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THE USE OF MORINGA OLEIFERA LEAVES AS A PROTEIN SOURCE IN THE DIET OF AFRICAN CAT FISH CLARIAS GARIEPINUS

Samirah Idris Umar

Biology Department
School of Science
F.C.T College of Education, Zuba, Abuja

Abstract

Aquaculture is an important weapon in the global fight against malnutrition and poverty particularly in developing countries (Tacon, 2001).Thus, Moringa oleifera leaves as an ingredient in the compounding of fish meals was studied using African cat fish, Clarias gariepinus,(juveniles) as the test fish. The study was carried over a 56-days period using standard procedures. Five different fish meals were prepared using Moringa oleifera leaves (MOLM) at 0%, 25%, 50%, 75% and 100% as a substitute for protein. All the diets contain 50% crude protein. Coppen fish meal served as standard. Experimental design was a complete randomized design (CRD).The data were subjected to one way analysis of variance and Tukey's multiple comparison tests so as to test if there are significant differences among the diets across the parameters. The mean weight gain (MWG), specific growth rate (SGR), mean length increase (MLI), fed conversion ratio (FCR), feed conversion efficiency (FCE) and protein efficiency ratio (PER) were calculated. The result obtained from the experiment showed that fish fed with 0% MOLM showed statistical significant ($p<0.05$) difference from fish fed on other inclusion levels of MOLM (25%, 50%, 75% and 100%), in terms of MWG, SGR and MLI. Although the best feed conversion ratio (FCR) was recorded for fish fed on 25% MOLM. However, there was no significant difference in fish fed on 25%, 50% and standard in terms of MWG, SGR, MLI and FCR. The result showed that fish meal in the diet of Clarias gariepinus can be replaced with up to 50% MOLM for good growth and nutrient utilization, as there is no significant difference between 25%, 50% and the standard in terms of growth performance. It can be recommended that farmers can substitute protein source with MOLM for fishmeal up to 50% so as to reduce cost and maximize profit.

Key words: Aquaculture, *Moringa oleifera* ,Clarias *gariepinus,* Growth Performance and Nutrient Utilization

INTRODUCTION

Aquaculture is an important weapon in the global fight against malnutrition and poverty particularly in developing countries (Tacon, 2001).The consumption and demand for fish as a cheap source of protein is on the increase in Africa, because of the level of poverty in the

land. Fish farming or culture (an aspect of aquaculture) is an integral component of the overall agricultural production system in Nigeria. The major species cultured in Nigeria include Tilapias, catfish and carp; however the African catfish *Clarias gariepinus* is the most farmed (Agbede, Adedeji, Adeyemo, Esuruoso and Yusuf, 2003).A number of studies have evaluated various protein sources for fish feeds, but the results were not consistent. Unfortunately, attempts by feed manufacturers and nutritionists to replace the fish meal component of practical fish feeds with alternative protein sources have generally led to reduced feed efficiency and growth (Tacon & Jackson, 1985).

Moringa Oleifera is a member of *moringaceae* a miraculous and multipurpose tree that thrive in both tropical and subtropical condition (Richter & Becker, 2003). *Moringa oleifera* leaves contain 2 times the protein of yoghurt, 7 times the vitamin C of oranges, 3 times the potassium of bananas, 4 times the vitamin A of carrots and a lot more calcium than is available in milk (Fahey, 2005). Despite the high crude content of *Moringa* leaf meal, there is little information regarding the utilization of *Moringa* leaves in fish feed. However, it has been found that *Moringa* leaves could be constituted in dietary protein of fish feed (Richter & Becker, 2003).Thus, this research investigate the feasibility of using *Moringa oleifera* leaves as a protein source in the diet of African cat fish C*larias gariepinus*.

MATERIALS AND METHODS

STUDY LOCATION

The experiment was carried out at the Faculty of Agriculture Farm, University of Abuja, Nigeria.

SOURCES OF FEED INGREDIENTS

Fresh Moringa leaves (*Moringa oleifera* Lam.) were plucked freshly from the trees in Tunga-maje of Gwagwalada area council and were authenticated in the Herbarium of Biology Department University of Abuja. Other feed stuffs (fishmeal, yellow maize meal, Vitamin premix) were obtained from kado fish market Abuja. Blood for the blood meal was obtained from a freshly killed cow at Dei-Dei abattoir Abuja.

DIET PREPARATION AND PROCESSING

Five isonitrogenous, isocaloric diets were formulated containing 50% crude protein using the Pearson square method. Feed were formulated with inclusions of varying quantities of fish meal combined with *Moringa* leaf meal. The experimental feeds were set up in the ratio of protein sources as follows: 0% MOLM= fish meal 100%: 0% *moringa oleifera* leaf meal, 25% MOLM =75% fish meal: 25% *moringa oleifera* leaf meal 50% MOLM = 50% fish meal: 50% *moringa oleifera* leaf meal, 75% MOLM=25% fish meal: 75% *moringa oleifera* leaf meal and 100% MOLM = 0% fish meal: 100% *moringa oleifera* leaf meal.

Prior to processing, the feed ingredients were ground individually to a fine powder by using harmer mill machine, then individually weighed and properly mixed together thoroughly with warm water to get a homogenous mixture or dough-like paste. The diets were then

pelletized using a 2mm meat mincer. The diets were sun-dried for 4 days and stored in airtight containers throughout the experimental period. Samples of the experimental diets were subjected to proximate analyses. All analyses followed the procedures of AOAC, (2000).

EXPERIMENTAL DESIGN

Two hundred and sixteen juveniles of *Clarias gariepinus* of size ranging from 7 - 10cm with an average weight of 11.95g were used for the experiment. During acclimatization (2 weeks) the fishes were fed with imported commercial fish feed (coppens) of 2mm size daily at 9:00am and 6:00pm at rate of 5% of their body weight. After acclimatization the fishes were distributed randomly into the experimental rectangular plastic tanks representing 5 treatments and standard (all in triplicates), each tank have 12 fishes. The experimental set-up consisted of eighteen (18) rectangular plastic tanks (60 x 30 x 20cm3) each tank has water holding capacity of 30 litres. Total weight and standard length measurements were taken fortnightly. The experimental fish at the beginning and the end of the feeding trial were subjected to proximate analysis. All analysis followed the procedures of AOAC,(2000).The experiment was designed for a period of 2 months using completely randomized design (CRD). Different dietary treatments were randomly assigned to the experimental units (tanks).

WATER QUALITY PARAMETERS

Water quality parameters were measured fortnightly. Temperature was measured using mercury in glass thermometer, was measured by Jenway pH meter (Model E 512) and dissolved oxygen was determined by the method of APHA, (1976).

STATISTICAL ANALYSIS

Data collected for those variables were subjected to one way analysis of variance using Genstat c 16 th discovery package, where significant difference exist among the experimental treatment ,then means were separated using Tukey's Multiple Comparison Test ($P < 0.05$).

RESULTS AND DISSCUSSION

The result of the proximate analysis of moringa leaf and feedstuffs used for diet formulation is shown in Table, 1.

Table 1: Proximate Analysis of Moringa Leafand Feedstuffs Used For Diet Formulation

Ingredient	(%) Moisture	(%) Lipid	(%) crude protein	(%) Ash
Moringa Oleifera (MOLM)	9.29	4.32	28.83	6.09
Yellow Maize	11.48	8.14	10	1.58
Fish (Fish Meal)	2.60	17.18	69.96	9.32
Blood Meal	10.00	1.10	80.00	8.70

The chemical composition of *Moringa oleifera* leaf meal in the present study showed that the crude protein (CP) content was 28.83%.This value was higher than 27.1% and 27.51% values reported by Booth & Wickens (1988) and Ibok , Oduro, Ellis & Deborah (2008) respectively. The variation in the crude protein could be attributed to environmental conditions, edaphic factors, age of harvesting, maturation stage as well as method of processing and analysis methods. The crude protein (CP) of the diet (calculated) used for the study was 50% and the formulated diet falls within the range of 49-50% CP as recommended by Omole Omole, Fapohunda, Bankole, Owosibo, & Omidiran, (2006) for *Clarias gariepinus* juvenile.

GROWTH PERFORMANCEAND FEED UTILIZATION

The growth performances of African catfish, *Clarias gariepinus* fed *on* varying inclusions levels of *Moringa oleifera leaf* meal (MOLM) over a period of 56 days is presented in Table, 2. The result obtained from the study showed that the growth response of fish fed with diet containing 0, 25, 50, 75 and 100% *Moringa oleifera* leaf meal (MOLM) replaced for fish meal is decreasing with increasing level of MOLM in terms of weight gain (WG), mean daily weight gain (MDWG), specific growth rate (SGR), mean final length (MFL), mean length increase (MLI). On the other hand, the standard group (coppens) was almost comparable with the fish fed with 25% and 50% MOLM in terms of MFW, MWG, MDWG and SGR. However, as the quantity of the *moringa* meal increased, less feed was consumed. This observation is an indicator of the level of acceptability and palatability of the various diets. This observation corresponds with the findings of Francis, Makkar, & Becker.(2002) which showed that when MOLM was used in *Tilapia nilotica* feeds, it indicated growth-reducing effects at high levels of inclusion of raw leaf meal.High inclusion of plant protein in fish diet have frequently been reported to result in reduced growth or high mortalities attributed to poor palatability, high crude fibre, reduced digestibility of lipid and energy, imbalance of essential amino acid and presence of anti-nutritional factors (Tacon, 1993; Fagbenro, 1999;Mambrini,Roem, Cravedi, Lalles & Kaushik,1999 ;Francis, Makkar & Becker , 2001 ; Ogunji & Warith, 2001).The study showed that there was no significant difference between fish fed with 25% MOLM, 50% MOLM and control as regards to growth performances of MWG, MLI and SGR. However, fish fed on 0% MOLM was significantly higher than the foregoing. The study also showed that fish fed with 75% MOLM and 100% MOLM are significantly low on each of the growth performance indicators. This implies that inclusion of up to 50% MOLM could be used to replace the coppen. This work agrees with earlier studies which have showed that up to 50% de-hulled sunflower meal could be used to replace fish meal as a protein source in the diet of Nile tilapia, *Orechromis niloticus* without significant effect on the body weight (El-saidy & Gaber 2004).Amisah, Oteng & Ofori (2009) reported that Leucaena leaf meal could be included up to 30% level in *Clarias gariepinus* diet without any negative effects on growth. However, Olaniyi Ajani & Adetomi (2013) reported MOLM inclusion level of up to 12.5% while Bello (2013) reported a lower level of MOLM inclusion of up to 10% in *Clarias gariepinus* diet without any negative effect on the growth rate and feed efficiency.

Table 2: Growth Performance, Nutrient Utilization And Survival Parameters Of Cat Fish (Clarias Gariepinus) Fed With Varying Inclusion Level Of Moringa Oleifera.

	Inclusion						
Parameter	**0**	**25**	**50**	**75**	**100**	**Standard**	**Se±**
MIW	11.98^{a}	12.07^{a}	11.70^{a}	11.90^{a}	12.11^{a}	12.18^{a}	0.809
MFW	95.98^{a}	84.73^{ab}	71.60^{ab}	55.18^{bc}	32.77^{c}	83.52^{ab}	10.34
MWG	84.00^{a}	72.66^{ab}	59.91^{ab}	43.28^{bc}	20.66^{c}	71.34^{ab}	10.25
MDWG (g/day)	1.500^{a}	1.297^{ab}	1.070^{ab}	0.773^{bc}	0.369^{c}	1.274^{ab}	0.1830
SGR (%/day)	3.668^{a}	3.474^{ab}	3.197^{ab}	2.720^{b}	1.762^{c}	3.438^{ab}	0.2669
MIL (cm)	10.39^{a}	10.57^{a}	10.42^{a}	10.78^{a}	10.57^{a}	10.80^{a}	0.2276
MFL (cm)	22.62^{a}	21.23^{a}	20.41^{a}	18.17^{ab}	14.79^{b}	22.37^{a}	1.338
MLI (cm)	12.230^{a}	10.660^{ab}	9.993^{ab}	7.394^{bc}	4.213^{c}	11.573^{ab}	1.376
FCR	1.604^{b}	1.459^{b}	1.682^{b}	1.811^{b}	2.924^{a}	1.717^{b}	0.3068
FCE(%)	64.34^{ab}	69.84^{a}	61.86^{ab}	56.22^{ab}	35.79^{b}	58.23^{ab}	8.51
PER	1.287^{ab}	1.397^{a}	1.237^{ab}	1.124^{ab}	0.716^{b}	1.165^{ab}	0.1703
Survival Rate (%)	83.33^{a}	77.78^{a}	83.33^{a}	86.11^{a}	88.89^{a}	91.67^{a}	11.36

Means followed by the same letters within row are not significantly different using tukey(P>0.05) comparism test.Codes:0%MOLM:100% fishmeal and 0% moringa leaf meal, 25% MOLM:75% fishmeal and 25% moringa leaf meal, 50% MOLM :50% fishmeal and 50% moringa leaf meal, 75% MOLM :25% fishmeal and 75% moringa leaf meal, 100% MOLM:0% fishmeal and 100% moringa leaf meal. STANDARD :coppens

In this experiment feed conversion ratio (FCR) in fish fed diet Containing 100% MOLM was significantly highest among all the treatments. All the other treatmentsare not significant and have FCR ranging from 1.4-1.8 which is good feed conversion ratio. However, the lower the FCR value the better the performance of the fish since FCR determines how much of the feed is taken, utilized and converted to edible meat Chris *et al* (2011). However, the value obtained for feed conversion efficiency (FCE) were a reflection of the FCR since the FCE is the reciprocal of the FCR expressed in percentage. The FCE in this study was found to be highest in fish fed with25% MOLM while the least FCE value was obtained in fish fed with 100% MOLM. The result showed a very good FCE across the treatment group except fish fed on 100%MOLM as reported by Chris *et al*., (2011) that FCE`s greater than 50% are considered good feed utilization.

Protein efficiency ratio (PER) was higher in fishes fed with 25% MOLM.PER seems to decrease with increase in MOLM level. These finding has a direct link with palatability of the diet which caused reduced feed intake. The importance of feed intake by fishes as a determinant of its performances has been emphasized Preston (1987),Faturoti (1989) and pillay (1990).

Survival rate of fish during the experimental period was not significantly different among the experimental diet.The highest survival rate was observed in fish fed on standard group (coppens) while the least was observedin fish fed with 25% MOLM. This could be as result of the presence of antinutrional factor this findings agreeswith the findings of Alegbeleye*et al*., (2004) reported a relatively high mortality rate for fish fed with rawlocust bean diet due to the presence of toxin in the raw diet.

CARCASS COMPOSITION OF FISH

The proximate composition of experimental fish at the beginning and the end of the experiment were presented in Table 3. The proximate composition of the initial and final carcass composition was observed on moisture, crude protein, ash, lipid and crude fibre.

Table 3: Initial And Final Carcass Proximate Composition Of Clarias Gariepinus Fed With Different Inclusion Levels Of Moringa Oleifera Leaf Meal (MOLM).

		Proximate Inclusion						
Composition	**Initial**	**0**	**25**	**50**	**75**	**100**	**Standard**	**Se±**
Moisture	14.72	10.27^{C}	13.57^{a}	12.08^{abc}	10.34^{c}	12.64^{ab}	11.39^{bc}	0.406
Crude protein	36.45	45.78^{a}	49.09^{a}	45.93^{a}	49.87^{a}	52.29^{ab}	50.09^{a}	0.577
Ash	16.40	23.30^{a}	25.10^{a}	18.82^{bc}	20.05^{b}	16.34^{c}	18.40^{bc}	0.577
Lipid	20.17	16.91^{a}	14.03^{b}	18.01^{a}	17.20^{a}	17.64^{a}	17.31^{a}	0.286
Crude Fibre	1.15	1.330^{a}	1.030^{a}	1.370^{a}	1.140^{a}	1.020^{a}	1.36^{a}	0.0728

Means followed by the same letters within row are not significantly different using tukey(P>0.05) comparism test. Codes:0%MOLM:100% fishmeal and 0% moringa leaf meal, 25% MOLM:75% fishmeal and 25% moringa leaf meal, 50% MOLM :50% fishmeal and 50% moringa leaf meal, 75% MOLM :25% fishmeal and 75% moringa leaf meal, 100% MOLM:0% fishmeal and 100% moringa leaf meal. STANDARD :coppens

The final fish carcass crude protein contents for all the dietary treatment were higher than the initial carcass crude protein, this result agreed with Bello & Nzeh (2013) who found out higher carcass crude protein content than the initial carcass crude protein in *Clarias gariepinus* fed with MOLM. This indicates that there was synthesis and increased tissue protein production and the growth of fish were not due to increase in weight alone (Fuller, 1969). Carcass of Fish fed on 100% MOLM had better protein than other carcass of fish fed on 0%, 25%, 50% and 75% indicating that Moringa *oleifera* was able to improve the carcass protein. This is followed by the carcass of those fish fed on coppens. The initial carcass lipid content of fish was higher than the final carcass lipid content of fish fed on different inclusion levels, this is so as *Moringa oleifera has* a definite hypocholesterolenic activity (Ghasi, Nwobodo & Ofili,2000) and found to contain high levels of unsaturated fatty acids (Lalas & Tsakin, 2002).The carcass ash content varied among the different inclusion levels. The initial carcass ash content was lower than the final carcass ash content in all the inclusion levels except in fish fed with 100%MOLM, suggesting the mobilization of both plant and animal protein sources for bone and mineral metabolism. Generally, the higher the ash content of fish meal, the higher the calcium, phosphorus and magnesium content (De Boer & Bickel, 1988).

WATER QUALITY PARAMETERS

The water parameter result of the present study shown in Table 4 revealed that there was no significant difference (P>0.05) between dissolved Oxygen (DO),pH and conductivity within the experimental tanks fed with varying inclusion levels of MOLM. Temperature of fish fed

with 25% and 50% MOLM had the highest temperature and were not significantly different (P<0.05).

Table 4.: Water Quality Parameter Of The Experimental Tanks Growth Fed With Varying Inclusion Level Of Moringa Oleifera.

Parameter	0	25	50	75	100	Standard
Dissolved Oxygen (DO)	4.27^{a}	5.33^{a}	4.40^{a}	4.90^{a}	5.13 ^{a}	5.23^{a}
pH	6.42^{a}	6.30^{a}	6.37^{a}	6.45^{a}	6.41^{a}	6.37^{a}
Temperature	29.3^{ab}	29.3^{a}	29.5^{a}	28.6^{b}	28.8^{ab}	28.9^{ab}
Conductivity	333.5^{a}	353.5^{a}	370.3^{a}	348.9^{a}	347.6^{a}	338.4^{a}

Means followed by the same letters within row are not significantly different using tukey(P>0.05) comparism test. Codes:0%MOLM:100% fishmeal and 0% moringa leaf meal, 25% MOLM:75% fishmeal and 25% moringa leaf meal, 50% MOLM :50% fishmeal and 50% moringa leaf meal, 75% MOLM :25% fishmeal and 75% moringa leaf meal, 100% MOLM:0% fishmeal and 100% moringa leaf meal. STANDARD :coppens

CONCLUSION

Based on the results obtained from this study, it can be concluded Moringa has considerable potentials for becoming animal and fish feed ingredients, because of their high nutritional quality and low anti-nutritional factors. This research has shown that protein source, in the diet of *C. gariepinus*, can be efficiently replacedwith up to 25% and 50% *Moringaoleifera* leave meal, for good growth and nutrient utilization, comparable with the fishmeal-based diet which seem to get performance closely together with the control (coppens).The increased carcass protein composition in all the treatment is a clear indication that synthesis of protein occurred when fish were fed with *Moringaoleifera* leaf meal.

RECOMMENDATION

It is recommended that farmers can substitute protein source with MOLM for fishmeal up to 50% so as to reduce cost and maximize profit.

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