Use of the African locust bean, *Parkia biglobosa* waste slurry as energy feedstuff in practical diets for Tilapia, *Oreochromis niloticus* L

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Abstract

An assessment of the nutritive value of the waste slurry of the African locust bean, Parkia biglobosa as an energy source in practical diets for tilapia was carried out in glass aquaria. Five diets (35% crude protein) were formulated in which yellow maize was replaced at varying level with parkia slurry waste as follows: Diet 1, (100% slurry), diet 2, (100% yellow maize); diet 3 (75% slurry, 25% yellow maize), diet 4 (50% slurry, 50% yellow maize), diet 5 (25% slurry, 75% yellow maize). Growth performance and nutrient utilization of the fish were based on average daily weight gain (ADG), specific growth rate (SGR), feed conversion ratio (FCR), and protein efficiency ratio (PER). Good growth and feed utilization efficiencies were obtained in all diets, however diet 5 had significantly better growth and food utilization with the highest average daily weight gain (ADG) of 0.60, SGR (2.32) and PER (3.05% per day). Difference in SGR were not significantly different between all diets. The result showed that parkia slurry was better utilized by tilapia fish in diets 3 and 5 where their replacements were neither wholly nor equal.

Keywords: Parkia slurry, energy, feedstuff, Tilapia

Introduction

The high cost and the shortage of complete feeds for fish in aquaculture ventures in Nigeria places a constraint on the successful operation of intensive aquaculture business. Fish meal, which is the major source of protein, is used at a high level in all feeds. Fish meal is not locally produced at commercial level in Nigeria, and hence has to be imported. The need to reduce this cost is very paramount in the aqua-business. It has been observed that this cost could only be reduced by employing one of these two options: (a) by replacement of the fish meal (Tacon, 1981; Jackson *et al.*, 1982) and (b) by utilizing the protein-sparing action of carbohydrate or lipids and thus reducing the amount of fish meal required (Adron *et al.*, 1976; Austreng *et al.*, 1977; Wee and Ng, 1986). In order to satisfy these objectives, Hephher (1979) opined that by feeding energy rich ingredients as a supplementary diet, significant increased fish

production could be realized while at the same time cutting cost. Research studies into cheaper alternative protein and energy feedstuffs for the development of low-cost feeds for small-scale farmers has become an utmost priority in the developing countries. It is in this context that the present study was conducted, using the Africa locust bean slurry waste.

The African locust bean tree (*Parkia biglobosa* Jacq.) is a perennial tropical tree legume (Campbell-Platt, 1980). In West Africa, the seed of this leguminous tree crop is fermented to yield a traditional food condiment called 'dawadawa' or 'iru' (Odufa, 1981).

The freshly harvested African locust beans are contained in pods. The pods contain a yellow dry powdery pulp in which the dark brown seeds are embedded. The first major operation in the production of 'dawadawa' is the removal of the

locust bean seeds from the pods. One of the by-products of this operation is the yellow pulp, which forms thick slurry when water is added. This locust bean slurry (LBS) causes pollution in the water and even in the environment where harvesting and processing of this crop is a viable trade.

The present study was therefore designed to incorporate locust bean slurry as replacements (in certain proportions) for yellow maize. The five diets were formulated to contain a constant level of protein and varying amounts of energy supplied by LBS. The growth rate, feed conversion efficiency, survival rate and carcass quality of *Oreochromis niloticus* L, fed the diets were assessed.

Materials and Methods

Sample collection and processing

The pakia pods were collected from the wild within the farms of the College of Environmental Resources Management, University of Agriculture, Abeokuta, Nigeria. The seeds were removed from the pods and soaked in water for 10 hours.

Thereafter, the soaked seeds were rubbed manually to ease the separation of the slurry from the seeds. The separated slurry was packed into jute bags and pressed so as to drain off excess water. The slurry was left for 4 hours to ferment before sun drying. The dried slurry was then grounded into powder form using an electric blending machine. Five diets (35% crude protein) were formulated containing varying level of LBS substituted at the rate of 100%, 75%, 50%, 25% and 0% with yellow maize (Table 1)

Table 1: Ingredient and nutrient composition (g/100g) of diets

Ingredients	1	2	3	4	5
Fish meal	30.00	30.00	30.00	30.00	30.00
Yellow maize	-	52.00	26.00	39.00	13.00
Slurry waste	52.00	-	26.00	13.00	39.00
Rice grain	5.00	5.00	5.00	5.00	5.00
Oyster shell	4.50	4.50	4.50	4.50	4.50
Vit./Mineral	4.00	4.00	4.00	4.00	4.00
Vegetable oil	2.50	2.50	2.50	2.50	2.50
Starch binder	1.60	1.60	1.60	1.60	1.60
Salt (NaCL)	0.40	0.40	0.40	0.40	0.40
CPV (%)	35.00	35.00	35.00	35.00	35.00
Nutrient content					
Crude protein	10.53	13.25	13.06	18.37	15.38
Crude lipid	6.58	6.17	3.27	7.01	9.33
Crude fibre	19.34	18.54	18.80	17.86	17.48
Ash	36.20	34.65	36.10	33.45	32.15
Moisture	8.86	8.86	9.48	9.35	8.78
NFE	18.49	19.43	19.29	13.46	16.88

Ingredients were thoroughly mixed in a Hobart A-200T pelleting and mixing machine to obtain a homologous mass. The mass was then passed

through a mincer to produce 0.9mm sized pellets. They were sun dried and consequently

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broken into convenient sizes, and kept in the refrigerator before being fed to the fish.

Experimental procedure and the fish

The feeding trial was conducted in glass tanks (40x90x40cm) in the Fish Laboratory of the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Nigeria. All male fingerlings of *O. niloticus* (12.5 ± 1.2 g) produced from Eweje Fish Station, Eweje, Odeda Local Government, Ogun State were procured. The fish were acclimatised in glass tanks for 7 days. They were fed with commercial feed obtained from the Nigeria Institute of Oceanography and Marine Research, Victoria Island, Lagos, Nigeria. 20 fish were randomly stocked into each tank, with two replications per treatment. The experimental diets were assigned randomly to the tanks, and each group of fish was fed at 5% body weight day⁻¹ in two equal portions at 9.00-10.00 hour and 16.00-17.00 hour for 8 weeks (56 days). Weight of feed was adjusted every week after weighing the fish. The physico-chemical parameters of the water medium were investigated in accordance with the procedures of A.O.A.C 1984.

Diet performance evaluation

The diet performance was evaluated according to Olvera-Novoa *et al.*, (1990) as follows:

ADG (average daily weight gain) =

$$\frac{\text{Final weight} - \text{initial weight}}{\text{Number of days of experiment}}$$

SGR (% day⁻¹) (specific growth rate) = $100 \times \frac{(\log_e \text{final body weight} - \log_e \text{initial body weight})}{\text{No of days of experiment}}$

FCR (feed conversion ratio) =

$$\frac{[\text{dry weight of feed fed (g)}]}{[\text{Fish weight gain (g)}]}$$

PER (protein efficiency ratio) =

$$\frac{[\text{Fish weight gain (g)}]}{[\text{Protein fed (g)}]}$$

PPV (protein productive value) = $100 \times (\text{protein gain/protein fed})$

At the end of the experiment, the final total fish population (those that survived during the experiment) was deducted from the initial fish population to determine the survival rate. Five fish from each tank were killed by decapitation and used for carcass analyses.

Statistical analysis

Data resulting from the experiment were subjected to one-way analysis of variance (ANOVA) using the SPSS (Statistical Package Computer Software, 1988 Version). Duncan's multiple range test was used to compare difference among individual means at the 0.05 significance level (Duncan, 1995).

Results and Discussion

In all the tanks, the fish were observed to readily accept the experimental diets, the feeds were completely consumed within the first 1 - 15 minutes of administration. After the first 2 days, there was no mortality and the fish appeared to be morphological normal at the close of the experiment. The water quality parameters were all within the tropical tolerance for *Tilapia* as showed in Table 3. The water temperature ranged from 25.8 to 32.9°C, while the dissolved oxygen was between 8.84 and 12.9 mg/l and pH values between 8.2 and 9.6.

Table 2: Proximate composition of dietary ingredients (g/100g dry matter)

Components	Crude protein	Lipid	Crude fibre	Ash	Moisture	NFE
Fish meal	60.3	8.1	0.9	11.6	7.8	11.3
Yellow maize	9.5	4.1	3.0	2.8	6.9	73.7
LBS	7.9	2.3	18.9	12.3	9.3	49.3
Rive bran	10.6	8.8	12.3	9.1	5.5	53.7
Oyster shell	5.7	4.4	2.9	3.6	2.6	80.8

Table 3: Water parameter in experimental tank for the duration of the experiment

Parameter	Range	Mean value
pH	8.2-9.6	8.7
Temperature °C	25.8-32.9	30.2
Total ammonia mg/l NH ₃ -N	0.19-4.22	2.65
Total alkalinity mg/l CaCO ₃	279-469	384
Dissolved oxygen mg/l	8.84-12.9	10.8

A summary of the growth performance and nutrient utilization is presented in Table 4. Fish grew well in all treatments except for diets 2 and 1 (100% yellow maize and 100% LBS respectively) that had relatively lower average daily growth (ADG) of 0.5 and 0.55 respectively. Difference in specific growth rate (SGR) were not significantly different between all the diets. Good protein efficiency ratio (PER)

was obtained from all the diets, ranging from 2.03 in diet 2 to 3.05 in diet 5. the PER obtained is considered to be very good when compared to the values (1.70 – 1.83) obtained when Balogun and Fagbenro (1995) fed all male tilapia with macadamia press cake. Fashakin *et al.*, (1999) also obtained lesser PER values (1.7-2.1) when all-male tilapia was fed with duck weed as protein feedstuff.

The carcass composition of the experimental fish showed that the body, viscera and ash were unaffected by the different levels of inclusion of both LBS and yellow maize. This is in line with the observation of Anderson *et al.* (1984). There was however an increase in carcass lipid content within the different diets. This confirms that the dietary lipid was deposited in the body and not completely utilized (Woo and Jib 1986). Variations in carcass composition in the present study were not significant (P>0.05) and the carcass composition is probably due to

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Table 4: Growth response and feed utilization of *O. niloticus* fed varying LBS/yellow maize substitution

	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	± SEM ^b
Mean initial weight (g)	12.6 ^a	12.9 ^a	12.7 ^a	12.7 ^a	12.8 ^a	1.7
Mean final weight (g)	43.2 ^a	41.5 ^b	43.0 ^b	46.5 ^b	46.3 ^a	1.29
ADG ^c (g)	0.55 ^a	0.51 ^a	0.56 ^a	0.60 ^a	0.60 ^a	0.06
SGR ^d (%/day)	2.20 ^b	2.09 ^b	2.21 ^{ab}	2.32 ^{ab}	2.30 ^b	0.04
PER ^e	2.95 ^a	2.03 ^a	2.63 ^a	3.05 ^a	2.46 ^b	0.03
PPV ^f (%)	32.06 ^h	29.63 ^a	31.09 ^a	32.88 ^a	30.61 ^a	1.77
FCR ^g (%)	0.82 ^a	0.94 ^a	0.79 ^a	0.70 ^a	0.85 ^b	0.03
Total digestibility	52.6 ^a	49.3 ^a	52.8 ^a	49.9 ^a	59.1 ^a	
APD ^b	49.7 ^a	54.3 ^a	47.4 ^a	56.7 ^{ab}	44.3 ^a	1.74
Carcass composition						
(%)						
Moisture	80.4 ⁱ	76.7	75.9	78.9	76.4	NS
Protein	12.8 ⁱ	11.7	10.8	12.3	12.1	NS
Lipid	4.9 ⁱ	5.6	5.7	5.3	5.2	NS
Ash	4.4 ⁱ	4.1	4.2	4.2	4.3	NS

^a values in the same row having the same letter are not significantly different ($P > 0.05$)

^b ± SEM denotes standard error of the pooled means

^c Average daily gain; ^d Specific growth rate; ^e Protein efficiency ratio; ^f Protein productive value

^g Feed conversion ratio; ^h Apparent protein digestibility; ⁱ Initial value

NS = Not significantly different ($P > 0.05$); SEM = Standard error of mean.

Diet 2 with 100% yellow maize gave the highest conversion ratio (FCR) of 0.94 while diet 5 with 25% LBS and 75% yellow maize gave the lowest FCR value of 0.70. The highest apparent protein digestibility (APD) value (56%) was obtained from the diet 5 (25% LBS), this was however followed by diet 2 (100% yellow maize), 54.3%, the lowest value (44.3%) was obtained from diet 3 (25% yellow maize).

The carcass composition of the experimental fish showed that the body protein and ash were unaffected by the different levels of inclusion of both LBS and yellow maize. This is in line with the observation of Andseron *et al.*, (1984). There was however an increase in carcass lipid content within the different diets. This probably confirms that the dietary carbohydrate assimilated was deposited as fat and not completely utilized (Wee and Ng, 1986). Variations in carcass analyses at the beginning and the end were not significant ($P > 0.05$) for all the nutrient components, this is probably due to

the fact that all diets contained similar nutrient levels.

The results of this experiment showed that up to 25% of LBS can be incorporated as a replacement for yellow maize in the diets of tilapia as energy source. An equal level of replacement showed a lower performance (ADG) when compared to diets 5 and 3 where different levels of replacement were incorporated. Reduced growth was observed in diets 1 and 2 where 100% of LBS and 100% of yellow maize were used respectively.

Tilapia accepted and utilized these diets better than catfish, when compared to a similar work where these diets were fed to fingerlings of *Clarias gariepinus*, (Akegbejo and Olagunju, 2002). With a higher ADG, SGR and PER, *O. niloticus* performed better than *C. gariepinus*. This confirms the observation of Cowey and Sargent (1979) that some carnivorous fish

species are much less able to metabolize carbohydrate than the herbivores.

Generally, LBS has higher values of crude fibre, ash and moisture content than yellow maize while the crude protein value compare favorably with that of yellow maize. This study showed that inclusion of LBS into fish diets will prove to be highly cost effective when used to replace yellow maize. In addition, results of fish growth (that is ADG and SGR) as shown in diets 3 and 5 reveal that partial replacing yellow maize with LBS is most suitable for fish growth and fish yield. The cost of LBS is glaringly lower than that of yellow maize and hence its substitution is profitable to the fish farmer under the current market conditions. Further more, LBS has no competitive uses and its available throughout the seasons of the year. In Nigeria its use can be encouraged through effective extension network, especially where LBS is currently abandoned in streams and river banks after processing and removal of the beans. Further research is however needed to determine the amino acid profile of LBS and to ascertain the actual level of inclusion of LBS in the practical diet of tilapia.

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