and 4.1kcal/g for protein, lipid, and carbohydrates, respectively.

Table 4 shows the summary of means of growth performance of *Clarias gariepinus* fed with local smoked fish discarded meal based diets in plastic bowls for 56days.

Table 4: Summary of means of the growth performance of *Clarias gariepinus* fed with local smoked fish discarded meal based diets in plastic bowls for 56days.

Diets	Initial weight (g)	Final weight (g)	Weight gain (g)	DWG (g/d)	RGR (%)	SGR (%/day)	(FCR)	SR (%)
1	38.83±0.52^{a}	159.50±1.40^{e}	20.67±1.92^{e}	0.36±.03^{e}	53.30±5.65^{e}	0.77±0.60^{e}	5.64±0.03^{a}	96.66±3.33^{a}
2	38.36±0.10^{a}	155.27±6.70^{d}	116.69±6.90^{d}	2.08±0.01^{d}	334.78±68.82^{d}	2.49±0.08^{d}	1.41±0.18^{b}	93.33±0.00^{b}
3	38.30±0.20^{a}	214.90±7.59^{c}	176.60±7.79^{c}	3.15±0.01^{c}	461.21±2.75^{c}	3.08±0.17^{c}	1.00±0.17^{c}	100±0.00^{a}
4	38.10±0.66^{a}	271.35±4.510^{b}	271.35±4.510^{b}	3.60±0.04^{b}	597.47±6.54^{b}	3.46±0.01^{b}	1.01±0.55^{c}	100±0.00^{a}
5	39.00±0.66^{a}	357.27±42.25^{a}	357.27±42.25^{a}	5.68±0.79^{a}	815.48±99.35^{a}	3.94±0.01^{a}	0.96±0.05^{c}	100±0.00^{a}

*Value in each row the same superscripts are not significantly difference (p>0.05).

*DWG, Daily weight gain; RGR, Relative growth rate; SGR, Specific growth rate; FCR, Feed conversion ratio and SR, Survival rate.

The water quality parameters monitored weekly during the experimental period is presented in Table 5.

Discussion

Table 1 gives the proximate composition of the ingredients used in the fish diets for the experiment. The formulation of the experimental diet is shown in Table 2 while the proximate compositions of the experimental diets are presented in Table 3. The percentage crude protein content of the diets was not distinctively different ranging from 38.78% in DT2 to 40.83% in DT5 which is similar to the crude protein content of most commercially used catfish feeds in Nigeria. Table 4 shows the summary of means of growth performance of *Clarias gariepinus* fed with local smoked fish discarded meal based diets in plastic bowls for 56days. Based on the growth parameters measured, there was significant difference (p>0.05) between the weight gain, relative growth rate, specific growth rate and feed conversion ratio of fish fed with all the diets respectively.

In the present study, fish became accustomed to the experimental diets and were observed to feed actively throughout the duration of the study without external signs of nutritional deficiency. This finding suggests that local smoke fish discarded meal could be a good alternative protein source and may replace imported fish meal protein in fish diets. Growth performance (final body weight, weight gain, specific growth rate and growth rate per fish per day) of *Clarias gariepinus* fed diets containing various levels of local smoke fish discarded meal were more than those of fish fed control diet in this study.

The weight gain of *Clarias gariepinus* was highest in Diet 5 with 100% local smoked fish discarded meal without imported fish meal as the protein source. This demonstrates that fish fed with diets containing 100% replacement level of local smoke fish discarded meal can grow favourably well without any combination with imported fishmeal. This results agrees with the findings of Monsour, (1998) and El-Sayed, (1998) who reported that shrimp meal can replace fish meal in red tilapia (*O. niloticus* x *O. hormorum)*, and Nile tilapia diets, at 50% and 100% respectively, without significant retardation in weight gain.

Abdelghany *et al*., (2005) stated that local smoked fish discarded meal has good potential as a complete substitute for the protein supplied by herring fish meal in mono-sex Nile tilapia diets with no significant (p>0.05) adverse effects on growth and feed deficiency compared to fish fed the herring fish meal-based diet (control diet) in glass aquarium.

The result of this study indicated that diet containing 100% smoked fish discarded meal had a better growth. Oladele *et al*, (2009) in their study also reported that fish fed with diets containing 100% replacement of tigernut meal without maize components grew better than those fed with low maize meal diet.

The water quality parameters monitored weekly during the experimental period is presented in Table 5. Water temperature ranged from 26.24^{o}C to 28.84^{o}C with a mean of 27.54^{o}C, while the dissolved oxygen ranged from 5.20mg/l to 6.20mg/litre with a mean of 5.70mg/l. The pH stood within the neutral range of 7.4 to 7.8 and a mean of 7.6 while conductivity ranged from 360µhom/cm3 to 580µhom/cm3 with a mean of 444µhom/cm3.

The levels were considered adequate for the growth of *Clarias gariepinus* in line with the report of Boyd, (1990) which stated that *Clarias gariepinus* is a warm water fish and grows best at temperature between 25^{o}C and 32^{o}C, dissolved oxygen range of 5mg/l to 7mg/l and pH between 6.7 and 8.6.

Conclusion

This experiment was carried out to evaluate the growth of *Clarias gariepinus* fingerlings fed local smoked fish discarded meal compared with imported fish meal. The result indicates that local smoked fish discarded based meal may safely replace up to 100% of imported fish meal in practical diets of *Clarias gariepinus* fingerlings. These findings will in no small way assist in reducing the cost of feed ingredients in the diet of *Clarias gariepinus* fingerlings. It may be necessary however, to take this work beyond the experimental stage in order to consolidate these

findings for further development of the aquaculture industry in Nigeria.

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