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Growth Performance and Nutrient Utilization of *Clarias Gariepinus* Fed Moringa Oleifera Leaf Meal

Olaniyi C.O*, Ajani,N.O, Adetomi, M. N
Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
E-mail: oludayo.olaniyi@gmail.com

Abstract
A ten weeks feeding trial was conducted to evaluate the growth performance and nutrient utilization of *Clarias gariepinus* fed varying inclusion levels of *Moringa oleiifera* leaf meal. A total of two hundred and twenty five fingerlings were allotted to five varying treatments of *Moringa oleifera* leaf meal at 0%, 5%, 7.5% 10% and 12.50% indicating treatments 1,2, 3, 4 and 5 respectively. Fifteen fingerlings were stocked in a tank of 50 liters each and the treatments were replicated three times .At the end of the feeding trial, the growth parameters determines were total daily feed intake, average feed intake and weight gain. .All the growth parameters were significantly different ($p<0.05$). Highest mean weight gain (MWG) 14.35g was observed in treatment 5 (12.5% *Moringa oleifera* leaf meal) and the least value (7.75g) was recorded in treatment 2.. The positive linear increase in mean weight gain observed in the treatments 1-5 showed that all formulated diets were nutritionally adequate. Treatment 5 (12.5% *Moringa oleifera* leaf meal) had the highest percentage weight gain 82.50%. However, the least percentage weight gain 43.63% was recorded for treatment 2 (5% *Moringa oleifera* leaf meal). In the same vein, highest specific growth rate (SGR) 0.84 %/day was shown by treatment 5 (12.5% *Moringa oleifera* leaf meal) and treatment 2 had least value of 0.52%/day . The best feed conversion and protein efficiency were achieved by the treatment 5(12.5% *Moringa oleifera* leaf meal).The results clearly showed that fish fed 12.5% Moringa oleifera leaf meal performed excellently well. Therefore, it can be concluded that Moringa oleifera leaf meal can replace Groundnut cake up to 12.5% in the nutrition of *Clarias gariepinus.*
Keywords: Growth, treatment, Feed conversion ratio and percentage inclusion level

Introduction

In Nigeria of today, a daily dietary protein intake of 70g comprising of 35g of plant and animal protein respectively has been recommended (FAO, 1996). Even though, animal protein contains a well-balanced amino acid profile and better utilised compared to plant protein since it plays vital role in human physiological functions. However, the minimum recommended daily intake of 6.5g of animal protein per head is yet to be met in Nigeria (Smith, 2001). The inability to meet up with this standard led to so many dietary deficiency problems in man. Therefore, the need to meet the protein requirements in human diets has led to increasing demand for fish and the domestication of some animals.

Feed being a major inputs in aquaculture production, high cost of fish feed has caused a lot of problem in aquaculture sector, which has actually hindering aquaculture development in Nigeria since the fish feed cost account for at least 60% of the production cost (Gabriel et al, 2007). Expensive feeds has actually reduced the profitability of fish farming thereby limiting the expansion of farms and reducing the yield in terms of quantity and quality (Adikwu,1992). This has brought about the search for local protein feed stuffs that are cheap and high in quality as alternative protein feed fo*r Clarias gariepinus* quality. *Moringa olifera* leaf is said to be an excellent source of vitamins, minerals and proteins: perhaps more than any other tropical vegetable and commonly known as “The Miracle Tree,” “Horseradish-tree,” or “Ben oil tree”) is the best known and most widely distributed species of Moringaceae family, having an impressive range of medicinal uses with high nutritional value throughout the world (Shuaib et al, 2012). It is used as growth hormone, green manure and for medications. Many do use *Moringa oleifera* leaves to fight against malnutrition and its associated diseases, such as the treatment of cardiovascular diseases: as the roots, leaves, gum, flowers, and infusion of seeds have nitrite, mustard oil glycosides, and thio -carbonate glycosides as their chemical constituents which are suggested to be responsible for the diuretic, cholesterol lowering, antiulcer, hepatoprotective, and cardiovascular protective property of the tree (shuaib et al, 2012). *Moringaoleifera*contain an appreciable amount of nutrients, the nutritional composition is as following crude protein (C.P) 25.0%, crude lipids (C.L) of 10% and crude fibre (C.F) 8.4%, beyond some common fruits, milk and carrot, which contained; 25 times the Iron of Spinach, 17 times the Calcium of Milk, 15 times the Potassium of Bananas, 10 times the Vitamin A of Carrots, 9 times the Protein of Yogurt, 0.5 times the Vitamin C of Oranges (Luna Shyr, 2012).

Therefore, this study investigates the growth performance and nutrient utilization of *Clarias gariepinus* fed varying levels of *Moringa oleifera* leaf meal as well as detemining the uptimum replacement level of *Moringa oleifera* leaf meal.

2. Materials and methods

2.1Experimental site

The experiment was carried out at the fishery unit, Ladoke Akintola University Teaching and Research Farm, Department of Animal Production and Health for period of twelve weeks.

Experimental Procedure

The fingerlings used were purchased at a reputable farm in Ilorin, Kwara state. They were acclimatized for three weeks (3) in the farm before they were exposed to treatment.

Two hundred and twenty five fingerlings were allotted to fifteen circular plastic tanks of 50liters size, at the rate of fifteen fingerlings per tank and the treatments were replicated three times. The water used was sourced from the university farms, exposed for a minimum of three (3) days for aeration. The fish were acclimatized for two weeks before the feeding trial commences.

Processing of *Moringa Oleifera* Leaf

Moringa oleifera leaf was obtained at the university farm. It was air dried in a clean room for about three weeks to obtaine a constant weight for easy grinding. It was grounded using manual grinder to obtain right particle size for pelleted feed.

Experimental Diets

Feed ingredients were purchased from a reputable feed mill in Ogbomoso. The ingredients used were maize, wheat offal, groundnut cake, fishmeal blood meal, vegetable oil, oyster shell, bone meal, salt, premix and lysine. Five experimental diets were formulated; diet 1 contained 0% of *Moringa oleifera* meal and serve as control and diet 2, 3, 4 and 5contained 5%, 7.5%, 10% and 12.5% replacement levels *Moringa oleifera* leaf meal respectively.

The ingredient was weighed according to their calculated weight, mixed thoroughly and then pelletized to replaced dustiness and for proper acceptance by fingerlings. The pellets were sun dried for two days to prevent deterioration and the feeds were stored in an air tight container.

Feeding and Management of the Fingerlings

The fingerlings were fed 3% of their total body weight daily. Feeding was done twice daily at 0900 hrs and 1500 hrs the fish regime was adjusted with respect to body weight.

Chemical Analysis of the Test Diet and Fish

The proximate composition of the test ingredients (*Moringaoleifera*leaf) and fish were determined on dry matter basis using the method of A.O.A.C (1990). An initial carcass analysis was done at the beginning and also at the end of experiment for each treatment.

Data Collection

The parameters measured were Weight Gain; Average Daily Weight Gain;; Feed intake;

Each of these parameters was measured at 2 weeks interval. Performance characteristics were evaluated according to the method of Olvera- Novoa*et al*, (1990) as follows:

Mean Weight Gain (MWG) = Final mean weight (g) - Initial mean weight (g);

Average Daily Weight Gain (ADWG) = Mean weight gain (g) / length of feeding trial (days);

Percentage Weight Gain (PWG) = Mean weight gain (g) / Initial mean weight; x 100

Specific growth rate ($_{SGR}$ % /day) = $100[(Log_eW_2 - Log_eW_1)/N_O$ of days

Feed conversion ratio (FCR) = total feed fed (g) / net weight gain (g);

Protein Intake (PI) = total feed consumed X % Crude protein in feed

Feed intake (FI) = This is the amount of feed throughout the period of the experiment ;

Protein Gain (PG) = mean protein intake (g) / length of feeding trial (days);

Protein Efficiency Ratio (PER) = Net weight gain (g) / Amount of protein fed (g) while

Protein productive Value (PPV) = protein gain in fish (g) / Protein in food (g) x100.

Statistical Analysis

The results were subjected to One Way Analysis of Variance (ANOVA) using completely randomized design (CRD), SAS (2000). Means were separated by Duncan's Multiple Range Test using the same computer package.

3. Results

The proximate composition of the experimental diets was presented in table 4. The crude protein (C.P) values of the diets 2, 3 and 5 were not significantly different ($p>0.05$). The highest value was recorded for the diet 1 (30.41) which serves as control but diet 2 recorded the highest value for the test diet (29.05) while the lowest value was recorded in diet 4 (27.05). The crude fat (C.F)in all the diets were significantly difference ($p<0.05$). The highest value was observed in the treatment 1 (control) with the value of (4.18) while the lowest value recorded was in diet 2 (3.18). The crude fibre in the diets 1,3 and 4 had no significant difference ($p>0.05$) while treatment 2and 5 were significantly difference ($p<0.05$), the highest value was recorded in treatment 2 (5.53) with the lowest value of (4.42) in diet 1. The total ash in diet 1 and 5 shown no significantly difference ($p>0.05$) while in 2, 3 and 4

were significantly different ($p<0.05$), the highest value recorded was in diet 2 (9.68) with the lowest value of (7.25).

Table 3: showed the chemical composition of *Moringaoleifera* (M.O)leaf, the crude protein (C.P) content was 26.44% suggesting that (M.O) leaf is a good source of protein for the fish. The ether extract, crude fibre, ash and nitrogen free extract were as following values 6.30%, 8.13%, 11.41% and 47.72% respectively.

Table 4 showed the parameter observed and recorded in the growth performance and the nutrient utilization of *Clariasgariepinus*fingerlings fed levels (0%, 5%, 7.5%, 10% and 12.5%) of *Moringaoleifera*leaf meal in the diets. The mean weight gain (MWG) were significantly different ($P< 0.05$), highest value was recorded in treatment 5 with the value of 14.35g while the lowest value was recorded at treatment 2 with the value of 7.75g. Percentage weight gain (PWG) were significantly different ($P<0.05$), highest value was recorded in treatment 5 with the value of 82.58% while the lowest value was recorded in treatment 2 with the value of 43.63%. Treatment 5 had the highest specific growth rate of (0.84%/ day) and the least value was recorded for treatment 2 (0.52% /day). The best feed conversion and protein efficiency 0.11 and 27.41 respectively were achieved by the treatment 5(12.5% *Moringa oleifera* leaf meal)

4.Discussion

Chemical composition of *Moringa oleifera* Leaf

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 chemical composition of *Moringa oleifera* leaf meal in the present research revealed that the crude protein (C.P) content was 26.44%. This value was higher than the value 17.01% reported by Ogbe et al, 2011 and closer to the result of Richter et al, (2003) who revealed the C.P content of 25.0.%. The difference in the value might be attributed to differences in environmental conditions types of soil, harvesting time, frequency of defoliation, maturation stages as well as processing methods, degree of freedom from errors during the chemical and statistical analysis, as a matter of fact, genotype have a strong influence on nutrient content of *Moringaoleifera*leaf. Although, the nutritional quality of *Moringaoleifera* would be determined by the growth parameters of the fish fed with these leaves.

Chemical Composition of Diet

The crude protein (C.P) of the diet targeted was 40% and the CP of the formulated diets fall within the range of 15-40% C.P recommended by Lovell (1997) for *Clarias gariepinus* fingerlings, contrary to minimum C.P below an average value of 35% for *Clarias gariepinus* fingerlings reported by Robinson et al (2001) which could be detrimental to *Clarias gariepinus* fingerlings performance. The crude fat (C.F) of 3-4% in the diet was observed, this result agreed with Robinson et al (2006) who found out that the C.F of 3-4% could be accepted by *Clarias gariepinus* fingerlings without any adverse effect.

Growth Performance

In the present study, term of growth performance parameters, the fishes fed 12.5% Moringa oleifera dietary significantly ($P<0.05$) had the highest final weight gain of 32.10g higher than the report of earlier researcher, Ladipo *et a*l, 2005 who reported weigh gain (WG) of 30.30g The present study revealed that *C.gariepinus* can tolerate up 12.5% level of replacement without any adverse effect. This means that *Moringaoleifera* leaf meal was able to increase the weight gain by 2g beyond the earlier researcher, Ladipo et al, 2005. Higher average feed intake (AFI) recorded in treatment 1 (0.83g) and the lowest value (0.69g) recorded in the treatment 2 revealed that the highest grams of feed were consumed by the fishes in the treatment 1 while the lowest was consumed in the treatment 2 to produce their recorded weight in each treatment, the fishes in treatment 5 (12.5% *Moringaoleifera*) are able to maximize their feeds to produce the best final weight gain. The positive mean weight gain observed in the diet 1-5 showed that all formulated diets were nutritionally adequate. Treatment 5 (12.5% *Moringaoleifera*leaf meal replacement) had the highest percentage weight gain (PER) 82.50 although (0% *Moringaoleifera* leaf meal replacement) with the value of 71.62 and diet 3 (7.5% *Moringaoleifera*leaf meal replacement) had a very close value of 71.00. However, the lowest percentage weight gain value recorded in the diet 2 (5% *Moringaoleifera*leaf meal replacement). In the present research,specific growth rate(SGR) showed the highest value with 0.82 per days in treatment 5, higher than the report of Nlewadim et al, 2004 who found out (SGR) to be 12%(0.12) per day for *Clariasgariepinus* cross breed and 11.60%/ day for heterobranchus cross with *Clarias gariepinus* which is in contrary with (Abdel-Warith, 2002) who reported SGR to range between 3.11 to 2.78 %/ day and FCR to range from 0.82 to 0.83 for *Clarias gariepinus*. The present research showed that, highest FCR was recorded in treatment 2 with the value of 0.21 while the lowest value (0.09) was recorded in treatment 1 (control) and 5 which was lower than the value reported by (Abdel- Warith, (2002) and PER recorded the highest value (33.31) in treatment 1 while the lowest value was recorded in treatment 2 with the value of (18.05) which was greatly higher than the value reported for fancy carp by (Bundit et al, 2012) who reported that the FCR ranges from 0.59 to 0.41and PER ranged from 0.72 to 0.43. The utilization protein corresponded positively with protein intake (P.I) suggesting that the higher the protein intake the higher the

utilized since protein consumed in excess of requirement would be voided in feaces.

Carcass Characteristics

The results on the carcass shown in this study showed that the dietary levels of 5%*Moringa* and 12.5% *oleifera* diet had highest level of crude protein (C.P) with values of 59.85% and59.31% respectively.7.5% level of inclusion(Treatment 3) also was relatively next in value with 58.28%.It showed that they were almost the same and higher than that of 0% level of replacement (control) by implication it is means that the increase in the crude C.P content of the fish carcass for all except 10% level of replacement with the value of 50.02% is an indication that *Moringa oleifera* has able to improve the carcass protein relatively to control. It was indicated that initial fish had the highestC.P this was an indication that imported fish feed was able to increase the C.P relative to local way of preparation.

5. Conclusion

From the result of obtained, diet 5 (12.5% replacement level) had the best performance in term of FCR,SGR, PER and FWG therefore it can be concluded that GNC can be replaced with *Moringaoleifera* leaf mealup to 12.5% level in the diet of*Clariasgariepinus* fingerling.

6. Recommendation

It can be recommended that farmer should replace GNC with *Moringaoleifera* leaf meal up to 12.5% so has to reduce cost and maximize profit. Also research can be done on other various processing technique that can be used in the processing *Moringaoleifera* leaf so as to increase the biological value, acceptability and palatability of its protein

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Table 1: Gross Composition of the Experiment Diets

Ingredients	Diet 1	Diet 2	Diet3	Diet 4	Diet 5
Maize	24.38	23.38	22.38	21.38	20.28
Rice bran	6.10	4.10	3.80	2.60	1.60
GNC	41.26	39.26	38.56	38.26	37.86
Fish Meal	16.51	16.01	16.51	16.51	16.51
Moringa Leaf Meal	0.00	5.00	7.50	10.00	12.50
Blood meal	8.25	8.25	8.25	8.25	8.25
Vegetable oil	0.25	0.25	0.25	0.25	0.25
Oyster shell	0.50	0.50	0.50	0.50	0.50
Bone meal	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	1.50	1.50	1.50	1.50	1.50
Lysine	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100
Replacement Level	0%	5%	7.5%	10%	12.5%

*Composition per 2.5kg of Premix
Vitamins A 12,500,000 I.U, vitamin D3 2,500,000 I.U, Vitamins E 40,000mg, Vitamin K3 2,000mg, Vitamin B1 3,000mg, Vitamins B2 5,500mg, Niacin 55,000mg, Calcium Panthothenate 11,500mg, Vitamins B6 5,000mg, Vitamin B12 25mg, Choline Chloride 500,000mg Folic Acid 1,000mg, Biotin 80mg, Manganese 120,000mg, Iron 100,000mg, Zinc 80,000mg, Copper 8,500mg, Iodine 1,500mg, Cobalt 300mg, Selenium 120mg, Anti-oxidant 120,000mg

Table 2: Chemical Composition of Experimental Diets Fed to *Clarias Gariepinus* Fingerlings

	Diet Number					SEM
Components	1	2	3	4	5	
Dry matter	90.63^{b}	90.99^{a}	91.02^{a}	90.99^{a}	91.03^{a}	0.05
Moisture	9.38^{a}	9.03^{b}	8.99^{b}	9.01^{b}	8.97^{b}	0.05
Crude protein	40.41^{a}	40.05^{b}	40.88^{b}	40.05^{c}	40.84^{b}	0.20
Crude fat	4.18^{a}	3.45^{d}	3.62^{cd}	4.11^{ab}	3.86^{bc}	0.06
Crude fibre	4.42^{c}	5.53^{a}	$4.77b^{c}$	4.51^{c}	5.05^{b}	0.09
Total ash	9.43^{b}	9.68^{a}	8.80^{c}	7.25^{d}	9.35^{b}	0.17
Nitrogen free Extract	41.58^{d}	41.30^{c}	42.01^{b}	44.08^{a}	40.48^{c}	0.30

a,b,c and d.Mean in the same row with different superscripts are significantly different ($p<0.05$). SEM: Standard Error of Mean.

Table 3: Proximate Composition of *Moringa Oleifera* Leaf Meal

Parameter	Percentage Weight
Dry matter	93.70
Moisture	6.30
Crude Protein	26.44
Ether extract	6.30
Crude fibre	8.13
Ash	11.41
Nitrogen free extract	47.72

Table4: Growth Performance and Nutrient Utilization of *Clarias Gariepinus* Fingerlings of *Moringa Oleifera* Leaf Meal

Parameters	Treatments					SEM
	1	2	3	4	5	
IMW (g)	17.75	17.75	17.75	17.75	17.75	0.01
FMW (g)	30.45^{ab}	25.50^{c}	29.95^{ab}	27.00^{ab}	32.10^{a}	0.65
MWG (g)	12.70^{a}	7.75^{c}	12.20^{b}	9.25^{c}	14.35^{b}	0.75
DWG (g/day)	0.26^{a}	0.11^{c}	0.17^{b}	0.13^{c}	0.21^{b}	0.01
PWG (%)	71.62^{ab}	43.63^{c}	71.00^{ab}	52.12^{bc}	82.58^{a}	3.79
SGR (%/day)	0.77^{ab}	0.52^{c}	0.75^{ab}	0.61b^{c}	0.84^{a}	0.03
AFI (g)	0.83^{a}	0.69^{c}	0.79^{b}	0.75^{ab}	0.80^{ab}	0.01
FCR	0.09^{a}	0.21^{a}	0.11^{b}	0.12^{b}	0.11^{b}	0.01
PI	0.32^{a}	0.27^{c}	0.31^{ab}	0.30^{b}	0.31^{ab}	0.00
PER	33.31^{a}	18.05^{c}	26.94^{b}	23.81^{b}	27.41^{b}	1.12

Table 5:Pr0ximate Carcass Composition of *Clarias Gariepinus* Before and After the Experiment.

Parameters	Initial	0% MO	5% MO	7.5% MO	10% MO	12.5% MO	SEM
Dry matter	93.29^{c}	92.88^{c}	94.09^{b}	93.75^{b}	94.91^{a}	94.06^{b}	0.12
Moisture	6.71^{a}	7.13^{b}	5.92^{b}	6.25^{b}	5.09^{c}	5.95^{b}	0.12
Crude protein	59.318^{c}	56.32^{e}	59.85^{ab}	58.28^{d}	50.02^{a}	59.68^{b}	0.22
Crude fat	21.54^{b}	22.00^{a}	17.83^{d}	19.15^{c}	16.66^{e}	17.97^{d}	0.33
Crude fibre	2.83^{b}	2.37^{c}	1.58^{e}	2.45^{c}	3.15^{a}	3.15^{a}	0.10
Total ash	13.43^{ab}	12.36^{d}	11.85^{e}	13.21^{bc}	12.88^{c}	13.75^{a}	0.12
Nitrogen free extract	2.04^{a}	6.93^{c}	8.90^{e}	6.93^{c}	7.31^{d}	5.83^{b}	0.11

a,b, c and d.Mean within the same row with different superscripts differ significantly $p< 0.05$,
SEM: Standard Error of Mean
MO: *Moringaoleifera*leaf meal

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