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Growth and Body Composition of Catfish, *Clarias gariepinus* Fingerlings Fed Graded Inclusion Levels of Raw Locust Bean, *Parkia biglobosa* Meal as Replacement for Fish Meal

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Abstract

High cost of fish meal calls for alternative protein source especially from plant. Locust bean (*Parkia biglobosa*) a plant protein whose availability and low cost can be exploited for advancement of aquaculture production was examined in the research. 180 Catfish, *Clarias gariepinus* fingerlings of 3.46±0.01g average weight were fed raw locust bean at 0%, 5%. 10% and 15% inclusion levels at 50% crude protein. The results obtained indicated significant differences (P<0.05) for 15% raw locust bean meal inclusion which had the highest mean weight gain (5.10g), SGR (1.62), FCR (1.10) and PER (1.99) as second best performed diet to 100% fishmeal based diet. The study recommends 15% inclusion of raw locust bean meal as replacement for fishmeal in the diet of *Clarias gariepinus*.

Key words: Alternative, Protein, Anti-nutritive factors, Fishmeal, Locust bean meal.

Introduction

Versatility of fish makes it a useful protein source for humans (FAO, 2009). With the declining stocks of fish from capture fishery, investigation into the ways of replacing or substituting for fish meal with less expensive feed stuff becomes imperative (Sales and Janssens, 2003). The superiority of fishmeal in growth performance due mainly to its nutritional composition and its amino acid profile needed for optimum growth cannot be over emphasized (Anderson, 2003). Rapid development of fish farming calls for greatly stepped up production of locally produced quality fish feed which accounts for 40-60% of management cost in Aquaculture (De Silva and Hassan, 2007).

African locust bean seed is available in the tropics (Oluwole *et al.*, 2005). It is as condiment in soup (Dawadawa), rich in protein, lipids and vitamin B_2 (Hopkins, 1983) as well as rich in lysine (Steinkraus, 1996). Since feed is the most important component of aquaculture, efforts must be made to formulate and produce feed from locally available raw materials to reduce cost of production and increase economic return. This research sought to determine the growth and body composition of *Clarias gariepinus* fed raw locust bean meal.

Materials and Methods

Experimental site:

The research was carried out at the Research and Teaching Laboratory of Department of Water Resources, Aquaculture and Fisheries Technology, Minna, Niger State, Nigeria. The experimental design was Randomized Complete Block Design (RCBD). A total number of 180 *Clarias gariepinus* fingerlings of average weight 3.14g±0.52g obtained from the National Institute for Freshwater Fisheries Research hatchery, New Bussa Niger, State. The fish were stocked at 15 fishes per tank (30 x 60 x 30cm) in triplicates (12 tanks). The tanks were filled with borehole fresh water to 20L volume capacity of a recirculatory water system. Fishes were fed 3% body weight with adjustment fortnightly. The diets were formulated isonitrogenously comprising 0%, 5%, 10% and 15% raw locust bean seed. The water quality parameters were monitored weekly for temperature using clinical thermometer, dissolved oxygen using Winkler's method, hydrogen ion concentration (pH) was also measured with the aid of pH meter while, the conductivity was monitored using conductivity meter (APHA, 1980). The trial lasted for eight weeks.

Raw Locust bean seed processing:

1 kg of locust bean seeds was weighed, cleaned oven dried to reduce the moisture level to ensure a smooth ground. The seeds were then ground using hammer mill and then sieved through 0.4mm wire mesh. The raw ground African locust bean flour was packed in plastic container sealed with aluminum foil and stored at room temperature for use (Oluwole *et al.*, 2005).

Chemical Analysis:

Proximate chemical analysis of feedstuffs, formulated diets and carcass were determined for crude protein, crude fiber, lipid, ash and moisture contents using the Macro Kjeldahl method as described by Association of Official Analytical Chemists (2000).

Table 3: Formulated diets containing LBM and their Proximate Compositions

Feedstuffs (%)	Diet 1 0% Locust Bean Meal (Control)	Diet 2 5% Locust Bean Meal	Diet 3 10% Locust Bean Meal	Diet 4 15% Locust Bean Meal
Fish meal	59.94	54.28	48.89	43.76
Maize meal	32.06	32.72	33.11	33.76
Locust bean(LBM)	0	5	10	15
Vitamin Mineral premix	5	5	5	5
Oil	3	3	3	3
Total	100	100	100	100
Proximate Compositions (%)				
Crude protein	49.91	49.06	49.2	49.1
Crude fat	9.92	6.86	27.9	8.13
Crude fiber	6.81	3.86	3.92	4.14
Ash	3.64	3.89	3.94	4.16
Dry Matter	7.36	6.52	7.66	9.23

Table 4: Weekly Water Quality Parameters

Treatment	T°C	pH	Conductivity (μS/cm)	DO (mg/l)
Diet 1	26-30	6.70-7.37	373-427	4.00-6.00
Diet 2	26-30	6.71-7.39	368-456	4.60-6.00
Diet 3	26-30	6.84-7.26	353-451	4.00-7.50
Diet 4	26-30	6.82-7.64	351-432	4.30-6.00

Growth Response Evaluation:

Biological parameters measured were according to Maynard *et al*, (1979) and Halver (1989) as described below:

Mean Weight Gain (g) W_2-W_1; W_2 mean final carcass weight, W_1 mean initial carcass weight (g).

Specific Growth Rate (SGR % Day) $\ln W_2 - \ln W_1 / T \times 100$ W_1 = initial weight (g), W_2 = final fish weight (g), T = Time (day), Ln = natural logarithm.

Food Conversion Ratio (FCR) = Feed fed (g dry weight)/Live weight gain (g).

Protein Efficiency Ratio (PER) = Live weight gain (g) / Crude protein fed (g)

Apparent Net Protein Utilization (ANPU) = ANPU (%) = (P2 – P1) / Total protein consumed (g) x 100; P1= Initial protein in fish carcass (g), P2 Final protein in fish carcass (g)

Acid Insoluble Ash (AIA) as internal marker Cockrell *et al*. (1987).

$$\% \text{ Acid insoluble Ash} = \frac{\text{wt. of Acid Insoluble Ash} \times 100}{\text{Wt. of sample taken}}$$

Apparent Digestibility Coefficient (ADC) Determination of diets was evaluated according to Maynard *et al*. (1979 as follows using Acid insoluble Ash (AQIA) as internal indicator.

$$\% \text{ ADC} = \frac{100 - (100 \times \% \text{AIA in diets} \times \% \text{ Nutrients in faeces})}{\% \text{ AIA in faeces} \times \% \text{ Nutrient in diets}}$$

Statistical Analysis:

Data obtained were subjected to statistical analysis. One way analysis of variance using Minitab release 14 statistical software and Duncan multiple-range test was used to separate the means where they are statistically different according to Steel and Torrie (1981).

Results

The results shown in Table 5 on growth parameters exhibited significant differences ($p<0.05$) among the treatments. 15% inclusion level of locust bean meal exhibited the best growth performance in terms of mean weight gain (MWG) of 5.01 g which is significantly different ($P<0.05$) from other diets except for the control diet. The specific growth rate value of 1.62 was also significantly higher ($P<0.05$) than other diets. The feed conversion ratio (FCR) was lowest (1.10) while the protein efficiency ratio (PER) was significantly higher than the control diet, however, apparent net protein utilisation (ANPU) exhibited the lowest value (29.83%)

Moreover, Diet 4 with the highest inclusion level of raw locust bean meal recorded the highest percentage of mortality (37%) while the lowest was diet 3 (10% locust bean meal), but from the trend of the mortality rate for the diets including the control diets, the mortality may not be traced to diet since the rate was equally high even for the control diet. Similarly, the water quality parameters were within the acceptable standard for all the treatments.

Table 5: Growth Parameters of *Clarias gariepinus* fingerlings fed Raw Locust Bean meal for 56 days.

Growth Parameters	Diet 1 0% Locust Bean Meal (Control)	Diet 2 5% Raw Locust Bean Meal	Diet 3 10% Raw Locust Bean Meal	Diet 4 15% Raw Locust Bean Meal	SD±
Initial mean weight gain (g)	$3.14^{b}\pm0.05$	$3.83^{a}\pm0.78$	$3.35^{a}\pm0.66$	$3.11^{b}\pm1.14$	0.6
Final mean weight gain (g)	$9.57^{a}\pm2.78$	$7.87^{b}\pm0.82$	$8.05a^{b}\pm0.49$	$8.12^{c}\pm0.46$	0.9
Mean weight gain (g)	$6.44^{a}\pm2.78$	$4.05^{c}\pm0.28$	$4.70^{b}\pm1.12$	$5.01^{a}\pm1.19$	1.1
Specific Growth Rate (%/Day)	$2.14^{a}\pm0.80$	$1.33^{d}\pm0.58$	$1.33^{d}\pm0.58$	$1.62^{b}\pm0.54$	0.3
Feed Conversion Ratio	$1.17^{c}\pm0.39$	$1.51^{b}\pm0.17$	$1.60^{a}\pm0.26$	$1.10^{c}\pm0.15$	0.5
Protein Efficiency Ratio	$1.86^{b}\pm0.68$	$1.51^{c}\pm0.14$	$1.45^{c}\pm0.25$	$1.99^{a}\pm0.26$	0.5
Apparent Net Protein Utilization (%)	$98.40^{b}\pm8.40$	$134.73^{a}\pm16.93$	$122.91^{ab}\pm8.94$	$29.83^{b}\pm6.93$	2.6
Mortality (%)	$28.9^{b}\pm6.83$	$24.4^{c}\pm7.83$	$17^{d}.8\pm9.03$	$37^{a}.8\pm8.43$	3.6

Data on the same row carrying same superscripts are not significantly different from each other ($P>0.05$

The proximate composition for carcass was significantly high for 10% raw locust bean meal (68.66%) while it was optimum for 15% inclusion level. differences among treatments (Table 6). The 1% raw locust bean meal has significantly low body fat (9.00) and moderate fibre content (4.12) than other diets while diet containg 15% locust bean meal has high body fibre but with body fat which is not significantly different ($P>0.05$) to that of diet 3.

Table 6: Body Composition of *Clarias gariepinus* fingerlings fed Raw Locust Bean Meal for 56 days.

Proximate compositions (%)	Initial Body Compositions (%)	Diet 1 0% Locust Bean Meal	Diet 2 5% Raw Locust Bean Meal	Diet 3 10% Raw Locust Bean Meal	Diet 4 15% Raw Locust Bean Meal	SD ±
Crude Protein	$62.62^{d}\pm0.01$	$65.97^{b}\pm0.01$	$66.50^{b}\pm0.01$	$68.66^{a}\pm0.01$	$63.35^{c}\pm1.01$	0.01
Crude fat	$5.10^{c}\pm0.01$	$10.99^{a}\pm0.06$	$10.95^{a}\pm0.01$	$9.00^{b}\pm0.01$	$9.20^{c}\pm1.01$	0.01
Ash	$4.45^{b}\pm0.01$	$8.98^{ab}\pm0.01$	$9.45^{a}\pm0.01$	$9.79^{a}\pm0.01$	$7.98^{c}\pm1.01$	0.01
Crude Fibre	19.26 ± 0.01	6.84 ± 0.01	$2.90^{b}\pm0.01$	4.12 ± 0.01	9.77 ± 0.01	0.16
Moisture Content	$8.57^{b}\pm0.01$	$7.20^{c}\pm0.01$	$10.20^{a}\pm0.02$	$8.43^{a}\pm0.01$	$9.70^{a}\pm1.01$	0.15

Data on the same row carrying same superscripts are not significantly different from each other ($P>0.05$

Table 7 showed the results of digestibility trial whose protein and fat ADC% values were not significantly different (P<0.05) for 5%, 10% and 15% inclusions. However, it was apparent that, the digestibility of the diets decreased as inclusion level increased.

Table 8: Apparent digestibility coefficient of *Clarias gariepinus* fingerlings fed raw locust bean meal for 56 days.

Body Compositions (%)	Diet 1 0% Locust Bean Meal	Diet 2 5% Raw Locust Bean Meal	Diet 3 10% Raw Locust Bean Meal	Diet 4 15% Raw Locust Bean Meal	SD ±
Crude Protein	77.51^{a}±0.06	63.10^{b} ±0.02	60.70^{b} ±0.01	59.60^{b} ±1.01	0.74
Crude Fat	66.00^{a} ±0.06	50.50^{b} ±0.01	44.30^{c} ±0.01	38.50^{c} ±1.01	0.08
Crude Fibre	31.90^{a} ±0.01	31.89^{a} ±0.01	21.02^{b} ±0.01	31.10^{a} ±1.01	0.01
Ash	20.40^{c} ±0.01	74.30^{a} ±0.01	24.80^{c} ±0.01	49.40^{b} ±1.01	0.01
Dry Matter content	60.30^{a} ±0.01	48.10^{b} ±0.02	56.80^{a} ±0.01	38.40^{c} ±1.01	0.02

Data on the same row carrying same superscripts are not significantly different from each other (P>0.05)

Discussion

From the results obtained, *Clarias gariepinus* fingerlings responded to diets containing raw locust bean meal despite the presence of anti nutritional compound in the raw locust bean meal. However, the *Clarias gariepinus* fish utilized the protein in the locust bean meal for growth of up to 15% inclusion level. The low growth response of fish fed diets containing 5% and 10% raw locust bean meal may be due to the level of nutrients and antinutritional compounds like saponin, hydrocyanide and tannin. The negative impact of these is evident from the performance of the control diet (0% locust bean meal). The apparent good performance of 10% locust bean mean as observed on the body compositions can be attributed to low fiber content and high digestibility of the diet that allowed for high nutrient utilization (Sruamsiri and Silman 2008).

Conclusion

The experiment revealed that fishmeal can be substituted at up to 15% inclusion level of raw locust bean meal. Furthermore, processing of locust bean seed may improve its nutrient availability by lowering the anti-nutritive compounds in the seed.

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