World Journal of Agricultural Sciences 6 (1): 18-22, 2010
ISSN 1817-3047

Evaluation of Tigernut (*Cyperus esculentus*) Meal as a Replacement for Maize Meal in the Diet of Catfish (*Clarias gariepinus*) Fingerlings

A.K. Oladele, P.S. Alatise and O. Ogundele

Federal College of Freshwater Fisheries Technology,
P.M.B. 1500, New Bussa, Niger State, Nigeria

Abstract: The effects of replacing maize meal with tigernut (*Cyperus esculentus*) meal on the growth and performance of Catfish (*Clarias gariepinus*) fingerlings in aquaria tanks system were studied. *Clarias gariepinus* fingerlings (12.50 ±1.13 g) were fed five isonitrogenous diets (40% crude protein) with varying levels of tigernut inclusion. The diets were A (0%, control), B (25%), C (50%), D (75%) and E (100%). The fish were fed to satiation at 5% body weight twice per day for 8 weeks (56 days) and the fish growth parameters measured. There was an increase in mean weight gain (MWG) as the amount of tigernut meal increased from 0 to 100%. One hundred percent inclusion level of tigernut meal gave the highest mean weight gain (MWG), mean final weight, specific growth rate (SGR), total fish production (TFP) of 9.20 g, 22.13 g, 0.96%/day and 2.11 kg/m^3 respectively and the best feed conversion ratio (FCR) of 4.12. There was a significant difference ($P<0.05$) in the mean weight gain and feed conversion ratio of the fish between the diets.

Key words: Tigernut · *Cyperus esculentus* · Growth performance · *Clarias gariepinus* · Aquaria tanks

INTRODUCTION

Fish production through fish culture is on the increase in Nigeria. Among the problems of the sector is lack of nutritionally balanced and low-cost feeds [1]. Fish feed accounts for about 60-70% of the variable cost in fish culture. This is due to high cost of feed ingredients especially maize which is the conventional source of dietary energy in fish and livestock feeds. Maize is also a staple food for Nigerian populace. In view of the scarcity and escalating costs of most conventional animal feed ingredients, it has become necessary to search for cheaper alternative nutrient sources to enhance fish culture development. Efforts geared towards substituting maize with cheaper substitutes have yielded positive results. Some industrial by-products, wastes and some under-utilized crops used as maize substitute in fish and livestock feed production include wheat offals [2], cassava peel [3], coffee pulp [4], cocoa pod husks [5] and tigernut [6,7] among others.

Tigernut is an under-utilized sedge of the family Cyperaceae. Tigernut oil is rich in unsaturated fatty acids (oleic and linoleic) and compares favourably with other valuable oils such as olive oil [8,9]. It is also high in oil (22.5%) and carbohydrate (33.8%) [10] and contains the essential amino acid such as lysine [11] which is lacking in many cereals such as maize. Tigernut has uses as food flavour [12], in milk ("Horchata De Chufa") production and as a source of flour [13]. Research has shown that tigernut meal (*Cyperus esculentus*) can be used as a prospective energy source for poultry and livestock [6, 7, 14, 15] but information on its utilization in fish feeding is scanty. The aim of this study was to investigate the effect of replacing maize meal with tigernut meal (*Cyperus esculentus*) on the growth and performance of *Clarias gariepinus* fingerlings.

MATERIALS AND METHODS

Preparation of Experimental Feeds: The percentage composition of the experimental feeds is shown in Table 1.Tigernut was dried and ground into a fine powder using hammer mill. Clupeid (*Pellonula afzeliusi*) bought in dried form served as source of fish meal.

The various feedstuffs were thoroughly mixed, made into dough, pelleted, sun-dried for 12 h and milled. The feeds were packaged in an air-tight polythene bag and stored at room temperature. The proximate composition of

Corresponding Author: A.K. Oladele, Federal College of Freshwater Fisheries Technology,
P.M.B. 1500, New Bussa, Niger State, Nigeria

Table 1: Percentage composition of the experimental diets

Components	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%)
Tigernut meal	0.0	10.0	20.0	30.0	40.0
Maize meal	40.0	30.0	20.0	10.0	0.0
Fish meal	18.0	18.0	18.0	18.0	18.0
Soya bean	25.0	25.0	25.0	25.0	25.0
Groundnut cake	10.0	10.0	10.0	10.0	10.0
Vegetable oil	2.0	2.0	2.0	2.0	2.0
Bone meal	1.0	1.0	1.0	1.0	1.0
Vitamin premix	1.5	1.5	1.5	1.5	1.5
Starch	2.0	2.0	2.0	2.0	2.0
Salt	0.5	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0	100.0

Table 2: Proximate composition of the experimental diets

	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%)	Tigernut[a]	Yellow[b] maize
Moisture (%)	2.00	2.00	2.00	2.00	2.00	3.63	9.06
Crude protein (%)	40.50	40.25	40.01	39.89	39.96	2.68	10.77
Crude lipid (%)	11.34	12.10	12.12	12.16	12.20	29.67	3.56
Crude fibre (%)	5.93	6.52	7.23	6.93	7.54	12.88	3.47
Ash (%)	12.29	12.30	12.00	11.90	11.75	2.48	1.94
NFE (%)	27.94	26.83	26.64	27.12	26.55	52.29	71.20

a- Umerie *et al*. [24]; b- Eyo, [25]

the experimental feeds was determined using AOAC [16] methods.

Stocking and Sampling Methods: Two hundred fingerlings of Catfish (*Clarias gariepinus*), average weight of 22.80±0.04 g, were obtained and acclimatized for three days in aquaria tanks during which they were fed with 40% crude protein feed before the commencement of the experiment. Ten glass aquaria tanks (60×30×30 cm) were used for the study. It consists of five replicated treatments in a completely randomized design. Twenty fingerlings of *Clarias gariepinus* were stocked in each aquarium where they were fed twice daily (morning and evening) with the feed at 5% of their body weight for 8 weeks. Sampling was carried out weekly to determine the growth parameters.

Measurement of Growth Parameters: The growth parameters were measured according to the methods described by Oleva- Novoa *et al*. [17]. Mean weight gain (MWG) was calculated as the difference between the initial and final weight divided by the number of the surviving fish at the end of the culture period.

$$MWG = \frac{\text{Final body weight - Initial body weight}}{\text{Number of surviving fish}} \times 100$$

Specific growth rate (SGR) (%/day): This is the relationship of the difference in the weight of the fish within the experimental period.

$$SGR = \frac{(\text{In } W_f - \text{In } W_o)}{\text{Time}} \times 100$$

Feed conversion ratio (FCR) was determined by dividing the total weight of the food given by the total increase in weight gained by the fish over a period of time while feed intake (FI) was calculated as the addition of daily mean feed intake of the fish during the period. Average daily growth (ADG) was calculated as the difference between the final weight and the initial weight divided by the number of days i.e. the experimental period

$$ADG = \frac{\text{Final weight - Initial weight}}{\text{Number of days}}$$

Total fish production (kg/m^3) was calculated as the product of final weight and survival rate divided by 1000. Water quality parameters i.e. temperature, pH and dissolved oxygen, were also monitored at regular interval using thermometer, pH meter and Winkler's titration methods respectively.

Statistical Analysis: Data were subjected to analysis of variance (ANOVA) and Duncan's multiple range tests was used to compare differences among individual means [18].

RESULTS AND DISCUSSION

The proximate composition of the feeds was similar (Table 2). All tested diets were accepted and actively fed upon by the fish while no pathological symptom resulting from nutritional deficiency was observed among the fish. Fish mortality due to dietary treatment was also low (5%).

Table 3: Nutrient utilization, growth and survival data of *Clarias gariepinus* fingerlings fed different levels of tiger nut meals for eight weeks

Parameters	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%)
Mean Initial weight (g)	12.80	12.54	12.75	13.01	12.93
Mean Final weight (g)	17.07	18.35	19.31	19.81	22.13
Mean weight gain (g)	4.27	5.81	6.56	6.80	9.20
Daily growth rate (g/day)	0.08	0.10	0.12	0.12	0.16
Relative weight gain (%)	33.44	46.41	51.06	52.27	71.15
Specific growth rate (%/day)	0.52	0.68	0.74	0.75	0.96
Feed Intake (g)	34.69	35.41	35.99	37.39	37.85
Feed conversion ratio (FCR)	8.12	6.10	5.56	5.50	4.12
Survival rate (%)	95.00	95.00	100.00	100.00	95.00
Total fish production(Kg/m^3)	1.62	1.74	1.93	1.99	2.11

Table 4: Summary of statistical analysis of growth parameters for *Clarias gariepinus* fingerlings fed different levels of Tigernut meals for eight weeks

	Treatments				
Parameters	Diet 1 (0%)	Diet 2 (25%)	Diet 3 (50%)	Diet 4 (75%)	Diet 5 (100%)
Mean weight gain (g)	4.28c	5.82b	6.51b	6.80b	9.20a
Specific growth rate (%/day)	0.52a	0.68a	0.74a	0.75a	0.96a
Feed conversion ratio (FCR)	8.12a	6.10b	5.56c	5.50bc	4.12c
Total fish production (Kg/m^3)	1.62a	1.74a	1.93a	1.99a	2.11a

Values with the same subscripts across the rows are not significantly different ($P<0.05$)

This could be attributed to the good water quality which is within the recommended limits for Clarias Spp. [4].

The nutrient utilization, growth and survival data of the fish are presented in Table 3. There was an increase in mean weight gain as the amount of tigernut meal increased from 0% (diet 1) to 100% (diet 5).

Better weight gain and specific growth rate were achieved at high inclusion level of tigernut meal compared to low inclusion levels (Table 3). Higher substitution levels recorded higher feed intake. This could be due to better conversion and utilization of the diet as a result of its high fibre on one hand and high feed intake on the other. The grinding/scraping effect of the vomerine teeth of the fish which increases the surface area of the feed to digestion is another significant factor. High digestibility of high fibre diet was reported for *Clarias mossambicus* [19] and *Clarias isheriensis* [4]. The high fibre digestibility in *C. Isheriensis* was partly attributed to the presence of the enzyme cellulase in its digestive tract. Belewu *et al*. [15] also reported a high crude fibre digestibility for tigernut diets and corresponding weight gain for African dwarf goat while Bamgbose *et al.* [7] reported an increase in cockerel body weight for 33.3% tigernut meal substituted feed. Although the protein content of maize was higher than that of tigernut, the result showed that the fish probably utilized the protein in tigernut than in the uncooked maize. Cooking has been proved to increase maize nutrient digestibility [20]. In a similar feeding trial with *Clarias gariepinus,* Alatise *et al.* [21] recorded the highest weight gain and best conversion ratio with a ration of *Ananas* peel meal. There was significant difference ($P<0.05$) in the mean weight gain and feed conversion ratio of fish fed tigernut-based diets.

The superior growth and nutrient utilization resulting from the use of tigernut meal in place of whole maize is of great economic importance to fish farmers in that the competition for the latter by man and livestock is on the increase being one of the staples in the tropics. This is important in aquaculture because the cost of fish feeds currently accounts for 70% of the variable costs of fish farming ventures [22].

The mean weight gain (g) of *Clarias gariepinus* fingerlings fed different levels of tiger nut (*Cyperus esculentus*) meal diet is illustrated in Fig. 1.

Diet 5 containing 100% tiger nut meal inclusion gave the highest mean weight gain, final weight per fish, specific growth rate, total fish production of 9.20 g, 22.13 g, 0.96%/day, 2.11$kg/m^3$and best food conversion ratio of 4.1.

The means of the physico-chemical parameters of the water in the aquaria tanks during the feeding trial were temperature, 29.5°C, dissolved oxygen, 6.7 mg/l, pH,

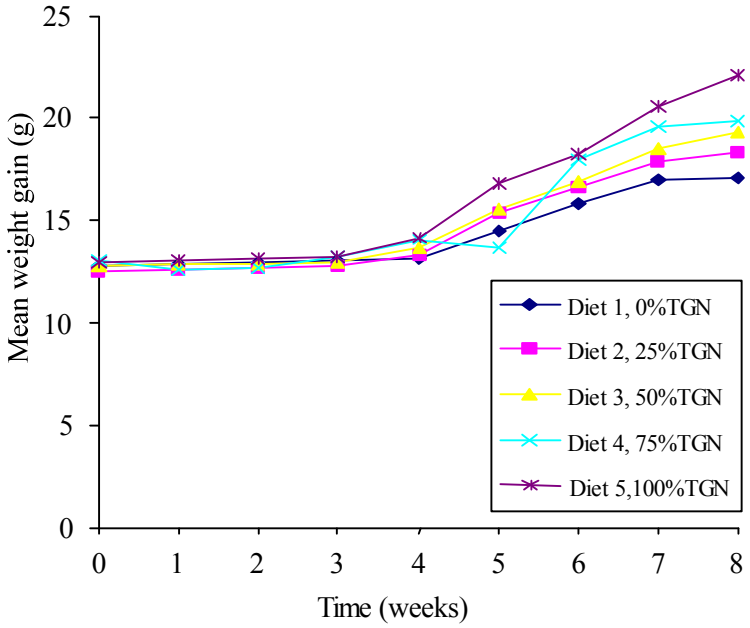

Fig. 1: Mean weight gain (g) of Clarias gariepinus fingerlings fed different levels of tigernut meals for eight weeks

7.4 and conductivity, 220 µmhos/cm^3. The water quality parameters were adequate for the culture of *Clarias gariepinus* as defined for warm species [23].

CONCLUSION

This study demonstrated that tigernut is a suitable replacement for yellow maize in the diets for *C. gariepinus*. The acceptability of the tigernut based diets by the fish without adverse effects on survival and growth performance showed that *C. gariepinus* can digest the fibrous tigernut and utilize the nutrient effectively. Therefore, complete replacement of maize meal by tigernut meal could be practiced in order to reduce cost and increase output. The substitution of maize meal with tigernut meal in *C. gariepinus* diets could shift attention on the use of maize as the energy source in fish feed thereby spare it for human consumption. However, there is need to ascertain the anti-nutritional factors in tigernut and reduce or eliminate them for higher performance in fish feed formulation.

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