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The effects of feeds formulated with *Moringa oleifera* leaves on the growth of the African catfish, *Clarias gariepinus*

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ABSTRACT

Three experimental diets were formulated to contain Moringa oleifera leaf meal at levels of 20%, 40% and 60% of the total dietary protein (Diets 2, 3 and 4 respectively) and Diet 1 as a control, which included only fishmeal and soya bean meal as protein sources were fed to cat fish (Clarias gariepinus) of mean weight 19.00 ± 2.00g and mean length of 14.00 ± 0.5cm in replicates for 60-day growth period. The best growth response was obtained in fish fed 20% Moringa oleifera leaf inclusion. Fish fed 60% Moringa leaves had the lowest growth response. All the treatment diets showed that growth due to increasing dietary Moringa leaves were significant ($p<0.05$). The results revealed that optimum inclusion level of Moringa leaves in the formulation of practical diets for the improved growth of Clarias gariepinus was 20% inclusion level.

KEYWORDS

Moringa oleifera;
Catfish
(*Clarias gariepinus*);
Diet.

INTRODUCTION

Feed is one of the major inputs in aquaculture production, and fish feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the world[1]. High cost of fish feed has been observed as one of the major problems militating against aquaculture development in Nigeria[1].

Recently, in the increasing popularity of aquaculture, feeds constitute one of the highest operating expenditure in intensive practices. Expensive feeds will marginalize or even nullify the profitability of fish farming and thereby, incapacitate the expansion of farms to increase production. This will lead to low yield in terms of quality and quantity, resulting in the scarcity of the commodity (fish) and eventually high cost of the few available ones to the disadvantage of the populace [2]. Fish feed account for at least 60% of the total cost of production[1].

A number of plants continue to be investigated for their potential use in supplementing or even replacing fishmeal. *Moringa oleifera* (Lam), a miracle plant, has been identified to hold the potential to make contributions to fish nutrition with the possibility to reduce the total dependence of fish farming on fishmeal. *Moringa oleifera,*

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although native to Sub-Himalayan parts of Northern India, is now widely cultivated in the tropics and sub-tropics[3-5]. It has been used to combat malnutrition especially among nursing mothers and infants because the leaves are edible and nutritious[6,7]. Apart from its dietary importance, local folklore credits *Moringa* with a lot of herbal potency and many uses[5].

The high cost of fishmeal makes commercial production of cat fish intensive as it accounts for between 30% and 60% of variable operating cost [8]. This has motivated the search for local, cheap alternative sources of protein that aim to reduce production cost without compromising fish quality. These sources should hold the potential to supplement, replace or partly replace the imported fishmeal. Therefore, this work is aimed at determining the optimum inclusion level of *Moringa oleifera* leaf meal in formulated diets of *Clarias gariepinus* and also to examine growth performances of the African cat fish, *Clarias gariepinus,* fed with varying inclusion levels of *Moringa oleifera* leaf meal. The proximate analysis and amino acid content of the leaf were also determined.

MATERIALS AND METHODS

Sources of ingredients and diet preparation

Feed components namely fishmeal, soya bean meal, cornmeal, wheat bran, vitamin and mineral premix, vegetable oil, salt and starch binder were obtained locally from the market while *Moringa oleifera* leaves were freshly plucked from their branches at Amaenyi village, Awka, Anambra State, Nigeria. The catfish fingerlings were obtained from Aqua fish farms, Awka, Anambra State. The leaves were dried under shade at room temperature (35 ^{o}C) for 5 days. The dried leaves were ground to fine powder using hammer mill machine. The milled samples were kept in screw-capped containers and stored in a deep freezer and analyzed within seven days. Four diets containing different levels of *Moringa oleifera* leaf meal (0%, 20%, 40% and 60%) were prepared TABLE 1. The experimental diets with crude protein level of 40% were formulated using Pearson square method. The ingredients were thoroughly mixed together with hand and adequate water was added to ensure smooth pellets. The strands were cut into short pieces and dried for 3 days to remove moisture[9].

TABLE 1 : Percentage composition of experimental diets in different treatments.

Treatments	1 0% MLI (Control)	2 20%MLI	3 40%MLI	4 60%MLI
Fishmeal	30	24	18	12
Moringa leaves	0	6	12	18
Soya beans	20	20	20	20
Corn meal	15	15	15	15
Wheat flour	15	15	15	15
Wheat offal	15	15	15	15
Vitamin premix	1	1	1	1
Mineral premix	1	1	1	1
Vegetable oil	2	2	2	2
Salt	1	1	1	1
TOTAL	100	100	100	100

Where, MLI = *Moringa* leaf inclusion

Proximate analysis

The methods of the Association of Official Analytical Chemists[10] and American Public Health Association[11] were used for the proximate analysis of *Moringa oleifera* leaf and the different leaf diets.

Determination of amino acid content

The amino acid content of *Moringa oleifera* leaf was determined using methods described by Speckman *et al*,[12]. The dried and milled leaves were defatted, hydrolyzed, evaporated in a rotary evaporator and then loaded into the Technicon sequential Multi-Sample Amino Acid Analyzer (TSM). The amino acid values of the sample were calculated from the chromatogram peaks.

Experimental proceedure

A total of 80 African catfish, *Clarias gariepinus,* fingerlings (19.00 ± 2.00g and 14.00 ± 0.50cm for weight and length respectively) were used for the experiment. The fingerlings were allowed to acclimatize for one week prior to the start of the experiment. The feeds were formulated with *Moringa oleifera* leaves to test their efficacy on the growth performances of the catfish. The experimental diets varied with increasing levels of *Moringa oleifera* leaf meal 0%, 20%, 40% and 60% with decreasing levels of fishmeal.

Most ingredients of standard catfish feeds formulas can be substituted for, but whenever fishmeal has been left out of catfish diets, poorer growth and food conversion have resulted[13]. For this reason, feed was formulated with inclusions of varying quantities of fishmeal combined with *Moringa oleifera* leaf meal. The emphasis in this intervention is to formulate protein diets that can substitute or reduce the quantities of expensive fishmeal in formulated diets without compromising growth performance of the fish.

Fish feeding and culture

The fish were fed twice daily, between 8.00-9.00am and 3.00- 4.00pm at 3% body weight throughout the experiment. The ration was adjusted every one week when new mean weights of fish for various experimental units had been determined. The water in the tanks was also changed with pipe-borne water every two days. Water quality parameters were measured during each sampling fortnightly. Temperature, pH and Dissolved oxygen were measured using mercury in glass thermometer, Jenway pH meter (model 3150) and Winkler's method respectively.

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) test and the mean from the various treatments were compared for significant differences ($p < 0.05$).

RESULTS

The proximate composition and amino acid content of *Moringa oleifera* leaves are shown in Figures 1 and 2 respectively. Of importance, are the %crude protein (27.60 ± 0.14) *and %crude lipid (*20.00 ± 2.30) *content of* the leaf. That shows that the leaf is a very good source of proteins and lipids. The most abundant essential amino acid is leucine (7.53g/100g protein) while that of non-essential amino acid is glutamic acid (9.46g/100g protein). The leaves contained the essential amino acids needed for maximum growth of animals and humans.

The proximate composition of the *Moringa oleifera* leaf diets used for the growth trials are shown in Figure 3. The 0%, 20%, 40% and 60%

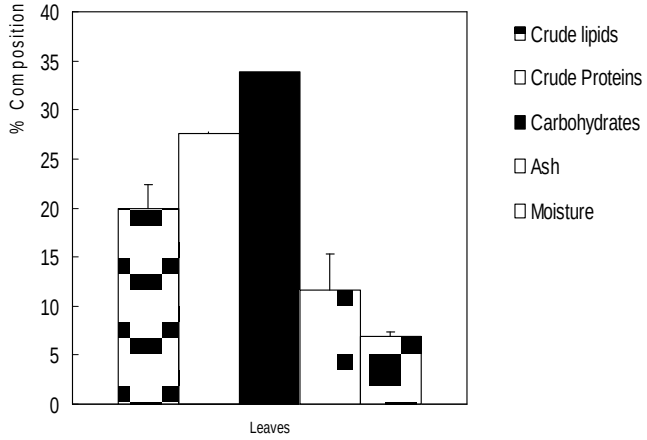

Figure 1 : The proximate composition of *Moringa oleifera* leaves (Mean ± S.E.M).

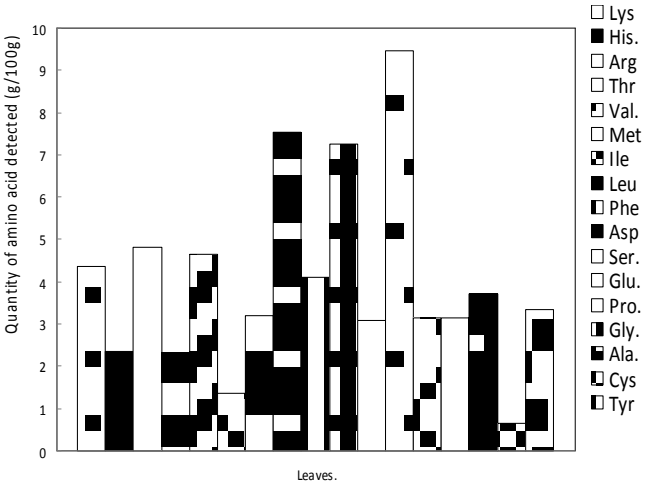

Figure 2 : The amino acid content of *Moringa oleifera* leaves.

Moringa leaves inclusion diets contain 37.40, 38.11, 37.75 and 37.22% crude protein.

The growth performance of African catfish fingerlings fed with *Moringa oleifera* leaf meal (MLM) for 56 days are shown in Figure 4. The weight gained by the fingerlings are 7.0 ± 1.0, 9.0 ± 1.0, 6.0 ± 0.0 and 5.0 ± 1.0 for 0%, 20%, 40% and 60% MLM diets respectively. The water quality fluctuations in experimental tanks containing the African catfish, *Clarias gariepinus,* are shown in Figures 5(a-c). The ranges of values of the physiochemical parameters during the experimental period were 6.80 -7.30, 3.00 - 4.50mg/l and 26.50 -27.50 ^{o}C for pH, Dissolved oxygen and Temperature respectively.

DISCUSSION

When alternative food sources such as plant proteins are used in fish diets, one of the common problems encountered is the acceptability of the feed by fish, and this frequently relates to the pal-

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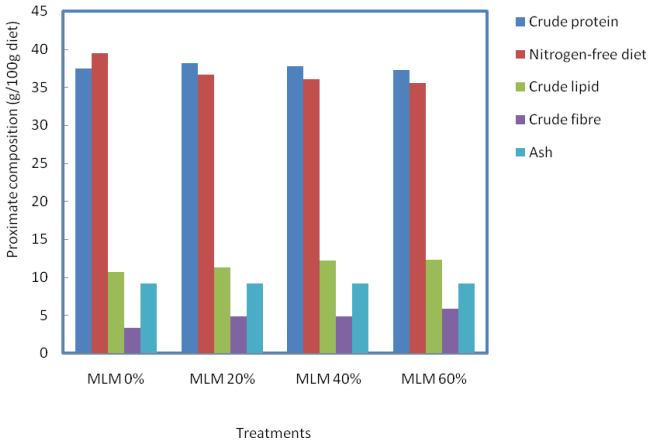
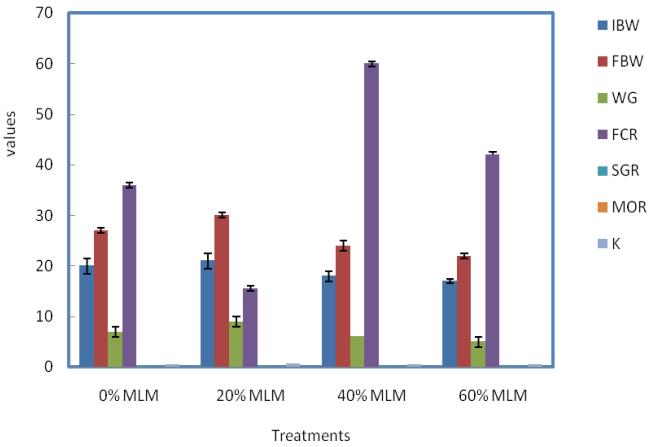


Figure 3 : Proximate composition of *Moringa oleifera* diets used for the growth trial (g/100g diet).where, MLM = *Moringa* leaf meal.



Where, IBW = Initial body weight; FBW = final body weight; WG = weight gain; FCR = feed conversion ratios; SGR = specific growth rates; MOR = Mortality; K = condition factor

Figure 4 : The growth performance of african catfish fingerlings fed with *Moringa oleifera*eaf meal (MLM) for 56days.

atability of the diets[14]. Another problem encountered with alternative food sources is the amount of essential amino acids they contain. *Moringa oleifera* leaves contain all the essential amino acids needed for normal body functioning, as can be seen in Figure 2. The proximate composition of the leaf in Figure 1 shows that *Moringa oleifera* is a good source of proteins (27.60 ± 0.14%), since according to Pearson, any plant food that provides more than 12% of its calorific value from protein is a good source of protein. However, a slight variation in proximate composition Figure 3. was observed among the diets fed to the fish. The crude fibre content increased with an increase in MLM, with 60% MLM diet having almost double the fibre content of 0% MLM diet.

Fish in all the treatment diets Figure 4. indicated that growth due to increased *Moringa oleifera* leaf meal were significantly different ($p < 0.05$). Catfish fed with MLM at 20% inclusion level gave the best growth performance ($p < 0.05$) which was marginally better than those fed with higher levels of MLM inclusions. Fish fed with 60% MLM (Diet 4) resulted in the lowest growth performance. The lowest growth response by fish fed 60% *Moringa oleifera* leaf inclusion was probably due to reduced palatability of the diet which led to reduced feed intake. The highest weight gain (9.0 ± 1.0) and specific growth rate (0.25 ± 0.05) were found in fish fed with 20% MLM. The condition factor was not significantly different ($p < 0.05$) from all the treatments.

Mean temperature, pH and dissolved oxygen levels Figure 5 were not affected by feeding frequency during the eight weeks feeding trial. The recorded mean values of all the parameters were within the acceptable limits for fish growth and health[15,16].

In this present study, it has been demonstrated that *Moringa oleifera* leaves have the potentials to partly replace fishmeal and considerably reduce expenditure on fishmeal, without compromising growth performances of the African catfish.

Shortage in world production of fishmeal, the conventional protein feed source, coupled with increased demand of fishmeal in feeds for livestock and poultry, is likely to reduce the dependence on fishmeal as a single protein source in aqua-feeds. The use of *Moringa oleifera* leaf meal as a possible fishmeal substitute to reduce the cost of fishmeal is receiving increasing attention by fish nutritionists around the world[17]. In this present study, not all the experimental diets were accepted by *Clarias gariepinus* fingerlings, indicating that the levels of inclusion of *Moringa oleifera leaf meal did affect* the palatability of the diets. This was more pronounced in fish fed with 40% and 60% MLM diets. This might be attributed to the processing technique which involved drying at room temperature that might have not reduced the anti-nutrients in *Moringa oleifera* leaf meal, thereby decreasing its palatability in Clarias gariepinus.

The potential of a feedstuff such as leaf meal in fish diets can be evaluated mainly on the basis of its proximate composition, particularly the crude protein content. The proximate composition of *Moringa oleifera* leaf in this present investiga-

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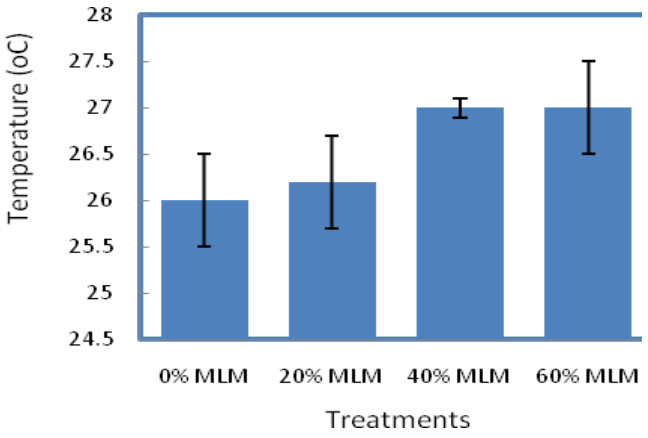

Figure 5a : Temperature (water quality fluctuation) in experimental tanks containing the african cat fish, *Clarias gariepinus.*

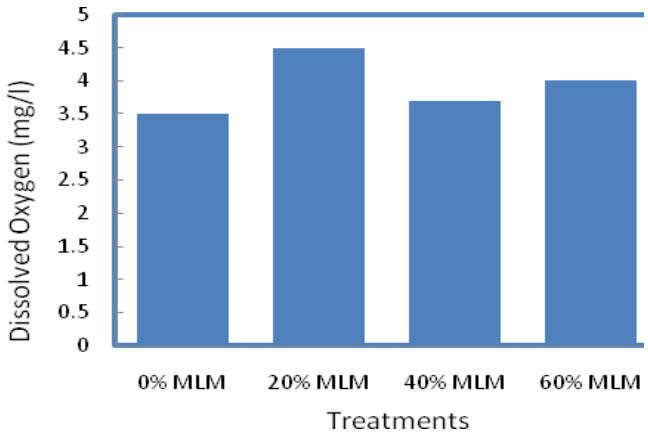

Figure 5b : Dissolved oxygen (water quality fluctuation) in experimental tanks containing the african cat fish, *Clarias gariepinus.*

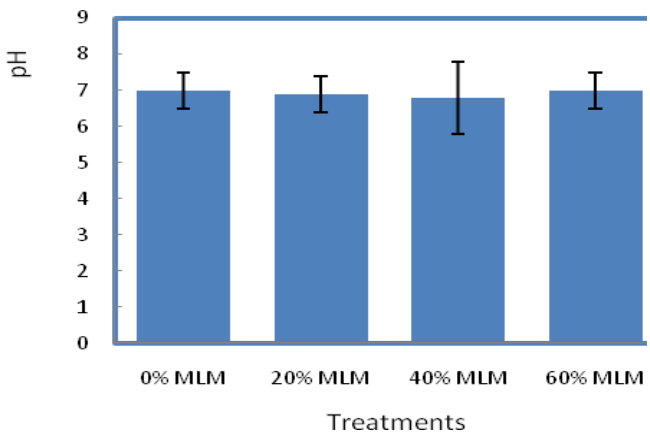

Figure 5c : pH (water quality fluctuation) in experimental tanks containing the african cat fish, *Clarias gariepinus.*

tion revealed that the crude protein content was 27.60 ± 0.14%). The nutritional quality of *Moringa oleifera* leaf meal as determined by *Clarias gariepinus* body weight gain, specific growth rate and feed conversion ratio were higher ($p > 0.05$) in fish fed on 20% leaf meal diet, significant differences ($p < 0.05$) were observed in other experimental diets.

CONCLUSION

The leaves of *Moringa oleifera* have the potential to make considerable contributions to growth of the African catfish. It also holds the potential to partially replace fishmeal in a feeding regimen and, thereby, reduce feed cost to the fish farmer, whose most important production cost comes from feed. This study has demonstrated that *Moringa oleifera* leaf meal could be included up to 20% level in *Clarias gariepinus* diets and therefore, suggests it as the optimum requirement for catfish growth performance.

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