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Graded Inclusion Level of Canarium schweinfurtii Waste Chaff (CSWC) in the Diet of African Catfish (Clarias gariepinus) Fingerlings as Energy Source.

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Abstract: *Three hundred Clarias gariepinus fingerlings with mean body weight of 3.85±0.06 g were fed five different inclusion level diets for (56) days in 15 glass aquarium tanks measuring 0.6 x 0.3 x 0.2 m length, width and depth respectively. This was aim at utilization of Canarium schweinfurtii Waste Chaff (CSWC) as energy source to replace maize in the diet. At the end of the experiment, the result showed significant differences (P<0.05) in the growth parameters among the diets fed. Diet 5 containing 20% CSWC exhibited best FCR, SGR and PER though not significantly different (p>0.05) as compared to other diets. This indicated that, CSWC can up to 20% be included in the diet of Clarias gariepinus fingerlings as energy source thereby converting waste to wealth.*
Key Words: *Canarium fruit, Waste chaff, Clarias gariepinus fingerlings and fish diet.*

I. Introduction

Fish farming is a growing industry and involves raising fish in tanks or enclosures in subsistent level or commercially. However, one of the greatest challenges in modern aquaculture is the high cost of feed which makes the feed industries and farmers to compromise quality (FAO, 2008). Agricultural waste products are wastes produced at agricultural premises as a result of agricultural activities (Orire and Abubakar, 2013). According to (Akinfemi, 2010) agricultural waste and by-products have been extremely employed in ruminant nutrition in many parts of the world as a substitute for concentrate feeds which are usually very expensive. In Nigeria only a few portions are used by ruminants while the largest proportion are burnt or discarded leading to environmental pollution and health hazards. There is need to supply cultured species with adequate diets to supply their needed nutrient requirements both qualitatively and quantitatively in order to achieve faster growth and high fish yield. The use of cheaper feed processes has shown potentials in terms of their nutrient supply as well as reduction in feeding costs. Falaye and Omoike (2012) reported on the profitable and beneficial use of rice bran and other farm by-products as ingredients in Nile tilapia rations. Four agricultural wastes: Castor Bean Leaves (CBL), Castor Bean Capsules (CBC), Jojoba Leaves (JL) and Jojoba Capsules (JC) were used as adsorbents for the adsorption of strontium from Abu Zeabal Industrial waste water (Kotb and Algharib (2014). Also, series of activated carbon have been prepared from Canarium schweinfurtii Seed Shell (CSSS) Zinc Chloride ($ZnCl_2$) and Phosphoric acid (HPO) as chemical activation agent Braton and Bradle (2011) cited by Yilleng et al. (2015). Activated carbon is said to be effective adsorbents for a wide range of toxic organic vapour phase species encountered in domestic and industrial situations. The skin and flesh of Canarium schweinfurtii fruit are edible after soaking in warm water. It contains large amount of protein, fat and carbohydrate, thereby making it an ideal food. However, some communities in Nigeria after extracting oil from the fruit discard the fleshy skin bark as waste. It is on the basis of this that Canarium schweinfurtii Waste Chaff (CSWC) regarded as agricultural by-product is use for socio-economic benefits particularly as energy source in fish diet. This experiment therefore, seeks to replace maize with CSWC as energy source in the practical diets of catfish (Clarias gariepinus) fingerlings.

II. Materials and Methods

Clarias gariepinus fingerlings with an average body weight 3.85±0.06 g were purchased at fish farm, Federal University of Technology, Bosso Campus, Minna. The experiment was conducted at the Toxicology unit of the farm for 56 days. At the commencement of the feeding trial, experimental fish were randomly selected and stocked in 15 glass aquarium tanks measuring 0.6 x 0.3 x 0.2 m length, width and depth respectively. There were five treatments and each treatment was replicated three times with 20 fish stocked per tank. Each tank was filled with clean 20 liter fresh water. The five treatment diets were at varying inclusion level of Canarium schweinfurtii Waste Chaff (CSWC) as energy replacement to maize. The feedstuff used for the experiment was purchased at Minna central Market, Niger State. These include fish meal, vegetable oil, CSWC and vitamin premix. The feed ingredients were milled separately and the feedstuffs were then analysed for their crude protein, lipid, ash and fibre content according to the method of AOAC (2000). Pearson square method of feed formulation was used to formulate the diets with a crude protein level of 50 % isonitrogenously. However, the diets contained varying inclusion level of CSWC at 0 %, (control) 5 %, 10 %, 15 % and 20 % to maize replacement (Table 1). The feedstuffs were mixed thoroughly with a little quantity of warm water added to form consistent dough for each diet. The dough thereafter was pelleted and oven dried. The proximate composition for crude protein, lipid, ash and fibre content of the five diets were carried out according to the analytical method of AOAC (2000). The fish were fed the test diets at 3 % body weight per day. The pooled weight of fish was taken bi-weekly and at the end of experiment. Water exchange was done on daily basis with the siphoning of faeces and uneaten feed. The water quality parameters monitored on weekly basis were temperature using thermometer, dissolved oxygen according to the method of Wrinkers (Lind, 1979; APHA, 1980). Hydrogen ion concentration (pH) was measured using a EIL 7045/46 pH meter in the laboratory while conductivity was determined using conductivity meter.

III. Chemical Analysis

10 fish were randomly selected and sacrificed for determination of initial carcass composition. At the end of the feeding trial, 10 fish from each treatment were collected for determination of final carcass composition. Chemical analyses were carried out on feedstuffs, diets and faecal matter for their proximate analysis for protein, lipid, ash, moisture and fibre content using standard procedure (AOAC, 2000).

Crude protein $= \frac{\text{TV x MA x nf x df x \% xpcf}}{\text{Weight of Samples}}$

Where, TV = Titration Value; MA = Molarities of Acid (0.05M); nf = Nitrogen Factor (0.014), df = Dilution Factor (10); pcf = Protein Conversion Factor (6.25).

Percentage Lipid $= \frac{\text{Weight of Extracted lipid}}{\text{Weight of Samples}} \times 100$

Percentage Crude Fibre $= \frac{\text{Total weight of fibre}}{\text{Weight of Samples}} \times 100$

Percentage Ash $= \frac{\text{Total weight of extracted ash}}{\text{Weight of Samples}} \times 100$

Percentage Moisture Content $= \frac{\text{Weight loss}}{\text{Weight of sample}} \times 100$

Table 1: Percentage Composition of Formulated Diets.

Ingredients	Diets (%)				
	D1	**D2**	**D3**	**D4**	**D5**
Fish Meal	69.09	69.77	69.77	69.77	69.77
CSWC	0.00	1.26	2.52	3.78	5.04
Maize Meal	25.90	23.95	22.69	21.44	20.17
Vitamin Premix	2.00	2.00	2.00	2.00	2.00
Palm Oil	3.00	3.00	3.00	3.00	3.00
TOTAL	99.99	99.98	99.98	99.99	99.98

Key: CSWC= Canarium schweinfurtii Waste Chaff, D1= Control (0 % CSWC), D2= (5 % CSWC), D3= (10 % CSWC), D4= (15 % CSWC) and D5= (20 % CSWC).

Table 2: Percentage Proximate Composition of Experimental Diets

Proximate Composition (%)	Diets				
	D1	**D2**	**D3**	**D4**	**D5**
Crude Protein	12.19	15.50	13.14	11.32	15.32
Lipid Content	11.20	10.31	14.42	12.56	11.48
Crude Fibre	0.30	1.10	0.25	0.45	0.25
Ash Content	12.19	15.50	13.14	11.32	15.32
Moisture Content	8.55	7.91	8.16	8.56	8.34

Percentage mortality, Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER), Percentage Apparent Net Protein Utilization (ANPU), and Percentage Apparent Digestibility Coefficient (ADC) were calculated as follows:

$$\% \text{ Mortality} = \frac{\text{No of dead fish}}{\text{No of fish stocked}} \times 100$$

$$\text{SGR} = \frac{\text{Log MFW (Mean Final Weight) x Log MIW (Mean Initial Weight)}}{\text{Time in days}} \times 100$$

$$FCR = \frac{\text{Weight of food fed (Dry gram weight)}}{\text{Weight gain of fish (Wet gram weight)}}$$

$$PER = \frac{\text{Weight gain of fish}}{\text{Protein fed}}$$

$$\%ANPU = \frac{\text{Carcass Protein gain (g)}}{\text{Protein fed}} \times 100$$

$$\%ADC = 100 - \frac{(100 \times \%AIA \text{ of diets} \times \%\text{Nutrient in Faecal})}{\%AIA \text{ of faecal} \times \%\text{Nutrient in diets}}$$

Key: Log MFW= Log Mean Final Weight; Log MIW= Log Mean Initial Weight; AIA =Acid Insoluble Ash

IV. Experimental Design and Statistical Analysis

The experimental design use was One-way Analysis of Variance (ANOVA) and data generated were analysed using statistical package Minitab Release 14 and at 5% significant level. Mean were separated using Duncan Multiple range test.

V. Results

The result in Table 3 showed that Diet 1 (control) was significantly different (P<0.05) in term of weight gain as compared to other diets. FCR in Diets 1, 3, 4 and 5 differed significantly when compared to diet 2. SGR in diets 1 and 5 showed significant difference (P<0.05) as compared to other diets. Diet 5 had highest value of PER though not significantly different (P>0.05) as compared to other diets. The highest mortality was recorded in D2 and D5 and differed significantly (P<0.05) as compared to diet 1. The result in Table 4 showed the body composition of the initial and final carcass. The crude protein and lipid in diet 4 differed significantly (p<0.05) as compared to other diets. Crude fibre in diet 3, ash and moisture contents in diet 2 differed significantly (P<0.05) as compared to other diets. The result in Table 5 showed Apparent Digestibility Coefficient (ADC) of the test diets fed the experimental fish. The crude protein in diets 1, 2, 3 and 4 showed significant difference (P<0.05) as compared to diet 5 while diet 3 and 4 differed significantly (P<0.05) as compared to diets 1, 2 and 5 in term of lipid content. The result in the Table also revealed that dry matter in diet 1 was significantly different (P<0.05) as compared to other diets as was similarly observed for crude fibre in diets 4 and 5 which differed significantly (P<0.05) when compared to other diets. Also ash content in diet 4 showed significant difference (P<0.05) as compared to other diets.

Table 3: Growth Response Of Clarias gariepinus Fingerlings Fed Canarium schweinfurtii Waste Chaff (CSWC) As Energy Source For 8 Weeks.

Growth Parameters	Diets					
	D1	D2	D3	D4	D5	SD±
Mean Initial Weight (g)	$2.02^{a}\pm0.02$	$2.01^{a}\pm0.00$	$2.01^{a}0.00$	$2.02^{a}\pm0.00$	$2.01^{a}\pm0.00$	0.00316
Mean Final Weight (g)	$20.19^{a}\pm2.44$	$9.50^{d}\pm0.68$	$17.17^{b}\pm0.98$	$13.21^{c}\pm0.82$	$19.49^{a}\pm1.20$	2.321
Mean Weight Gain (g)	$18.17^{a}\pm1.98$	$7.49^{d}\pm0.56$	$15.17^{b}\pm0.93$	$11.19^{c}\pm0.70$	$17.48^{a}\pm1.11$	1.989
Feed Conversion Ratio	$0.66^{a}\pm0.41$	$0.61^{b}\pm0.13$	$0.44^{b}\pm0.15$	$0.47^{b}\pm0.40$	$0.85^{a}\pm0.43$	0.334
Specific Growth Rate	$3.99^{a}\pm0.86$	$2.65^{b}\pm0.81$	$3.81^{ab}\pm0.21$	$3.40^{ab}\pm0.42$	$4.07^{a}\pm0.08$	0.540
Protein Efficiency Ratio	$0.97^{a}\pm0.37$	$1.66^{a}\pm0.67$	$1.38^{a}\pm0.31$	$1.42^{a}\pm0.52$	$1.77^{a}\pm0.89$	0.540
% Mortality	$21.67^{b}\pm24.66$	$53.33^{a}\pm22.55$	$50.00^{a}\pm10.00$	$46.67^{a}\pm25.17$	$53.33^{a}\pm34.03$	22.39

Mean data on the same column carrying different superscripts differed significantly (p<0.05) from each other.

Table 4: Body Composition Of Clarias gariepinus Fed Graded Levels Of Canarium schweinfurtii Waste Chaff (CSWC) For 8 Weeks.

Proximate Composition (%)	Initial Body Composition (%)	Final Body Composition (%) D1	D2	D3	D4	D5	SD±
Crude Protein (CP)	42.88^{d}±0.01	43.48^{d}±0.01	48.99^{b}±0.00	46.36^{c}±0.01	15.04^{c}±0.01	51.61^{a}±0.01	0.0105
Crude Lipid (CL)	10.23^{d}±0.01	12.81^{d}±0.01	17.20^{b}±0.01	14.31^{c}±0.01	18.60^{a}±0.01	16.94^{b}±0.01	0.0100
Ash Content (AC)	1.16^{d}±0.01	1.97^{d}±0.01	18.00^{a}±0.01	14.85^{b}±0.01	15.91^{b}±0.01	12.87^{c}±0.01	0.0100
Moisture Content (MC)	93.23^{a}±0.01	92.33^{b}±0.02	90.32^{c}±0.01	91.78^{c}±0.01	91.00^{d}±0.01	91.47^{c}±0.01	0.0111
Crude Fibre (CF)	11.15^{d}±0.01	13.14^{d}±0.01	16.30^{b}±0.01	18.52^{a}±0.01	14.30^{d}±0.01	13.42^{d}±0.01	0.0100

Mean data on the same column carrying different superscripts differed significantly ($p<0.05$) from each other.

Table 5: Apparent Digestibility Coefficient (ADC %)

% ADC	Treatments D1	D2	D3	D4	D5	SD±
Crude Protein	87.66^{a}±0.01	91.45^{a}±0.01	93.44^{a}±0.01	91.07^{a}±0.01	92.88^{c}±0.01	0.0091
Crude Lipid	64.81^{c}±0.01	69.21^{c}±0.01	84.60^{a}±0.01	82.75^{a}±0.01	76.38^{b}±0.01	0.711
Dry Matter	69.46^{a}±0.01	55.97^{c}±0.01	49.01^{c}±0.01	56.28^{b}±0.01	46.94^{d}±0.01	0.0091
Crude Fibre	20.64^{c}±0.01	42.84^{b}±0.01	26.44^{c}±0.01	65.01^{a}±0.01	61.30^{a}±0.01	0.0091
Ash Content	77.80^{b}±0.01	74.11^{c}±0.01	78.96^{b}±0.01	84.06^{a}±0.01	78.01^{b}±0.01	1.182

Mean data on the same column carrying different superscripts differed significantly ($p<0.05$) from each other.

VI. Discussion

Catfish (Clarias gariepinus) fingerlings fed graded inclusion level of CSWC meal exhibited utilization of the meal. Diet 1 containing 0 % CSWC had the highest mean weight gain, it is of interest to note that better weight gain was achieved at 5 % inclusion level of CSWC as compared to other diets. This however was contrary to observation made by (Falaye and Omoike, 2012) in their study on effects of maize bran diets on the growth and nutrient utilization of Tilapia (Oreochromis niloticus). They observed that better weight gain and specific growth was achieved at high inclusion level of maize bran compared to low incorporation levels of the test ingredients. This according to them might be due to the fingerlings better conversion and utilization of the diet as a result of its high fibre content. However, the poor values obtained for Mean Weight Gain (MWG) (diets 2, 3, 4 and 5), FCR (diet 2) and SGR (diets 2, 3 and 4) (Table 2) was indication of inefficient utilization of diets. Growth parameters serve as indicator of fish ability to utilize and retain nutrients in a given diet. From growth performance of the Clarias gariepinus fingerlings fed experimental diets in this study diet 1 recorded the best growth performance in term of weight gain and diet 5 nutrient utilization (Table 2). PER was recorded high in all the test diets, an indication of food conversion efficiency. The survival rate of the fish fed experimental diet was between 21-53 %. The moderate survival rate could be attributed to stress experienced by experimental fish especially during exchange of water and siphoning of dirt and faecal matter. Similar trend of survival rate was observed by Orire and Sadiku (2014) in their study effects of carbohydrate sources on the growth and body compositions of African catfish (Clarias gariepinus). Diet 5 performs best as compared to other diets. This performance reflects in the flesh and this corroborates the work of (Jauncey, 1998) and cited by Orire (2010) who stated that carcass composition should reflect the diet. All the diets except diet 5 recorded higher ANPU crude protein values with low FCR which implied adequate utilization of the diet as similar observation was made by Orire and Abubakar (2013).

VII. Conclusion

From the foregoing the research revealed that CSWC can up to 20% be included in the diet of Clarias gariepinus fingerlings as energy source without any adverse effect thereby converting waste to wealth.

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