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Research Article

Nutritional analysis of *Sphenostylis Stenocarpa* seeds partially included with soya bean meal in *Heterobranchus Bidorsalis* fingerling diet

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Abstract

Five experimental feeding trials were conducted to investigate the performance of *Heterobranchus bidorsalis* fingerlings to graded levels (0%, 25%, 50%, 75% and 100%) of *Sphenostylis stenocarpa* seed meal diets. Complete randomized design with triplicate groups of fingerlings was used for the study for ten weeks. The proximate, anti-nutritional factor and amino acid profile of the *S. stenocarpa* was analysed. The study showed that treatment C with 50% inclusion of *Sphenostylis stenocarpa* meal was significantly different ($p < 0.05$) and performed best among other treatments in terms of the net weight gain, standard growth rate, and survival. The feed conversion ratio was best in treatment C but not significantly different ($p > 0.05$) to other treatments.

More Information

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Introduction

The importance of fish as a valuable source of animal protein in human diets cannot be over-emphasized as low-income food-deficit countries account for 80% of the total reported harvest from inland capture fisheries and over 90% of global inland capture fisheries production is used for human consumption [1]. The expansion and intensification of aquaculture production has been recommended towards ensuring increase in food fish production to meet up with the global demand since capture fisheries have continued to be on the decline over decades, are often overwhelmed by marine fisheries and evidences of unrecorded or drastically underreported, particularly regarding the prevalence of small-scale fishing (i.e., subsistence and local trade) in inland waters [2-5]. According to [6] report, fish supplies from capture fisheries will, therefore, not be able to meet the growing global demand for aquatic food. Even though the ingredient composition of fish feed has changed over the past 20 years of fish farming, there is still a need to evaluate new ingredients from sources not in use today for the betterment of the fishery industries and quality human consumption.

African Yam Bean (AYB), *Sphenostylis stenocarpa*, is a grain legume cultivated in the Central African Republic, Zaire, East Africa, and Ethiopia for its tubers and south-eastern Nigeria for its edible seeds Uche, et al. In the report of [7], it showed that both the lysine and methionine contents of the protein are equal to or better than those of soybean. Although several works have been conducted on the African Yam Bean, consumers have not been showing an increasing interest in AYB seed because of limited information on their nutritional qualities and potential health benefit.

Methodology

The amino acid profile, anti-nutritional factors and proximate analysis of African yam bean was studied for use in experimental feed formulation. Proximate analysis for the feed ingredients, experimental diets, fish flesh, and water quality analysis during the experiment was carried out. The experimental feeds were formulated by the inclusion of graded levels of (0%, 25%, 50%, 75% and 100%) AYB into the basal diets containing different ingredients, enzyme, vitamins and micro minerals (Table 1). The experiment was a complete randomized designed, carried out in semi-indoor with glass aquaria in triplicate for each diet formulated at 40% crude protein. The aquaria were cleaned, partially filled with water for seven days before the stocking of fish and well ventilated with a netted material. Oxygen was provided by an aerator throughout the study period. Each aquarium was stocked with 10 fingerlings of *Heterobranchus bidorsalis* with an average body weight of 28.50 - 28.70 grams and fed with wheat offal for two weeks during acclimation.

The fish were fed experimental diets at 5% of their body weight at 0900 hours and 1700 hours respectively for 10 weeks. The feeding of fish was done after removing the waste materials and replenishing with clean water every morning during the study period to reduce pollution in the aquaria. Sampling was done every fortnightly to record the weight of fish, condition status and subsequent adjustment of feed in the experiment. The water parameters were studied using analytical instruments. The amino acid was done using an amino acid analyser. At the end of the study period, final sampling was done and three fish per replicate were randomly selected for haematology analysis and carcass proximate evaluation (Tables 2,3).

Calculations and statistical analysis

Parameters such as Weight gain = (Final weight – Initial weight); Apparent Feed consumed = (Estimated feed supplied during the experimental period); Feed conversion ratio (FCR) = (Apparent Feed intake/Weight gain); Specific growth rate (SGR) = {(In Final weight – In Initial weight/Experimental period) x 100%}.

Data obtained were subjected to one-way analysis of variance (ANOVA) using SPSS Version 16.0 for windows according to the statistical principle of [8].

Results and Discussion

The effect of different formulated diets was studied on the physicochemical parameters (temperature, pH, dissolved oxygen, total hardness) of water, and on survival, growth (length, weight and condition factor) and biochemical composition (protein, lipid, carbohydrate, moisture, ash) of the flesh of *H. bidorsalis.*

Physico-chemical parameters of water play a significant role in the physiology and other metabolic activities of fish and hence are very important for the survival and growth of fish [9]. The act of supplementary feeding improves fish growth, but the composition, digestibility and physical characteristics of feed may have significant effects on water quality [10,11]. The accumulation of feed uneaten or leftovers and faecal matter increases the biological oxygen demand and affects the dissolved oxygen content [12]. These above summations were guiding to adequate water conditions during the study. The temperature (°C) of water in the different treatments ranged from 26 to 26.7 °C during the experiment with no statistical difference ($p > 0.05$) recorded (Tables 4,5). Fish are cold-blooded animals and their rate of metabolism is directly

Table 1: Composition of 40% crude protein experimental diets (kg/100 kg).

Ingredients	Diet A (Control)	Diet B (25%)	Diet C (50%)	Diet D (75%)	Diet E (100%)
African Yam Bean (AYB)	0.00	5.75	11.50	16.25	23.00
Fish meal	25.00	25.00	25.00	25.00	25.00
Groundnut cake	25.00	27.00	27.00	28.70	30.00
Soya bean meal	23.00	16.25	11.50	5.75	0.00
Wheat offal	10.00	10.00	10.00	10.00	6.00
Maize bran	12.50	11.50	10.50	9.80	11.50
Starch	1.28	1.28	1.28	1.28	1.28
Groundnut oil	1.00	1.00	1.00	1.00	1.00
Premix**	0.50	0.50	0.50	0.50	0.50
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Vitamin B	0.03	0.03	0.03	0.03	0.03
Vitamin C	0.03	0.03	0.03	0.03	0.03
Bone meal	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Enzyme* (1 mg/kg)	0.01	0.01	0.01	0.01	0.01
Total	100.00	100.00	100.00	100.00	100.00

*Enzyme (Nutrase Xyla: Endo-1,4-Beta-Xylanase); **Provides per Kg diet: Vitamin A: 25,000 IU; Vitamin D_3: 2,000 IU; Vitamin E: 200 IU; Vitamin K: 8 mg; Vitamin B_2: 20 mg; Vitamin C: 500 mg; Niacin: 150 mg; Pantothenic Acid: 50 mg; Vitamin B_6: 12 mg; Vitamin B_{12}: 0.05 mg; Folic Acid: 4 mg; Biotin: 0.8 mg; Choline Chloride: 600 mg; Cobalt: 2 mg; Copper: 4 mg; Iodine: 5 mg, Iron: 40 mg; Manganese: 50 mg; Selenium: 0.2 mg; Zinc: 40 mg; Antioxidant: 100 mg, Lysine: 100 mg; Methionine: 100 mg.

Table 2: Proximate analysis of experimental diets (%).

Parameters	Diet A (Control)	Diet B (25%)	Diet C (50%)	Diet D (75%)	Diet E (100%)
Moisture	6.36 ± 0.07	7.06 ± 0.23	5.00 ± 0.98	6.82 ± 0.67	6.58 ± 0.55
Crude protein	28.39 ± 0.53	35.75 ± 0.07	33.68 ± 0.34	35.14 ± 0.27	34.45 ± 0.12
Crude fibre	5.27 ± 0.11	5.62 ± 0.78	6.25 ± 0.12	5.74 ± 0.18	4.47 ± 0.07
Crude lipid	17.33 ± 0.81	14.28 ± 0.85	11.71 ± 0.98	13.88 ± 0.36	13.48 ± 1.66
Ash	9.76 ± 0.57	10.77 ± 0.21	10.58 ± 0.49	10.56 ± 0.30	10.20 ± 1.18
NFE	32.87 ± 0.34	26.52 ± 1.54	33.48 ± 1.25	27.86 ± 1.19	30.83 ± 2.25

Table 3: Growth response and Nutrient Utilisation of *H. bidorsalis fingerlings* fed varying dietary inclusion of AYB.

Parameters	TRM A (Control)	TRM B	TRM C	TRM D	TRM E
Mean initial weight	28.54 ± 0.23^a	28.50 ± 0.3^a	28.63 ± 0.21^a	28.70 ± 0.1^a	28.59 ± 0.3^a
Mean final weight	112.10 ± 28.25^b	76.70 ± 20.46^a	167.46 ± 49.66^c	162.13 ± 50.01^c	112.86 ± 43.09^b
Net weight gain	83.56 ± 15.42^b	48.20 ± 26.68^a	138.83 ± 41.43^c	133.43 ± 47.55^c	84.27 ± 52.97^b
Percentage net weight gain	292.78 ± 52.4^b	169.12 ± 93.3^a	484.91 ± 146.1^c	464.91 ± 164.0^c	294.75 ± 186.2^b
Specific growth rate	0.85 ± 0.11^b	0.61 ± 0.17^a	1.10 ± 0.09^c	1.07 ± 0.10^c	0.85 ± 0.14^b
Feed conversion ratio	0.57 ± 0.03^a	0.63 ± 0.18^a	0.53 ± 0.03^a	0.54 ± 0.03^a	0.62 ± 0.07^a
Protein efficiency ratio	2.94 ± 0.54	1.35 ± 0.75	4.12 ± 1.23	3.80 ± 1.35	2.45 ± 1.54
Survival	90.00 ± 1.73^b	73.33 ± 1.52^a	93.33 ± 1.15^b	90.00 ± 1.73^b	80.00 ± 3.46^c

Data are mean values ± SD (n = 3); means in the same row with the same superscript were not significantly different ($p > 0.05$)

Table 4: Haematological analysis of *H. bidorsalis fingerlings* fed varying dietary inclusion of AYB.

Parameters	TRM A (Control)	TRM B	TRM C	TRM D	TRM E
WBC (× 10 ^ 9/L)	30.06	139.38	36.19	52.67	45.03
LYM (× 10 ^ 9/L)	29.84	134.0	35.90	52.23	44.24
RBC (× 10 ^ 12/L)	1.29	2.61	1.4	1.51	1.36
HGB (g/dL)	4.3	9.4	4.6	5.3	4.8
MCHC (g/dL)	29.56	30.63	28.57	29.21	27.30
MCH (pg)	33.39	36.03	32.80	35.18	35.27
MCV (fl)	112.96	117.65	114.81	120.45	129.18

Table 7: Proximate analysis of experimental fish carcass (% DM).

Parameters	TRM A (Control)	TRM B	TRM C	TRM D	TRM E
Moisture	5.22 ± 0.15	5.51 ± 0.21	7.07 ± 0.14	5.77 ± 0.05	5.73 ± 0.41
Crude lipid	12.99 ± 0.86	10.86 ± 0.34	12.69 ± 0.77	12.72 ± 0.14	9.93 ± 0.25
Crude fibre	0.37 ± 0.03	0.49 ± 0.01	0.49 ± 0.01	0.46 ± 0.04	0.43 ± 0.03
Crude protein	54.75 ± 1.23	51.22 ± 1.76	60.35 ± 2.08	60.04 ± 2.69	63.57 ± 0.78
Ash	10.05 ± 1.00	6.59 ± 0.28	7.72 ± 0.13	6.85 ± 0.11	8.86 ± 0.32
NFE	16.90 ± 2.48	25.34 ± 1.85	11.67 ± 3.14	14.14 ± 2.84	11.45 ± 0.40

Table 5: Water profile analysis.

Treatment	pH	Water temperature (°c)	Air temperature (°c)	Dissolved oxygen (mg/L)	Conductivity (µ/cm)
A	7.6	26.7	25.0	7.10	180
B	7.5	26.4	25.0	6.80	200
C	7.6	26.2	25.0	6.80	180
D	7.5	26.2	25.0	7.00	180
E	7.5	26.0	25.0	6.80	200

Table 6: Chemical profile of African Yam Bean.

Anti-nutrients	(mg/100 g)
Hydrogen cyanide	2.46
Phytates	1.23
Tanins	0.68
Oxalate	0.24
Trypsin inhibitor	-
Alkaloid	0.46
Proximate	**(% DM)**
Moisture	2.60
Crude protein	30.01
Crude fat	3.74
Crude fibre	6.03
Ash	3.12
NFE	54.83
Amino acids	**(g/100 g protein)**
Glycine	4.16
Alanine	4.06
Serine	3.83
Proline	3.99
Valine	3.69
Threonine	3.31
Isoleucine	4.39
Leucine	7.10
Aspartate	11.72
Lysine	5.80
Methionine	0.89
Glutamate	20.64
Phenylalanine	4.11
Histidine	2.17
Arginine	9.14
Tyrosine	2.68
Tryptophan	1.08
Cysteine	1.9

influenced by water temperature. Temperature range for optimum growth of fish varies with species and so does the upper and lower temperature tolerance [13]. An important factor to ensure good fish production is water pH [14]. The optimum pH range differs among species; however, the pH 6.5 - 9.0 range is generally accepted for fish culture [15] which correlates with the study (Tables 6,7).

The average final body weight (g) in different treatments increased from 28.54 to 112.10 in A, 28.50 to 76.70 in B, 28.63 to 167.46 in C, 28.70 to 162.13 in D and 28.59 to 112.86 in E (C ≥ D > E ≥ A > B). A significant difference ($p < 0.05$) in body weight was observed for different treatments. The NWG, %NWG, SGR and PER were maximum in C (138.83 g, 484.91%, 1.10 and 4.12) and significantly different at $p < 0.05$ compared to all diets except treatment D. however, the study showed that the FCR in all the treatments were not significantly different at $p < 0.05$. At the termination of the experiment, survival of fish was significantly different ($p < 0.05$) with the least survival rate in treatment B which recorded a 73.33% and treatment C with the highest survival rate of 93.33%.

The study showed that treatment C is the best result among other treatments in most of the growth parameters which constituted 50% substitution of SBM with AYB, hence, this treatment C could be used in fish feed formulation for better growth of *H. bidorsalis*. This correlates with the study of [16], which showed that AYB performed better in the growth of *Clarias gariepinus* and can be substituted in the diet at a 45% inclusion level.

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