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Cost and Benefit of Utilizing Processed *Moringa oleifera* Seed Meal in The Diets of *Clarias gariepinus* (Burchell, 1822)

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Abstract

The study evaluated the economic potentials of processed *Moringa oleifera* seed meal as alternative dietary ingredient to fishmeal for *Clarias gariepinus* fingerlings. Five isonitrogenous and isocaloric diets were formulated, in which the processed seed meal replaced fishmeal at 0, 20, 40, 60 and 80 %, representing diets 1, 2, 3, 4 and 5 respectively. The fingerlings were fed the experimental diets for a period of twelve weeks. The highest economic conversion ratio 280.08±5.42 was recorded in fish fed the control diet T1 (0%) and was significantly different ($p<0.05$) from those of other treatments. Highest cost of feed consumed (176.53±0.57) was also recorded in fish fed the control diet, which was significantly different ($p<0.05$) from the remaining treatments. The lowest and highest profit indices of 0.80±0.00 and 1.58±0.01were recorded in fish fed diets T1 (0%) and T5 (80%), respectively. Incidence of cost was highest (12.41±1.00) in fish fed diet T1 (0%) and was not significantly different ($p>0.05$) with T2 (20%). Considering the lowest feed cost and highest profit index recorded in T5 (80%) which represents 42.52 % cost contribution of fish meal and 15.46 % of Moringa seed meal to the diet clearly indicates that more profit would be generated from fish produced on this inclusion level and is hereby recommended.

Keywords: Diet formulation, fishmeal, Moringa seed meal, cost.

1. Introduction

In an intensive aquacultural system, the cost of feed is known to account for over two third of the variable cost [1]. With effective financial management of aquaculture production there can be a great variance between profits and losses [2]. There is dearth of right information on the part of most aquaculture investors that could help in making appropriate investment decisions. This has been attributed to inadequate dissemination of research outcome on aquaculture economics [3], thus, investing in aquaculture with unrealistic prospects. This has resulted into failure and frustration among the investors and has led to a setback to the development of aquaculture sector [4].

Cost effective diets are essential for successful fish farming. The successful production of profitable compound feed hangs on the cost, availability and digestibility of the feed ingredients. It is therefore necessary to resourcefully search, explore, identify and utilize other plant protein sources such as *Moringa oleifera* seed, which could be cheaper, less competitive, not relatively in high demand and resistant to drought [5]. Compared to fishmeal which is expensive and highly competitive in utilization.

Essential or indispensable amino acids (EAAs) cannot be synthesized by fish and often remain inadequate but are needed for growth and tissue development [6]. Fishmeal is known to contain complete EAA profile that is needed to meet the protein requirement of most fish species. Since fishmeal is expensive as a feed ingredient, the use of nonconventional ingredients has been reported with good growth and better cost benefit values [7]. This study was therefore, aimed at determining the cost and benefit of utilizing the *Moringa oleifera* seed meal as substitute to fishmeal in diets of *Clarias gariepinus* fingerlings with a view to maximizing profit.

2. Materials and Methods

2.1 Experimental Site

The experiment was conducted at Teaching and Research Fish Farm, Department of Fisheries and Aquaculture, Usmanu Danfodiyo University, Sokoto. The study area is located on latitude 13^0 07' 47.6''N and longitude 05^0 12'11.3''E at 275m above sea level [8].

2.2 Plant Seeds Collection and Preparation

Dried mature fruits of *Moringa oleifera* were obtained from Maiyafe farm at *Kududdufawa* in Ungoggo Local Government, Kano State. The dried seeds were cleaned thoroughly to remove dirt, stones and deteriorated ones. The cleaned seeds were shelled manually to remove the kernels, dried under shade for three days and stored until required.

2.3 Processing of *Moringa oleifera* Seeds

Four processing methods involving toasting (10, 20 and 30 mins), boiling (30, 60 and 90 mins), soaking (8, 16 and 24 hrs) and combination of boiling (30, 60 and 90 mins) and soaking for 72 hours were employed in the treatment of anti-nutrients. Boiling for 90 mins and soaking for 72 hrs (B90 min/S72 hrs) was considered the best processing method as it was the only treatment that reduced all the anti-nutrients encountered to acceptable levels and was subsequently adopted for the formulation of experimental diets.

2.4 Diet Formulations and Production

The cake obtained after oil extraction from the Moringa seeds with the best processing method (B90 min/S72 hrs) was used. Five isonitrogenous and isocaloric diets were formulated and the test ingredient *Moringa oleifera* seed meal (MSM) was incorporated using Pearson's square method at 20-80% inclusion levels of fishmeal representing Diet A (0%), Diet B (20%), Diet C (40%), Diet D (60%) and Diet E (80%). The diets were formulated to 40% crude protein level and 3,274-3,417 Kcal Kg^{-1} metabolizable energy.

2.5 Experimental Fish

A total of 300 fingerlings of *C. gariepinus* of 1.53±0.02g and 6.21±0.04cm average weight and length, respectively, were purchased from the Hatchery Unit of the National Institute for Freshwater Fisheries Research (NIFFR), New-Bussa. Upon arrival, the fish were first conditioned to the water temperature at Teaching and Research Fish Farm, Department of Fisheries and Aquaculture, Usman Danfodiyo University, Sokoto, for proper acclimation for two weeks. This was achieved by stocking the fish in a concrete nursery tanks (1.0 m x 1.0 m x 1.0 m) and fed twice daily with a 40% crude protein diet (control).

2.6 Experimental Design and Set-Up

Fifteen concrete tanks (1m x 1m x 1m) were used for the feeding trial. The experiment consisted of five treatments (diets) replicated three times. The fish were stocked in a completely randomized design at the rate of twenty (20) fingerlings per replicate. Feeding was suspended 24 hours before commencement of the feeding trial in order to increase appetite and reception of fingerlings for the new diet [9].

2.7 Experimental Management

Fish were fed at 5% of their body weight daily. Diets were administered twice daily in two equal rations at 9.00 and 17.00h [10]. The quantity of feeds served per treatment was adjusted weekly based on the new weight of fish on the day of weight measurement; and this was done weekly throughout the 12 weeks duration of the feeding trial.

The leftover feeds together with fish fecal residues were siphoned every morning before feeding. The experimental tanks were completely washed every week and fresh water was added to ensure proper water quality monitoring and to maintain at least two third water levels in the experimental units.

2.8 Water Quality Monitoring

The water quality parameters monitored during the feeding experiment were conductivity, hydrogen ion concentration and temperature by adopting the method of Boyd [11]. These parameters were read for each of the treatments. The temperature and conductivity were determined using HM EC-3 Digital meter while ATC pen type pH digital meter was used to determine the pH of the experimental water.

2.9 Economic Evaluation of the Study

Economic evaluations in terms of economic conversion ratio (ECR), profit index (PI) and incidence of cost (IC) of substituting fishmeal with Moringa seed meal in the culture of *Clarias gariepinus* were determined according to Faturoti and Lawal [12]. Based on the price of each raw material and the amount required to make each diet, the cost for one kilogram of each diet was determined.

2.9.1 Economic conversion ratio (ECR): This was determined according to Faturoti and Lawal [9] using the following equation;

$$ECR = Cost\ of\ diet\ x\ Feed\ Conversion\ Ratio$$

2.9.2 Profit index (PI): This was determined from the relationship between value of fish produced and cost of feed consumed by fish as described by Vincke [13], Faturoti and Lawal [12] and calculated using the formula;

$$PI = \frac{Value\ of\ fish\ produced\ (₦/kg)}{Cost\ of\ feed\ produced\ (₦/kg)}$$

2.9.3 Incidence of cost (IC): Incidence of cost was determined as described by Vincke [13] and Faturoti and Lawal (1986) as follows:

$$IC = \frac{Cost\ of\ feed\ used\ in\ production\ (₦)}{Total\ weight\ of\ fish\ produced\ (kg)}$$

2.10 Statistical Analysis

Data obtained on economic indices were subjected to analysis of variance (ANOVA). Means were separated using Duncan's multiple range test [14] with the use of SPSS computer software, version 20.0. Significant difference between mean values was accepted at the 0.05 level of probability.

3. Results and Discussion

Quantity and price of feed ingredients used for the experiment are presented in Table 3.1, while the cost and benefit indices of *Clarias gariepinus* fed diets containing varying levels of *Moringa oleifera* seed meal are presented in Table 3.2. The highest economic conversion ratio 280.08±5.42 was recorded in fish fed the control diet T1 (0%) and was significantly different ($p<0.05$) from those of other treatments. Highest cost of feed consumed (₦176.53±0.57) was also recorded in fish fed the control diet which was significantly different ($p<0.05$) from the remaining treatments. The lowest and highest profit indices of 0.80±0.00 and 1.58±0.01were recorded in fish fed diets T1 (0%) and T5 (80%), respectively. Incidence of cost was highest (12.41±1.00) in fish fed the control diet in T1 (0%) and was not significantly different ($p>0.05$) with T2 (20%). The values for incidence of cost 9.05±0.11, 9.53±2.87 and 6.97±0.33 recorded in T3 (40%), T4 (60%) and T5 (80%) respectively were not significantly different ($p<0.05$).

The highest (₦176.53±0.57) cost of feed consumed was obtained in T1 while the lowest (₦57.17) was recorded in T5. This result affirmed the report of

Faturoti and Lawal [12], that fish meal prices are very high while the alternatives which have comparative nutritive value were preferably cheaper than conventional protein source. Profit index recorded was highest (1.58±0.01) in T5 (80%) and the least (0.80±0.00) was obtained in the control T1 (0%). The highest value of profit index recorded in T5 (80%) clearly indicates that more profit would be generated from fish produced on 80% substitution of Moringa seed meal for fish meal. This is in contrast with the finding of Adesina *et al.*[15] who reported highest profit index of (29.30) in *C. gariepinus* fed (20%) inclusion level of boiled sunflower seed meal (BSSM) above those of the higher inclusion levels (40% to 100%) of the diet which indicated more profit from fish produced on 20% BSSM diet.

Table 3.1: Quantity and Price of Feed Ingredients Used for The Experiment

					Quantity (g) and cost (₦) of diets		
Feed ingredient	Cost/Kg (₦)	Cost/g (₦)	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	T5 (80%)
Maize	156	0.16	104.85/ 17.82	81.42/ 13.84	69.44/ 11.80	59.54/ 10.12	54.12/ 9.20
Fish meal	1,100	1.10	125.87/ 138.46	87.38/96.12	63.12/69.42	41.43/45.57	22.10/24.31
Moringa seed meal	100	0.10	0.00/0.00	21.85/2.19	42.07/4.21	62.14/6.21	88.36/8.84
Groundnut cake	95	0.095	62.92/5.98	51.99/4.94	47.62/4.53	44.48/4.23	44.88/4.26
Blood meal	150	0.15	6.35/0.95	5.25/0.79	4.81/0.72	4.32/0.65	4.53/0.68
Bone meal	60	0.06	3.17/0.19	2.62/0.16	2.40/0.14	2.24/0.13	2.27/0.14
Vegetable oil	600	0.60	6.35/3.81	5.25/3.15	4.81/2.89	4.49/2.69	4.53/2.72
Methionine	2,400	2.40	3.17/7.61	2.62/6.29	2.40/5.76	2.24/5.38	2.27/5.45
Vitamin premix	1,000	1.00	3.17/3.17	2.62/2.62	2.40/2.40	2.24/2.24	2.27/2.27
Salt	100	0.10	1.59/0.16	1.31/0.13	1.2/0.12	1.12/0.11	1.14/0.11
Cost of feed consumed (₦)	5, 761	5.765	176.53	134.30	100.19	76.51	57.17
% Contribution by fish meal	…….	…….	78.43	71.57	69.29	59.56	42.52
% Contribution by Moringa seed meal	…….	…….	0.00	1.63	4.20	8.17	15.46

Table 3.2: Cost and Benefit Indices of The Experiment

Indices	Treatments				
	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	T5 (80%)
No. of fingerlings/treatment	20	20	20	20	20
Cost of each fingerling (₦)	20	20	20	20	20
Cost of feed consumed (₦)	176.53±0.57^{a}	134.30±0.51^{b}	100.19±0.06^{c}	76.51±0.04^{d}	57.17±0.16^{e}
Value of fish (₦/Kg)	140.57±0.57^{a}	124.55±0.50^{b}	114.78±0.50^{c}	92.23±0.12^{d}	90.20±0.17^{e}
Economic conversion ratio (₦/Kg)	280.08±5.42^{a}	207.30±16.31^{b}	172.00±19.12^{bc}	195.14±84.82^{bc}	129.02±5.89^{c}
Profit index	0.80±0.00^{e}	0.93±0.00^{b}	1.15±0.01^{c}	1.21±0.00^{d}	1.58±0.01^{c}
Incidence of cost	12.41±1.00^{a}	10.89±0.38^{ab}	9.05±0.11^{bc}	9.53±2.87^{bc}	6.97±0.33^{c}

Mean values having same letter in the same row are not significantly different (p>0.05)

4. Conclusion

Based on the lowest feed cost and highest profit index recorded in T5 (80%) which represents 42.52 % cost contribution of fish meal and 15.46 % of Moringa seed meal to the diet clearly indicates that more profit would be generated from fish produced on this inclusion level and is hereby recommended.

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