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GROWTH PERFORMANCE OF THE AFRICAN CATFISH, *CLARIAS GARIEPINUS* (BURCHELL, 1822) JUVENILES FED DIET CONTAINING MORINGA *OLEIFERA* LEAF MEAL

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ABSTRACT: *A 90 day feeding trial was carried out to investigate the effects of Moringa oleifera on the growth of Clarias gariepinus. A total of 80 juveniles of C. gariepinus were stocked in four concrete tanks measuring 9x4x2m*^{3} *with each tank containing 20 experimental fish arranged in duplicates. There was also another set of tank known as control where fish therein where fed diets containing fish meal. Plant based diet was formulated with Moringa oleifera leaves extract, unripe plantain powder, soybean meal and palm kernel cake. The experimental fish were fed twice daily at 5% body weight. Proximate composition of experimental diet included crude protein (35.68%), moisture (5.24%), crude lipid (15.64%), ash (4.92%), nitrogen free extract (24.83) and fibre (13.69%). Results of growth performance revealed the following: weight gain (7.51±1.22g), food conversion ratio (5.09±1.14gg*$^{-1}$*), specific growth rate (0.28±0.02%), and condition factor (0.91±0.02). The present study shows that the growth of C. gariepinus fed diets containing M. oleifera have compared favourably (P>0.05) with those fed diets containing fish meal. The use of plant-based ingredients such as M. oleifera in fish diets can reduce the cost of feed production leading to increase fish production.*

KEYWORDS: Growth performance, African catfish, Moringa Oleifera, Leaf Meal.

INTRODUCTION

Global gross fish production from aquaculture operations has increased steadily within the few years at a rate of 9.2% percent per annum (FAO, 2002). However, it has been noticed that aquaculture has not yet been able to reach the expected large-scale global food replacement for the teaming populace especially the rural poor of the world including Nigeria. In aquaculture, diet is often considered as the single largest cost item and can represent over 50% of the operating cost in intensive aquaculture (El-Sayed, 1999). The high cost of fishmeal makes commercial production of catfish highly capital intensive as it accounts for between 30 and 60% of variable operating cost (De Silva and Anderson, 1995). The general approach adopted to reduce diet cost has been to develop low cost diets which can favourably replace the costly diets containing fish meal with cheaper plant protein sources without compromising the health and growth or productivity of cultured organisms (Ugwumba and Ugwumba, 2003).

LITERATURE/THEORETICAL UNDERPINNING

A number of plants including groundnut and cowpea have been investigated for their potentials in supplementing or even replacing fish meal (Agbede and Aletor, 2003). *M. oleifera* belongs to the plant family Moringaceae and the most cultivated species in the Moringa genus. It is widely grown in the tropics for food, water purification and traditional herbal medicine. The leaves are the most nutritious among other parts, being rich in vitamins A, B, C and K, manganese, protein as well as other essential nutrients (Leone *et al*., 2015). More so, studies by Bamishaiye *et al*. (2011) indicated that Moringa contains some essential nutrients and health-promoting phytochemicals such as alkaloids, phenolics, saponins, flavonoids and steroids. The present trial focused on a comparative study of diets containing *M. oleifera* and those containing financially demanding fishmeal.

METHODOLOGY

The study adopted experimental method carried out in the Hatchery Complex of the Institute of Oceanography, University of Calabar, Nigeria which is located approximately at latitude 04^{o}55.9” and longitude 08^{o}26” along the coastal plain of Nigeria bordering the gulf of Guinea. This area is the peninsular within the Calabar and Great Kwa River located 42m above sea level (Ama-Abasi *et al*., 2004).

The experiment lasted for 90 days and involved the following steps: Fish feed was formulated with Moringa leaves and another feed with fishmeal as control. The experiment was carried out in two replications. The fish were fed twice daily between 8.00am and 16.00 pm at 5% of their body weight throughout the experiment. Food rations were adjusted every two weeks as new mean weights of fish at different experimental units were determined. Siphoning out of uneaten feed and faecal droppings in each tank were done on weekly basis. Likewise, water in the tanks was replaced with pre-treated pipe-borne water once a week and monitored daily to maintain ideal water quality.

A total of 80 juveniles of *Clarias gariepinus* with an average weight of 45.22± 0.38g were randomly collected from the Institute of Oceanography Fish Farm in the University of Calabar where 4 rectangular concrete tanks measuring 9x4x2m^{3} were used to stock experimental fish. Water volume was maintained at 0.7 m level to avoid escape of fish. The fish were stocked at a density of 20 specimens per tank and in duplicates. Before stocking, average initial lengths in cm and weights in g were obtained with measuring board and electronic balance respectively. The fish were allowed to acclimatise for 14 days prior to the start of the experiment (Amisah *et al*., 2009).

Specimens of mature *Moringa* leaves with their branches were harvested at the Botanical Garden of the University of Calabar, Cross River State, Nigeria. They were transferred in baskets to the Biochemistry Laboratory, University of Calabar and analyzed for proximate composition using standard methods of Association of Official Analytical Chemists (AOAC, 2002) (Table 1). Other experimental diets such as soy

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bean meal, palm kernel cake, fish meal, blood meal, wheat offal, garri, vitamin premix, bone ash, common salt and palm oil were obtained from a shop farm company. In the laboratory, the leaves of *M. oleifera* were removed from their branches, screened to remove debris and sundried for 24h and thereafter in hot air oven at 60°C for 48h. This was done to reduce the anti-nutrients in Moringa leaf meal, thereby increasing its palatability in *C. gariepinus*. Dry leaves were made to powder with mortar and pestle before they were extracted in warm water and preserved in a refrigerator for late use. One liter of pulverized extract was added to 1kg of feed prepared.

Table 1: Proximate composition of *Moringa oleifera* leaves obtained from botanical garden, University of Calabar

Nutritional components	% composition
Moisture	6.23±0.13
Carbohydrate	45.28±0.09
Crude protein	28.16±0.11
Crude lipid	2.52±1.02
Crude ash	9.48±0.03
Crude fibre	10.07±0.21

Each value is a mean±SD of three different determinations

Two experimental diets were formulated using Pearson Square method of fish feed formulation to obtain a feed containing crude protein level of 35%. The different feed ingredients were mixed according to their calculated percentages by weighing. After mixing, the feed were moulded manually into smaller sizes by hand and there after oven dried at a 50°C. After drying, the feed were stored in a cool and dry place to avoid the growth of mould. Table 2 shows the percentage composition of the feed ingredients with *M. oleifera* and fishmeal (control).

Table 2: Percentage composition of the feed ingredients of the experimental feed.

Feed ingredients	Percentage composition (%)	
	Diet with *M. oleifera*	Diet with fishmeal (Control)
Moringa leave extract	-	25
Soya bean meal	29.7	29.7
Shrimp meal	25	-
Wheat offal	20	20
Palm kernel cake	19.3	19.3
Bone ash	0.5	0.5
Garri (Binder)	Not stated	Not stated
Palm oil	1	1
Vitamin premix	2	2
Common salt	1	1
Lysine	0.75	0.75
Methionine	0.75	0.75
Total composition (%)	100	100

Proximate analysis of the experimental diets was carried out in the Department of Biochemistry, University of Calabar. The moisture content, crude protein, lipids

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content, ash and carbohydrate content were analysed following standard procedures given by AOAC (2002) (Table 3).

Table 3: Proximate composition of experimental diets of *Clarias gariepinus* juveniles

Parameters (%)	Diet with Moringa	Diet with Fishmeal (Control)
Crude protein	35.68	35.96
Moisture	5.24	5.06
Crude lipid	15.64	16.28
Ash	4.92	4.12
Nitrogen Free Extract	24.83	25.14
Fibre	13.69	13.44

Data on fish growth performance were recorded every two weeks on Microsoft$^{(R)}$ Excel spread sheet. The experimental tanks were inspected daily to remove any dead fish. Growth performance indices such as Weight Gain (WG), Length Increment (LI), Specific Growth Rate (SGR) and Mean Growth Rate (MGR) were calculated following standard procedure given in Amisah *et al*. (2009). Data obtained from the experiment were analysed with Independent T-test to determine significant differences among treatment means at 0.05 probability level.

RESULTS/FINDINGS

The results of respective growth performance of *C. gariepinus* juveniles fed diets containing *M. oleifera* and Fishmeal (control) were as follows: 6.92.99±0.07g and 1065.74±36.99g (weight gain), 6.45±0.07cm and 12.05±0.07cm (length increment), 331.36±10.17% and 518.58% (percentage weight gain), 12.38±0.22% and 19.03±0.67% (growth rate) 2.61±0.04% and 3.255±0.007% (specific growth rate), 22.27±0.26% and 25.77±0.00% (mean growth rate). Student T-test of independence showed no significant difference in the growth performance of *C. gariepinus* juveniles fed diets containing *M. oleifera* and fishmeal as control (Table 4).

Table 4: Variation in growth performance of *Clarias gariepinus* juveniles fed diets containing *M. oleifera* and fishmeal

Growth indices	Diet with *Moringa oleifera*	Diet with Fishmeal (Control)	P-value	Significance
Weight gain WG (g)	7.51±1.22	8.02±1.07	1.42	No
Food conversion ratio (gg^{-1})	5.09±1.14	4.28±0.91	0.14	No
Specific growth rate (%)	0.28±0.02	0.21±0.01	0.22	No
Condition factor K	0.91±0.02	0.94±0.05	0.11	No

Mean values±SD with P>0.05 are not significantly different

DISCUSSION

There had been recent scarcity in the supply of fish meal due to over dependence on it as a conventional protein source in livestock and poultry feed production. This has caused shortage in world production of fish meal which has grossly affected aquaculture production and fish supply. Aquaculture was meant to supplement fish shortage in the wild and when this objective cannot be met, then there is need for urgent action to salvage the situation. Previous studies including that of Ali *et al*. (2003) have already evaluated the efficiency of various plant-based ingredients as alternative protein sources in aqua-feed production This had attracted a lot of trial experiments by fish nutritionists around the world on the use of leaf meal as a possible fish meal substitute with the aim of reducing the cost of fish feed (Bairagi *et. al*., 2004).

The result of this study was in line with the previous finding of Amisah *et al*. (2009) who reported that *Leucaena leucocephala* leaves can conveniently replace fishmeal at 20% inclusion level. Similarly, the present study included 20% *M. oleifera* in the diet of *C. gariepius* and the result compared favourably with those fed diet formulated with fishmeal. It is also important to note that the use of *M. oleifera* leaves do not conflict with human food security issues.

Implication to Research and Practice

Plant-based ingredients such as *M. oleifera* contains phytochemicals and nutritional composition that can enhance the growth of farm raised fish species if used in the right proportions. Exploring other plant resources in the tropical regions of the world would open more grounds for continuous utilization of plant based ingredients in aquaculture and animal rearing at large.

CONCLUSION

Based on the findings of this study, it can be concluded that the meal of *M. oleifera* leaves can substitute for fishmeal in formulated diets at an inclusion level of 20% without compromising growth performance of the fish. The use of plant-based ingredients such as *M. oleifera* in fish diets can reduce the cost of feed production leading to increase fish production and food surplus.

Future Research

There is need for further research that can compare the growth potentials of farmed fish species with *M. oleifera* and other plant resources as well as their combinations so that extensive conclusions could be drawn.

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