GROWTH RESPONSE, HAEMATOLOGY AND CARCASS COMPOSITION OF *Clarias gariepinus* FINGERLINGS FED DIETS WITH *Afzelia africana* SEED MEAL

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ABSTRACT

A 56 – day feeding trial was conducted to investigate the effect of replacing the dietary soybean meal with Afzelia africana seed meal (AAM) on the growth performance, carcass composition and some haematological indices of C. gariepinus fingerlings. Five iso-nitrogenous and iso-caloric diets were formulated with AAM replacing 0, 10, 20, 40 and 60% component of soybean meal (SBM) in the diets. The results revealed that, there were significant ($p < 0.05$) differences in body weight gain, specific growth rate (SGR), relative growth rate (RGR) and food conversion ratio (FCR) among the treatments with 0%AAM having the best performance. Significant ($p < 0.05$) differences were recorded in carcass parameters of fishes at the end of the feeding trial, with fishes fed 0 and 10% AAM diets having higher values. Among the haematological indices, except white blood cell (WBC) that increased significantly ($p < 0.05$), all other parameters like packed cell volume (PCV), haemoglobin concentration (Hb) and red blood cell (RBC) significantly ($p < 0.05$) decreased with increase in AAM in the diets. It was concluded that SBM protein in the diets for C. gariepinus can be replaced with 10% AAM protein without adverse effect on growth performance, carcass characteristics and haematological indices.

Keywords: African catfish, *Afzelia africana*, haematology, carcass composition, growth performance

INTRODUCTION

The farming of African catfish, *Clarias gariepinus* has become popular in Africa. This may be attributed to its fast growth, disease resistance, hardiness, excellent taste and high market demand as reported by Adewolu *et al*., (2008). Myriads of constraints have been identified to hinder the successful production of this fish. Prominent among these problems is the high cost of feed, which accounts for about 60 to 70% of the operational cost of fish production (Mgbenka, 2014). This has been attributed to the fact that most protein ingredients used in fish feed production are also used for livestock feeds and for human consumption, making them to be scarce and expensive (Eyo, 2005). This has necessitated the need to investigate the potentials of some other protein feedstuffs that are cheap and readily available with lower competition for human consumption. This will reduce the cost of feed and fish products among Nigerian populace.

Legumes are one of the most widely used non-conventional protein sources for animal/fish feed (Ogunji and Wirth, 2001). *Afzelia africana*, a leguminous plant, reported to be abundant in the savannah regions, has been shown to have good nutritional qualities that qualifies it as a good protein source in animal feed (Ogungbenle, 2014). Ayanwale *et al*. (2007) reported that the seed is high in protein, carbohydrate and fibre. The authors also reported the presence of anti-nutrients in the seed which will require processing to make the nutrients easily available to the fish.

Afzelia africana seed meal has been used in ration for broiler birds (Ayanwale *et al.,* 2007; Abbas, 2008). However, there is paucity of information on the utilisation of this seed in the diet for *C. gariepinus.* This study was therefore, designed to determine the effects of feeding *Afzelia africana* seed meal on the growth, carcass composition and some haematological profiles of *Clarias gariepinus.*

MATERIALS AND METHOD

Source and processing of *Afzelia africana*

Mature dried seeds of *Afzelia africana* were purchased from the farmers at the Central Market, Abakaliki, Ebonyi State, Nigeria. The seeds were inspected and those that look defective were discarded. The seeds were processed according to Ayanwale *et al.,* (2007). The milled *Afzelia africana* seed meal (AAM) was defatted using N-hexane as recommended by Enujiugha and Akanbi (2005).

Experimental diets

Five iso-nitrogenous (40% c.p) experimental diets were formulated such that *Afzelia africana* meal (AAM) replaced soybean meal (SBM) at 10%, 20%, 40%, and 60% dietary levels respectively (Table 1). Diet with 0% *Afzelia africana* seed meal served as control. Other conventional feed ingredients such as Maize, imported fish meal, blood meal, vegetable oil, vitamin/mineral premix, and cassava starch which served as binder were procured from the Central Market, Abakaliki, Ebonyi State. A sample of *Afzelia africana* meal and experimental diets were subjected to proximate analysis (Tables 2 and 3) using standard procedures according to AOAC (2000).

Table 1: Ingredients composition of formulated diets (% dry weight)

Ingredient (g/100g)	T1	T2	T3	T4	T5
Blood meal (82 % CP)	10.0	10.0	10.0	10.0	10.0
Fish meal (62% CP)	24.0	24.0	24.0	24.0	24.0
Soybean Meal (43% CP)	36.0	32.4	28.8	21.6	14.4
Afzelia africana seed meal (26% CP)	-	6.0	12.0	24.0	36.0
Maize (9% CP)	20.0	17.6	15.2	10.4	5.6
Vegetable oil	6.0	6.0	6.0	6.0	6.0
Vitamin/Mineral premix	2.0	2.0	2.0	2.0	2.0
Binder	2.0	2.0	2.0	2.0	2.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calculated Crude Protein level	40.60	40.39	40.19	39.60	39.37

Table 2: Proximate Composition of Soybean Meal (SBM) and *Afzelia africana* meal (AAM) used in the experiment

Composition	Soybean meal	Afzelia Africana meal
Crude protein	43.71^{b}	47.34^{a}
Crude fat	3.68^{a}	2.47^{b}
Crude fibre	4.40^{a}	3.13^{a}
Ash	5.93^{a}	4.91^{b}
Moisture	7.23^{a}	7.23^{a}
Nitrogen free extract	35.05^{a}	34.92^{a}

Values with same superscript in the same row are not significantly different (P>0.05).

Table 3: Proximate Composition of Treatment Diets

Feed sample	% Crude protein	% Crude fat	% Crude fibre	% Ash	% Moisture	% Nitrogen free extract (NFE)
T_1	41.74 ± 0.06^{a}	5.45 ± 0.02^{a}	2.48 ± 0.02^{a}	9.81 ± 0.14^{a}	5.82 ± 0.01^{a}	34.72 ± 0.07^{a}
T_2	42.32 ± 0.08^{a}	5.79 ± 0.12^{a}	2.43 ± 0.02^{a}	9.79 ± 0.02^{a}	5.92 ± 0.03^{a}	33.77 ± 0.23^{a}
T_3	42.84 ± 0.05^{a}	6.05 ± 0.01^{a}	2.52 ± 0.01^{a}	9.71 ± 0.02^{a}	5.67 ± 0.02^{a}	$33.22\pm0.08^{a,b}$
T_4	42.93 ± 0.05^{a}	5.60 ± 0.01^{a}	2.46 ± 0.02^{a}	9.73 ± 0.02^{a}	6.01 ± 0.04^{a}	$33.29\pm0.09^{a,b}$
T_5	43.21 ± 0.06^{a}	6.13 ± 0.02^{a}	2.50 ± 0.02^{a}	9.84 ± 0.02^{a}	5.64 ± 0.02^{a}	32.70 ± 0.09^{b}

Values with same superscript in the same column are not significantly different (P>0.05).

Experimental design and feeding trials

Three hundred (300) African catfish (*Clarias gariepinus*) juveniles of average weight 24.29 ± 0.91 g and 9.68 ± 0.67 average total length were purchased from Oluchika fish farm, Abakaliki, Ebonyi State, Nigeria and transported in oxygen bags to the Department of Fisheries and Aquaculture, Ebonyi State University, Abakaliki. The fish were acclimated for 7 days and were fed on commercial diet (Coppens). Prior to the commencement of the experiment; all fish were starved for 24 hours. This practice was considered necessary to to prepare the gastrointestinal tract for the experimental diets, while at the same time to increase the appetite of the fish. Fifteen plastic tanks of 70l capacity were randomly allocated to the five treatment diets (T1, T2, T3, T4 and T5) in triplicate and fish were randomly distributed into the tanks at a stocking density of twenty fingerlings per tank. Fish were fed throughout the duration of the experiment, twice daily, (8.00 hrs-9.00 hrs and 17.00 hrs-18.00 hrs) at 5% of their body weight. The water in culture tanks was changed twice weekly. During each change, the culture tanks were washed thoroughly to reduce the risk of infection and check fungal and algae growth. Subsequently, growth data were taken fortnightly and quantity of feed fed adjusted in accordance to the fish weight gain.

All the growth and nutrient utilization data like weight gains, specific growth rate (SGR), feed conversion ratio (FCR) and feed intake were calculated at the end of the experiment as follows:

Weight gain = final weight – initial weight,

SGR = (LnW2 - LnW1)/(T2-T1)100

RGR (%) = (W2-W1/T2-T1) 100

where W1 and W2 = initial and final weight of fish and

T1 and T2 = time in days.

FCR = feed fed/live weight gain.

Carcass analysis

At the end at the experiment, five catfish were randomly chosen from each tank and subjected to proximate analysis of whole fish body according to AOAC (2000).

Blood collection and haematological analysis

Fish were tranquilized with 150 mg/1 solution of tricane methane sulphonate (MS222) (Wagner *et al*., 1997) for blood collection. Blood samples were collected from 3 fish at the beginning of the experiment and fortnightly, subsequently from each tank from the caudal artery using 2 ml plastic syringes and needle treated with anti-coagulant. Collected samples were put in sample bottles. Haematocrit (PCV) was determined with microhaematocrit centrifuge by the Wintrobe and Westergreen method as described by Blaxhail and Diasley (1973) with commercially available heparinzed capillary tubes of 25 mm. Red Blood Cell (RBC) and White Blood Cell (WBC) counts were determined with a haemocytometer with improved Neubauer counting chamber as described by Blaxhall and Diasley (1973). Haemoglobin (Hb) concentration estimates were determined as described by Wedemeyer and Yasutake (1977).

Statistical analysis

All growth and heamatological data were subjected to one way analysis of variance (ANOVA).The significant difference between means were determined by Duncan's Multiple Range test ($p < 0.05$) using SPSS for windows (Version 20). Values were expressed as means ± SE.

RESULTS

The results of the proximate composition of the soybean meal (SBM) and *Afzelia africana* meal (AAM) used in this feeding trial revealed that AAM had significantly ($p < 0.05$) higher crude protein (47.34%) than SBM (43.71%). However, SBM had higher crude fat than AAM, but their either extracts level were statistically ($p > 0.05$) the same. The proximate compositions of the experimental diets were generally iso-nitrogenous. The protein content ranged from 41.74 ± 0.06% to 43.21 ± 0.06% and were not significantly ($p > 0.05$) different. Similarly, there were no significant difference in nitrogen free extract of the experimental diets and this parameter ranged from 32.70 ± 0.8 to 34.72 ± 0.7.

The growth response of *C. gariepinus* fed varying levels of *Afzelia africana* meal is shown in (Table 4). The feeding trials revealed that *C. gariepinus* responded to all the diets since increase in weight was recorded as shown in Table 4. The relative (268.72 ± 21.2) and specific (3.32 ± 0.81) growth rates were highest in the fishes fed the control diets and were lowest, 168.91 ± 64.3 (RGR) and 1.87 ± 0.31(SGR) in the fishes fed 0% AAM based diet. The relative growth rate (RGR) and specific growth rate (SGR) of the control diets differed ($p < 0.05$) significantly with the test diets but was comparable to the fishes fed 20% AAM based diet. Mean weight gain decreases with increase in the inclusion levels of AAM in the diets and were significantly ($p < 0.05$) different from the control. The highest FCR, 2.33 ± 1.03 was recorded in 60% AAM diet while the least, 1.22 ± 0.23 was obtained in 0% AAM inclusion. FCR of the control is significantly ($p < 0.05$) different from the test diets, but is statistically comparable with fish fed 10% AAM.

Crude protein, crud fat, ash and moisture content of carcass composition are presented in Table 5. There were significant differences in crude protein and crude fat among fish fed experimental diets ($P < 0.05$). However, fish fed control diet had a significantly higher crude protein and fat content than fish fed other diets ($P < 0.05$).

The effect of feeding AAM based diets on the haematological indices of *C. gariepinus* is presented in Table 6. The result indicated that there were significant differences ($p < 0.05$) in all the blood parameters studied. Whereas red blood cell (RBC), haemoglobin (Hb) and packed cell volume (PCV) showed decrease in value as the inclusion level of AAM increased, WBC showed increase in value with increasing level of AAM in the diet.

Table 4: Growth response of *C. gariepius* fed diets containing *Afizelia africana* seed meal diets

Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (40%)	T5 (60%)
Initial mean weight (g)	24.45±0.37 ^{a}	23.86±1.20 ^{a}	24.61± 0.98 ^{a}	24.22 ± 0.86 ^{a}	25.37±1.07 ^{a}
Final mean weight (g)	51.39± 1.56^{a}	40.20±0.55^{b}	36.34± 1.23^{bc}	39.57 ± 0.71^{b}	32.98 ±2.56 ^{c}
Mean weight gain (g)	26.94±1.44^{a}	16.34±0.70^{b}	11.73±1.52^{bc}	15.35±1.31^{b}	7.61±1.85^{c}
Food conversion ratio	1.22±0.23^{a}	1.44±0.81^{a}	1.94±0.77^{b}	2.01±0.47^{bc}	2.33±1.03^{c}
Relative growth rate	268.72±21.2^{a}	228.42±32.1^{ab}	210.9±37.2^{b}	194.77±28.5^{bc}	168.91±64.3^{c}
Specific growth rate	3.32±0.81^{a}	2.61±0.33^{a}	2.20±0.36^{ab}	2.26±0.75^{ab}	1.87±0.31^{b}

All values on the same row with different superscripts are significantly difference (P<0.05).

Table 5: Carcass composition of fish fed diet containing graded levels of *Afzelia africana* seed meal

Sample	% Crude Protein	% Crude Fat	% Fibre	% Ash	% Moisture
Diet 1	59.34^{a}	4.54^{a}	2.73^{a}	4.36^{a}	6.24
Diet 2	56.59^{b}	4.24^{ab}	2.60^{a}	4.01^{a}	6.53
Diet 3	56.43^{b}	4.08^{b}	2.55^{a}	3.51^{a}	6.34
Diet 4	53.07^{bc}	3.98^{b}	2.48^{a}	3.77^{a}	6.47
Diet 5	50.52^{c}	3.99^{b}	2.56^{a}	3.36^{a}	6.70

All values on the same column with different superscripts are significantly difference (P < 0.05).

Table 6: Haematology of *C. gariepinus* fed diets containing *Afzelia africana* seed meal for 56 days, mean ± S.E. of true replicates

Haematological Parameter	Initial	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
PCV (%)	11.30 ± 0.01^{b}	12.17 ± 0.17^{a}	10.10 ± 0.21^{c}	9.93 ± 0.04^{c}	8.79 ± 0.06^{d}	7.99 ± 0.01^{d}
HB(gd^{-l})	4.38±0.04^{b}	6.27 ± 0.01^{a}	5.29 ± 0.02^{b}	3.95 ± 0.21^{c}	3.40 ± 0.06^{c}	3.50 ± 0.01^{cd}
WBC(X 10^{3}/μl)	3258.33 ±1.67^{d}	3202.6 ± 2.19^{cd}	3321.67 ± 4.41^{c}	3386.67 ± 3.33^{b}	3399.00 ± 2.65^{b}	3430.33 ± 0.33^{a}
RBC(X 10^{6}/μl)	2.88 ± 0.02^{b}	3.00 ± 0.01^{a}	2.58 ± 0.44^{bc}	2.30 ± 0.00^{c}	2.01 ± 0.02^{c}	2.04 ± 0.12^{c}

* Means with similar superscripts in the same column are not significantly different (P>0.05).

DISCUSSION

Fish growth and its associated qualities depend upon quality and quantity of feed. In the present study, there was a general increase in weight gain in all treatments, thus indicating that the fish were able to convert feed protein to extra muscles. Weight gain and species growth rate are usually considered as the most important measurement of productivity of diets (Hossain *et al.*, 1995; Omitoyin and Faturoti, 2000). The increase in weight gain reported in all the treatments indicated that the fish responded positively to all the diets and that the protein contents of the experimental diets adequately enhanced growth and dietary energy supply of the fish.

However, the observed progressively decreasing pattern of growth parameters of the fish with increase in the inclusion levels of the test diets, thus exhibiting an inverse relationship may be attributed to the antinutrional factors present in *Afzelia Africana* seed (Adesina *et al*., 2013).

Ayanwale *et al*. (2007) and Ogungbenle and Omaejalile (2010) reported the presence of phytates and alkaloids in *Afzelia africana* seed. The reduced growth performance of the fishes fed the test diets when compared with the control may not be unconnected with the presence of anti-nutritional factors present in the AAM based diets. These anti-nutrients may have affected the palatability, mineral availability and consequently depressed the growth of the fishes (Ayanwale *et al*., 2007)

The PVC, RBC and Hb values obtained from this study indicated that the concentration is inversely proportional to the dietary inclusion of AAM in diets for *C. gariepinus*. The poor values ($p<0.05$) in PCV of fishes fed diets containing AAM may be attributed to the anti-nutrients (phytates and alkaloids) present in AAM that inhibit proper utilization of nutrients especially protein and iron necessary for red blood formation (Ayuk and Essien, 2009). Similar report was obtained when raw tigernut based diets were fed to broiler chick (Agbabiaka *et al.*, 2013). Nevertheless, the reductions in haemoglobin and red blood cell counts which significantly ($P<0.05$) differed in fishes fed AAM based diets could also be due to the anti-nutritional inhibitors particularly the phytate that chellates divalent metals utilization in monogastric animal metabolism (Obidinma, 2009). However, the increase in WBC observed in fishes fed AAM based diets in this study has similarly been noticed and reported by previous workers (Jimoh *et al*., 2014) who attributed it to an increase in the production of leucocytes in the haemotopoietic tissues of the kidney and perhaps spleen.

CONCLUSION

This study shows that *Afzelia africana* seed meal can be incorporated in the diets of *Clarias gariepinus* at a low level of 10% without adverse effect on growth performance, carcass characteristics and haematological indices. However, processing of *A. africana* is required prior to incorporation, in order to inactivate the anti-nutritional factors known to be present in the raw seeds. When the processed seed meal is defatted using N-hexane, it gives a product quality whose nutrients are biologically available and can, therefore, be utilized by fish.

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