AFM -09

Growth Performance and Nutrient Utilization of *Clarias gariepinus* Fingerlings Fed Varying Levels of *Moringa oleifera* Leaf Meal Diets

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Abstract
The effect of *Moringa oleifera* leaf meal as an ingredient in the diet of the African catfish, *Clarias gariepinus* of mean weight (9.27± 0.07g) was evaluated over an 84-day rearing period. Three experimental diets were formulated at 0% (control), 15% and 30% inclusion levels of *Moringa oleifera* meal. Leaves were harvested and air-dried under shed for three days. A control diet of fish meal with fish meal being the only protein source was formulated. All diets were isonitrogenous (35% protein). The 84-days feeding experiment was conducted in plastic tanks, each treatment having three replicates. Fish fed 0% *Moringa oleifera* meal recorded the best growth in body weight (171.32±0.16) and specific growth rate (1.42±0.003), although the best feed conversion ratio (FCR) was recorded for fish fed on the 15% diet of *M. oleifera* meal. There were no significant ($p>0.05$) differences between the condition factor of fish fed control diet and other experimental diets. The study showed that *M. oleifera* leaf meal may be included in the diets of *C. geriepinus* at inclusion levels up to 30% but it is better at 15% inclusion level. It is, therefore recommended that *M. oleifera* leaf meal be used to replace the costly fish meal.

Keywords: *Moringa* leaf meal, fish meal, *Clarias gariepinus,* food conversion, weight gain

Introduction
Aquaculture has become the fastest-growing food production sector of the world(Gupta and Gupta, 2013), with an average annual increase of about 10% since 1984 compared with a 3% increase for livestock meat and 1.6% increase for capture fisheries (FAO, 1997).

One major constraint of aquaculture production has been the cost of feed ingredients (Bbole *et al*., 2016) High cost of fish feed wasobserved as one of the problems hamperingaquaculture development in Nigeria and fish feed account for at least 60% ofthe total cost of production (Gabriel *et al*., 2007). This has motivated the research for local and cheap alternative protein feed for *Clarias gariepinus* that aim to reduce the cost of production withoutcompromising fish quality.

There has been an increased interest in the utilization of the leaf of *Moringa oleifera*, (Family *Moringaceae*) commonly known as horseradish tree or drumstick tree as a protein source for livestock (Makkar and Becker 1997; Sarwatt *et al*., 2002). The leaves contain high concentration of crude protein, essential vitamins, calcium, iron and proteins (Gidamis *et al*., 2003).

In view of the above, the present research was set up with the objectives ofdetermining the optimum inclusion level of *Moringa* leaves in the diets for *Clarias gariepinus* and to examine its growth performance when fed different inclusion levels of *Moringa oleifera* leaf meal.

Materials and Methods
Three isonitrogenous diets containing different levels of *Moringa* leaf meal (0, 15, and 30%) as shown in table 1. A total of 180 African catfish, *Clarias gariepinus* fingerlings of average weight 9.27 ± 0.07 were randomly allotted at the rate of 20 fingerlings per tank in nine experimental tanks, each trial in triplicates. The nine tanks of 1000L capacity were filled with water to 700L maximum level. The fish were acclimatized for 14 days and fed with control diet, after which the fish were starved for 24 hours to enhance their quick response to the experimental diets. Fish were fed at 7% of their body weight three times daily (8:00, 12:00 and 16:00 hrs) until apparent satiation. The ration was adjusted every week when new mean weights of fish for the various experimental units were determined. Left-over feed and feaces were siphoned out from each tank daily before feeding. Water quality parameters were monitored daily.

The following growth parameters were determined as follows:
1. Final weight (g)
2. Weight gain (g) = $W_2 - W_1$
3. Growth rate = $(W_2-W_1)/ T$
4. Specific growth rate (SGR) = $[\log W_2 - \log W_1] /T \times 100$

Where: W_2 = Final mean body weight
W_1 = Initial mean body weight
T = Duration of experiment in days

5. Feed conversion ratio (FCR) = Total feed consumed by fish (g)/ Weight gain by fish (g)
6. Condition factor $K = 100W/L^3$

Where W is Final mean body weight (g),
L is Mean standard length (cm)

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) test and the means from the various treatments were compared for significant differences ($p<0.05$), using the Duncan multiple range test. Statistical package for social scientists (SPSS 15) windows was used.

Results

The composition of experimental diets (% dry matter basis) with different levels of *Moringa oleifera* leaf meals were shown in Table 1. There were trends of increasing growth performances on basis of mean body weight gain with decreased in *Moringa* levels (Figure 1). There were significant differences ($p<0.05$) among the growth parameters as presented in table 2. Fish fed (Diet 2) showed the least growth, while fish fed Diet 3 gave the highest growth. The highest percentage weight gain, specific growth rate (SGR) were recorded from fish fed Diet 3, while highest FCR were from fish fed Diet 2.

Discussion

The ability of an organism to utilize nutrient especially protein will positively influence its growth (Sogbesan *et al*., 2008). In this study there were significant differences for growth and nutrient utilization for all the treatments at ($p<0.05$). The least weight gain was obtained in treatment containing 30 % MLM; similar report was given by Bbole (2016) that higher growth of fish was recorded in the control group compared to the experimental fish feeding on *Moringa* diet. Dias *et al*. (2005) reported that weight gain decreased when high plant protein diets were fed to fish. Thiscould be attributed to some anti-nutritional factors such as phenolics, saponin and phytic acids in *Moringa* leaves (Richter *et al*. 2003).

The condition factor for *C.gariepinus* of the treatments and the control were not significantly ($p>0.05$) different indicating that the nutrients in the diets were well utilized. The survival rate was above 93 % in all the diets, this may be attributed to efficient utilization of the diets and proper handling of fish. Water quality parameters recorded in this study conformed to the recommended range according to Viveen *et al*. (1985).

However, *Moringa* leaves are locally available in Nigeria and can be obtained throughout the year. The cost of a Kg of imported fishmeal cost #1000.00 while it cost little or nothing to collect *Moringa oleifera* leaves from the surroundings. It is therefore, less expensive to replace fishmeal with *Moringa* leaf meal at 15 % inclusion level without compromising farm profit.

These results have shown that *Moringa oleifera* leaves have the potential of partially replacing fishmeal in fish feed formulation, thereby, reducing the cost of fish production.

Table 1: Composition of experimental diets (% dry matter basis) with different inclusion levels of *Moringa oleifera* leaf meals

Ingredients	% Crude protein	0% MLM (Diet 3)(control)	30% MLM (Diet 2)	15% MLM (Diet 1)
Moringaoleifera	27.51	0	30	15
Fishmeal	72.00	35	29	32
Yellow maize	9.30	57	33	45
Cassava		4	4	4
Premix		3	3	3

Soya oil	1	1	1

Table 2: Growth performance of *Clarias gariepinus* fingerlings fed diet of deferent *Moringa oleifera* levels in 84 days.

Parameters	Diet 1 (15 %MLM)	Diet 2 (30%MLM)	Diet 3 (0%MLM) (control)
Mean initial weight (g)	9.13 ± 0.04^a	9.06±0.12^a	9.63±0.06^b
Mean final weight (g)	102.62± 0.09^b	54.85±0.09^a	171.32±0.16^c
Mean initial length (cm)	10.98±0.04^b	10.36±0.04^a	11.88±0.04^c
Mean final length (cm)	26.16±0.12^b	21.81±0.12^a	29.71±0.12^c
Mean length gain (cm)	15.63±0.07^b	11.45±0.07^a	17.83±0.07^c
Mean weight gain (g)	93.49±0.09^b	45.78±0.12^a	161.69±0.09^c
Total percentage weight gain	1023.67±5.55^b	505.36±8.10^a	1471.47±9.47^c
Specific growth rate	1.25±0.00^b	0.93±0.005^a	1.42±0.003^c
Feed Conversion Ratio	7.77±0.003^a	11.52±0.003^c	10.64±0.01^b
Final condition factor	1.08±0.005^a	1.07±0.005^a	1.13±0.005^a
Survival rate (%)	94.67±1.45^b	93.07±0.88^a	95.33±1.08^b

Mean values in the same row with different superscripts are significantly different ($p<0.05$)

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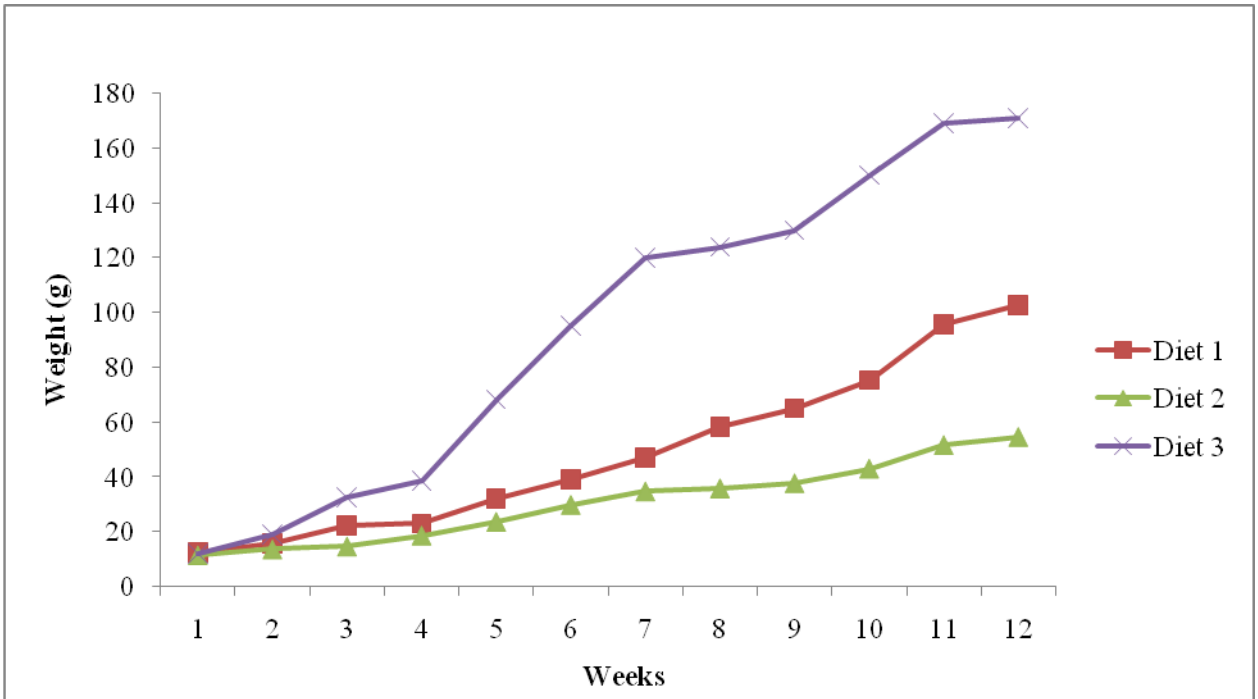

Figure 1. Growth pattern of *Clarias gariepinus* fed *Moringa oleifera* leaf meal