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EFFECTS OF GRADED LEVELS OF Moringa oleifera SEED MEAL ON APPARENT DIGESTIBILITY COEFFICIENT AND BODY COMPOSITION OF Clarias gariepinus

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ABSTRACT

The study evaluated the apparent nutrient digestibility coefficient and body composition of *Clarias gariepinus* fed graded levels of processed (Boiling for 90 minutes and soaking for 72 hours) *Moringa oleifera* seed meal. Five isonitrogenous and isocaloric diets were formulated and test ingredient *Moringa oleifera* seed meal (MSM) was incorporated at 20-80% inclusion levels of fishmeal representing Treatment A (0%), Diet B (20%), Diet C (40%), Diet D (60%) and Diet E (80%) and Chromic oxide (Chromium iii oxide, Cr_2O_3) was also incorporated at 1% as an inert indicator/marker of digestion. A total of 300 fingerlings of *C. gariepinus* of 1.53±0.02g and 6.21±0.04cm average weight and length, respectively were fed the prepared diets at 5% body weight per day thrice daily for two weeks and fecal samples were collected for apparent digestibility coefficient assessment. Proportions of chromic oxide in the diets and faeces were analysed and digestibility indices were determined. The apparent digestibility for dry matter was analysed using analysis of variance which recorded a significant difference ($p<0.05$) in all the treatments with the highest and lowest values of 29.30±17.92 and 9.67±3.55 recorded in T5 (80%) and T1 (0%) respectively. Significantly ($p<0.05$) highest 57.53±1.32and 57.14±0.85 apparent digestibility of crude protein values were observed in T1 (0%) and T2 (20%) diets respectively, while the lowest 50.92±10.30 was recorded in T5 (80%) diet. The study revealed that apparent digestibility decreased with the increased substitution of fishmeal with *Moringa oleifera* seed meal.

Keywords; Chromic oxide, diets, digestibility, faeces, fishmeal, utilization,

INTRODUCTION

Digestibility is one of the most important factors used in evaluating the efficiency of feedstuffs. Usman and Jafri (2002) stated that proper utilization of nutrients and energy from feed ingredients depends largely on the extent of digestibility. Digestibility measures the proportions or amounts of nutrients assumed to be absorbed by the gut mucusa by quantifying the nutrients ingested and those voided in the faeces (Fagbenro, 2001).

Digestibility studies constitute an important integral part of diet formulation and preparation and ideally should precede recommendation of feed formulation for a particular fish nutrient requirement. Digestibility coefficients are known to be influenced by many factors such as feeding level, feed/pellet size, size and age of fish, dietary components, types of nutrients, physical state of diet, and protein/energy ratio of diet as well as water quality (De Silva and Anderson, 1995; Fagbenro, 2001).

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 (Quattrocchi, 2000). It holds a considerable potential for becoming an ingredient for animal and fish because of its high nutritional quality that is comparable to other feed protein source (Becker, 2003).

The utilization of non-conventional feedstuffs of plant origin had been limited as a result of the presence of several anti-nutritional factors despite their nutrient values and low

cost implications (Sogbesan, 2006). These anti-nutrients factors negate growth and other physiological activities at higher inclusion levels (Oresegun and Alegbeleye, 2001).

Research in fish nutrition in recent years seems to focus on the replacement of animal protein sources by plant based proteins with the aim of reducing the cost of supplemental feeds (De Silva, 2001). The aquaculture feed industry relies heavily on the use of fishmeal because of its balanced amino acid profile that closely matched the fish's requirement pattern. However, the increasingly scarce supply of fishmeal with its concomitant rise in price and the increased competition from other livestock industry necessitates seeking a cost-effective replacement to supply dietary protein in aquaculture feeds. This aspect of fish feed development research is centered on the search for inexpensive, readily available and nutritious protein sources which can supply all the nutritional needs of the fish.

The African catfish, *Clarias gariepinus,* is a warm water aquaculture species that is widely introduced around the world, occurring in countries in Africa and Asia and has been recently introduced in Europe, the Middle East, and Latin America (FAO, 1997; Ali, 2001). African catfish have been shown to have high apparent digestibility coefficients when fed either plant or animal protein feedstuffs. Fishmeal is more digestible than most animal protein sources. Fagbenro (1996) found various crude protein (58-92%) and energy (50-93%) ADCs for animal and plant-based foodstuffs in *Clarias isheriensis* (47.5-51.2 g) using chromic oxide as an indicator and the rectal dissection method for faeces collection (Henken *et al*., 1985). This study was therefore aimed at evaluating the effects of using graded levels of moringa seed meal on feed digestibility and body composition of *Clarias gariepinus.*

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at Teaching and Research Fish Farm of the Department of Fisheries and Aquaculture, Usmanu Danfodiyo University, Sokoto, on latitude 13^0 07' 47.6''N and longitude 05^0 12'11.3''E at 275m above sea level (Elevation-map, 2019).

Seed Collection and Preparation

Dried mature fruits of *Moringa oleifera* were obtained from Maiyafe farm at Kududdufawa in Ungoggo Local Government, Kano State on latitude 12^o 05' 26^o N and longitude 8^o 29'48^o E. The seeds were cleaned thoroughly to remove dirt, stones and deteriorated ones. The cleaned seeds were shelled manually to remove the kernels, dried under shade and stored until required.

Processing of *Moringa oleifera* Seeds

Four processing methods involving toasting at 100^{o}C for (10, 20 and 30mins), boiling at 100^{o}C for (30, 60 and 90mins), soaking in water for (8, 16 and 24 hours) and combination of boiling (30, 60 and 90 minutes) and soaking in water for 72 hours were employed in the treatment of anti-nutrients. (B90min/S72hrs) was the only treatment that reduced all the anti-nutrients to the lowest level and was considered the best processing method and subsequently adopted for the formulation of experimental diets.

Diet Formulation and Production

The seed oil was extracted using a mini oil screw press extraction and the cake obtained after oil extraction from the Moringa seeds from the best processing method (B90min/S72hrs) was used. Five isonitrogenous and isocaloric diets were formulated and test ingredient *Moringa oleifera* seed meal (MSM) was incorporated at 20-80% inclusion levels of fishmeal representing Diet A (0%), Diet B (20%), Diet C (40%), Diet D (60%) and Diet E (80%).

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. The fish were transported in a 50 litres plastic container and upon arrival; the fish were first conditioned to the water temperature at Teaching and Research Fish Farm of the Department of Fisheries and Aquaculture, Usmanu Danfodiyo University, Sokoto, for proper acclimation for two weeks. This was achieved by stocking the fish in 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) at 5% body weight per day.

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 (CRD) at the rate of twenty (20) fingerlings per experimental unit. Feeding was suspended 24 hours before the feeding trial to increase appetite and reception for new diet (Madu and Akilo, 2001).

Experimental Management

Fish were fed at 5% body weight daily. Feed was administered twice daily in two equal rations at 9.00 and 17.00h (Marinmuthu *et al.*, 2010). The quantity of feed 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 uneaten feeds together with fish faecal 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.

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 (1979). These parameters were read for each of the treatments. The temperature and conductivity was determined using HM EC-3 Digital meter while ATC pen type pH digital meter was used to determine the pH of the water.

Apparent digestibility study

A two weeks digestibility feeding trial was conducted to study the trend of utilization of the experimental diets fed *C. gariepinus.*

Diet formulation and production for digestibility study

Indirect method of digestibility was adopted by incorporating Chromic oxide (Chromium iii oxide, Cr_2O_3) at 1% into experimental diets as an inert indicator/marker of digestion (Furukawa and Tsukahara, 1966). Five isonitrogenous and isocaloric diets were formulated and test ingredient *Moringa oleifera* seed meal (MSM) was incorporated 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 as recommended by Faturoti and Lawal (1986) for *C. gariepinus* juveniles.

Feeding trial and faecal collection

Fishes were fed the prepared diets at 5% BWD twice daily for two weeks and fecal samples were collected for digestibility assessment. Faecal matter was collected on daily basis by carefully inserting a small hose at the bottom of the plastic containers and siphoning the faeces early in the morning at 8:00 a.m. before feed was applied. Samples collected from each dietary treatment were filtered through a filter paper fitted inside a glass funnel mounted on a conical flask. Faecal matter was put in petri dishes, dried under shade and finely ground in a porcelain mortar, weighed, packaged in a small polythene bags, labelled separately according to each dietary treatment and stored in refrigerator at 4^{o}C prior to proximate analysis.

Proximate analysis for determination of digestibility indices

Proportions of chromic oxide in the diets and faeces were analysed according to the methods of Furukawa and Tsukahara (1966). The procedure involves digestion of a sample by concentrated nitric acid and subsequent oxidation of chromic oxide with 70% perchloric acid. 50 mg of the sample was put in a Kjeldal flask and 5 ml of concentrated nitric acid was added to the flask and the mixture was gently boiled for 20 minutes (carefully not to over boil to dryness). The boiled sample was cooled and 3 ml of 70% of perchloric acid was added to the flask. The resultant mixture was then gently reheated for another 10 minutes until the solution changed from green to orange to ensure complete oxidation.

The oxidized solution was then put inside a 100 ml volumetric flask and diluted to 100 ml volume with distilled water. The absorbance of the solution was determined by means of a spectrophotometer (Uvikon 810 Model) at 350 nm. Percentage chromic oxide

content in the sample was calculated according to the following formula:

$$Wt\ of\ chromic\ oxide\ in\ sample = \frac{(Absorbance - 0.0032)}{0.2089}$$

$$Chromic\ oxide\ (\%) = \frac{Weight\ of\ chromic\ oxide\ (g)}{Weight\ of\ sample\ (g)}\ x\ 100$$

Digestibility indices

The following digestibility indices were determined:

Apparent digestibility coefficient dry matter: This was determined as described by Windell *et al*. (1978).

$$ADC\ Dry\ matter = \ 100 - \{100\ x \frac{(\%\ marker\ in\ feed)}{(\%\ marker\ in\ feces)}\}$$

Apparent digestibility coefficients (ADC*):* This was calculated according to NRC (1993) formula:

$$ADC = \ 100 - \{100\ x \frac{(\%\ marker\ in\ feed\ x\ \%\ nutreint\ in\ feces)}{(\%\ marker\ in\ feces\ x\ \%\ nutrient\ in\ feed)}\}$$

RESULTS

Apparent digestibility coefficient (%) of dietary nutrient levels of *C. gariepinus* fed processed (B90mins/S72hrs) *Moringa oleifera* seed meal based diet

The apparent digestibility coefficient of dietary nutrient level of *C. gariepinus* fed *Moringa oleifera* seed meal based diet is presented in Table 1. The apparent digestibility for dry matter was significantly different ($p<0.05$) in all the treatments with the highest and lowest values of 29.30±17.92 and 9.67±3.55recorded in T5 (80%) and T1 (0%) respectively. Significantly ($p<0.05$) highest 57.53±1.32and 57.14±0.85 apparent digestibility of crude protein values were observed in T1 (0%) and T2 (20%) diets respectively, while the lowest 50.92±10.30 was recorded in T5 (80%) diet. The apparent crude fat digestibility coefficients were also significantly different ($p<0.05$) across all the treatments with the highest and lowest values of 42.94±4.20 and 31.42±3.57 recorded in T1 (0%) and T2 (20%) respectively.

Table 1: Apparent digestibility coefficient (%) of dietary nutrient levels of *C. gariepinus* fed graded levels of *Moringa oleifera* seed meal

Graded levels of *Moringa oleifera* seed meal	Dry matter %	Crude protein %	Crude fat %
T1 (0%)	9.67±3.55^{b}	57.53±1.32	42.94±4.20
T2 (20%)	15.21±2.04^{ab}	57.14±0.85	31.42±3.57
T3 (40%)	16.43±1.70^{ab}	54.37±0.86	38.18±2.53
T4 (60%)	20.48±2.55a^{b}	56.08±1.47	34.16±1.42
T5 (80%)	29.30±17.92^{a}	50.92±10.30	40.71±13.74

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

DISCUSSION

The apparent digestibility of dry matter observed in this study (Table 1) was much lower than the values of 84-89 and 66-77% reported by Eusebio *et al*. (2004) and Salim *et al*. (2004), respectively. The apparent digestibility coefficient for dry matter may be affected by the type of raw materials used. High level of ash generally affects digestibility of dry matter and results in high waste outputs and can also produce mineral imbalance (Cho and Bureau, 1998). The apparent digestibility for crude protein in the present study was less than that reported by Hossain and Jauncey (1989), who observed that apparent digestibility coefficient for crude protein of fish meal in carp, was 88.9%. Similar value of fish meal digestibility for *Labeo rohita* was also reported by Salim *et al*. (2004). According to Anonymous (1997), carp can digest up to 95% of proteins in fish meal. However, the value can decrease from 92 to 68%, depending on source and treatment of the meals (Pike *et al*., 1990). The difference in protein digestibility may be due to differences in chemical composition, origin and processing of various feed ingredients, method of faeces collection and fish species (Koproco *et al*., 2004). The high apparent digestibility on T1 (0%) and T2 (20%) might be due to better availability of amino acids than in T3 (40%), T4 (60%) and T5 (80%). Muzamel *et al.* (2003) observed that the level of essential amino acids in 30% protein diet was comparatively higher than 25 and 29% dietary protein levels.

The apparent digestibility of crude fat in this study was also lower than the values reported by NRC (1993). The values of NRC were in the range of 85-95% for fish meal. The values of crude fat digestibility of 81.35±3.64% reported by Jalal *et al*. (2000) were also higher than the result obtained in this study.

CONCLUSION

The apparent digestibility of dry matter, crude protein and crude fat observed in the present study was comparatively lower than other reported studies. However, the comparison of dietary protein levels revealed that apparent digestibility decreased with the increased substitution of fishmeal with *Moringa oleifera* seed meal.

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