FEED CONVERSION, PROTEIN EFFICIENCY. DIGESTIBILITY AND GROWTH PERFORMANCE OF *Oreochromis niloticus* fed *Delonix regia* Seed Meal

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ABSTRACT
Oreochromis niloticus fingerlings (mean weight- 5.27± 0.29g) were fed raw and boiled Delonix regia seed meals following standard procedures. The weight gain, specific growth rate (SGR). feed conversion ratio (FCR). protein efficiency ratio (PER). net protein utilization (NPU) were determined as growth indices. Diet formulated with seed boiled for 80 minutes showed significantly (P < 0.05) high values for the growth indices. Carcass nutrients composition were significantly (P < 0.05) higher than in the control (raw) diet. Delonix regia seed meal when boiled has high potential of being utilized efficiently by O. niloticus. The implications of the respective index in fish metabolism are discussed.

Key words: Oreochromis niloticus. Delonix regia seed meal, growth indices.

INTRODUCTION

There are increasing needs to investigate and utilize more of the locally available feed stuff for fish feed formulation. Nutrients values estimated from the locally available conventional and non-conventional plant sources are high and would appear to justify continous investigation and utilization of their nutritional potentials to enhance an economic fish production (Okoye and Sule, 2001).

A greater proportion of Nigerian fish supply is derived from capture fisheries which hardly satisfy the demand of the ever growing Nigerian populace. The need to increase fish production through aquaculture is paramount but these desires are drawn back by the high proportional cost of commercial feed (Lovell, 1981). The rapid expansion and success of commercial fish culture therefore depends largely on availability of good quality and cheap feed (Okoye and Sule, 2001). Most commercial feeds are formulated with cereals and protein sources that are largely utilized in human nutrition, hence the high cost of such feeds and uneconomical to aquaculture ventures. *Delonix regia* is an ornamental, leguminous plant which originated from Madagascar (Keay and Standfield. 1964). The plant grows wild and also is domesticated It produces tones of pods and seeds during the fruiting season. all wasted away unutilized.

The proximate and mineral composition of raw and cooked seeds were earlier reported (Biobaku, 1994) while the amino acid composition of fermented seed nuts were also determined (Kaga. 2000). Abdullahi and Abdullahi (2004) further analysed the raw and cooked seeds for the proximate. anti-nutrients and amino acids, the results were encouraging with high nutritional potentials

The high fecundity, survival traits, adaptation to all kinds of aquatic environments and good feed utilization makes *Oreochromis niloticus* a good tool in aquaculture especially where quick returns are desired.

An attempt is being made therefore in this study to document feed utilization and growth performance of *O. niloticus* fed *Delonix regia* seed meal formulated from various levels of heat treatments.

MATERIALS AND METHODS

Delonix regia fruit pods

Mature and dried pods were plucked from the trees in around Ahmadu Bello University, Zaria. The pods were further dried in the open air for 96 hours and then manually crushed with heavy stone. Seeds were collected and further sun-dried for 48 hours and store in 40kg sacks.

Experimental fish

One hundred and twenty *Oreochromis niloticus* fingerlings were procured form Maigana Fish Farm Hatcheries and transported in two large water baths to the laboratory for two weeks acclimatization. They were fed with commercial feed while the water parameters were monitored to avoid large fluctuations

Eperimental diets

Five diets containing varied heat treatments of *Delonix regia* seeds were formulated. The diets contained seeds boiled for 0, 20, 40, 60 and 80 minutes.

The diets were formulated using Pearson Square Method to obtain the desired 35% crude protein level as shown in Table 1.

Table 1. Feed composition for *Oreochromis niloticus*

Feed components	Percentages				
	1 Raw (control)	2 20min	3 40min	4 60min	5 80min
Delonix regia seed meal	29.5	29.5	29.5	29.5	29.5
Blood meal	12.6	12.6	12.6	12.6	12.6
Fish meal	12.6	12.6	12.6	12.6	12.6
Cassava meal	20.1	20.1	20.1	20.1	20.1
Maize meal	20.1	20.1	20.1	20.1	20.1
Red oil	2.0	2.0	2.0	2.0	2.0
Vitamins/minerals premix	2.8	2.8	2.8	2.8	2.8
Chromic oxide (Cr_2O_3)	0.5	0.5	0.5	0.5	0.5
TOTAL	100	100	100	100	100

The *Delonix regia* seeds were milled using commercial hammer into homogeneous powder after drying the boiled seeds in the open air. Appropriate weights calculated from the Pearson square method were taken and mixed up thoroughly. Each diet was mixed with water and manually pelleted, sundried and stored for the feeding experiment.

Experimental set-up

Twelve glass aquaria with 25 litre water capacity were used. Each aquarium measured 45cm x 30cm x 30cm. The water source was the tap-water supply. this was stored in large bath for de-chlorination before use. Oxygen supply was through electric aerator and the aquaria were covered with synthetic nets to prevent fish from jumping out.

The 120 fingerlings were randomly distributed at stocking rate of 10 fish per aquarium. The experimental diets were randomly allocated to duplicate aquaria and labeled. Fish in each tank were weighed at the commencement of the feeding experiments.

Feeding rate and management

The fish were fed at 5% of the total fresh body weight. Daily rations were weighed and split into two and fed twice 8 – 9 am and 4 – 5pm daily. The quantity of ration was gradually adjusted weekly to reflect weight increases. The aquaria were cleaned while the feacal matters were siphoned out before morning feeding. Water levels were maintained and aquaria were washed completely once a week. The aquaria temperature, pH and dissolved oxygen were read off daily and means calculated at the end of the experiment.

Fish measurement

The weight gains of fish in each aquarium were taken weekly. All fish in each aquarium were weighed together on Sortius Top Electric Loading Balance. Average initial and final weights were then calculated

Fish growth and feed utilization.

The percentage weight gain, PWG% (Wannigama *et al.*, 1985). specific growth rate, SGR%/day and feed conversion ratio, FCR (Hepher, 1988), protein efficiency ratio, PER (Wilson 1989). percentage net protein utilization, PNPU (Zeitoun *et al.*, 1973) and digestibility were calculated. Experimental diets and fish body were analsed for the proximate composition using the procedures of AOAC (1990).

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) and Duncan's new Multiple Range Test (Steel and Torie, 1981). Means and standard deviations were calculated following the standard statistical procedures (Miller and Miller, 1986).

RESULTS AND DISCUSSION

The data on aquaria pH, temperature and dissolved oxygen are presented in Table 2 The water temperature varied between 24 to 25 °C. Similar to the room temperature. the pH ranged between 7.1 to 7.8 with the peak in aquaria with the 60 to 80 minutes boiled *D regia* diets. Dissolved oxygen ranged from 4.2 to 8.7ppm with the highest in aquarium with the 40 minutes boiled *D. regia* meal.

Table 2: Temperature. DO and pH of aquaria water during experimentation with *O. niloticus*.

Treatments	Temperature (°C)	pH	DO (ppm)
1	$22 - 25^{a}$	$7.1 - 7.7^{a}$	$4.2 - 5.9^{a}$
2	$22 - 25^{a}$	$7.2 - 7.5^{b}$	$4.5 - 6.0^{b}$
3	$22 - 25^{a}$	$7.4 - 7.5^{b}$	$4.4 - 8.6^{b}$
4	$22 - 25^{a}$	$7.3 - 7.6^{b}$	$4.3 - 8.7^{a}$
5	$22 - 25^{a}$	$7.2 - 7.5^{b}$	$4.6 - 6.1^{a}$
6	$22 - 25^{a}$	$7.4 - 7.8^{a}$	$4.7 - 7.8^{b}$

Figures for same letter superscripts along the column are not significantly different ($p > 0.05$)

Duncan's test.

Water parameters are known to influence the feed availability. feed intake, physiology. growth and development of fish (Boyd, 1979). Calabrese (1969) reported that pH threshold of 6.5 – 9.0 are most suitable for tropical fish production. Similarly pond temperatures of 25 to 30°C and DO of 6.0 – 9.5ppm are most appropriate for optimal growth and development. The values obtained in this study were within the recommended ranges and their growth performance of the experimental fish is expected to be limited by only the formulated diet if the fishes are healthy.

The results of the analysis of the proximate components of the diets are presented in Table 3 The moisture contents were significantly higher ($p < 0.05$) in all diets except the raw (3.88 – 5.65g/100g).

Table 3. Proximate composition (g/100g) of experimental diets fed *O. niloticus*

Components	1 raw(control)	2 20min	3 40min	4 60min.	5 80min
Moisture	3.88[d]	4.9[c]	5.65[b]	5.53[b]	5.12[b]
Ash	8.99[a]	8.25[a]	6.00[b]	11.25[a]	8.90[a]
Crude fibre	14.23[b]	15.01[b]	12.21[a]	15.43[b]	11.95[a]
Crude lipid	3.98[a]	3.25[a]	3.62[a]	4.00[a]	6.25[b]
Crude protein	22.41[a]	22.50[a]	22.45[a]	22.43[a]	22.49[a]
Sub-total	50.14[a]	49.39[a]	41.89[b]	53.70[a]	49.41[a]
NFE + Cr_2O_3	49.86[a]	50.61[a]	58.11[b]	46.30[a]	50.59[a]
Dry matter	94.12[a]	95.10[a]	94.44[a]	96.47[b]	94.88[a]

Figures represent grand means of duplicate determinations.
Figures for same letter superscripts along the row are not significantly different ($p > 0.05$) Duncan's test.

The raw diet may probably be less hygroscopic than the rest. The ash contents ranged from 6.00 to 8.99g/100g, crude fibre 11.95 to 15.43g/100g, crude lipid 3.25 to 6.25g/100g. The crude protein levels were not significantly different ($p > 0.05$) in the formulated diets. The NFE was higher significantly ($p < 0.05$) in the 40minutes boiled seeds. The feed analysis is important because its composition determines what nutrient and what quantity can be available to the feeding fish, the feed consumption, feed conversion and digestibility. In this analysis, the feed composition and protein levels were within the reference values for *O. niloticus* fingerlings.

Weight gain is a good index or factor in measuring fish growth and development in response to experimental diets (Lovell, 1989). In Table 4, the data on weight gain, specific growth rate, feed conversion efficiency, protein efficiency ratio, apparent net protein utilization, digestibility and survival rate are presented.

Table 4. Growth indices of *O. niloticus* fingerlings fed experimental diets

Survival Rate	Diets	Initial mean wt. (IMW)	Final mean wt. (FMW)	Wt. gain (WG)	% Wt. gain (PWG)	Specific Growth Rate (SGR)	Feed Conversion Efficiency (FCE)	Protein Efficiency Ratio (PER)	Apparent Net Protein Utilization (ANPU)	Digestibity
95[a]	Diet 1 raw	5.6±4.74a	8.22±0.35a	2.61a	46.52[a]	1.0046[a]	0.23[a]	0.074[a]	88.90[a]	62.12a[a]
98[a]	Diet 2 (20min)	5.37±2.74a	8.51±1.83a	3.14a	58.47[b]	1.0055[b]	0.14[a]	0.065[a]	77.15[a]	84.23[a]
100[a]	Diet 3 (40min)	5.33±1.47a	8.82±0.49	3.29b	61.73[b]	1.0056[b]	0.12[a]	0.056[a]	61.18[a]	85.12[a]
100[a]	Diet 4 (60min)	5.28±3.04a	8.79±0.21b	3.69b	69.89[b]	1.0063[b]	0.11[a]	0.05[a]	58.40[b]	91.24[b]
100[a]	Diet 5 (80min)	4.91±0.63	9.01±0.97b	4.09b	83.13[b]	1.0072[b]	0.08[b]	0.024[b]	51.04[b]	98.54[b]

The growth parameters were consistently and significantly ($p < 0.05$) increasing towards the 80minutes boiled *D. regia* seed meal. Since the least growth was recorded with the raw meal, it therefore means that the anti-nutrient substances in the seeds reduce with higher period of boiling. This agrees with the report of Abdullahi and Abdullahi (2004) in which anti-nutrients in *D. regia* seeds reduces significantly ($p < 0.05$) with boiling period and subsequently becoming more palatable and consumption increases.

Eighty minutes boiling gave the highest growth performance. Proteins, being the major nutritional factors in growth are usually denatured and destroyed at high temperatures however the values obtained in this study indicated good feed conversion, utilization and protein efficiency. The energy requirement of the fish seemed provided by the diet at such temperatures and therefore proteins were sparred and maximally utilized for tissue protein synthesis. The results are supported by the findings of Shiau and Huang (1989) on the growth of *O. niloticus* in seawater tanks. The feed conversion efficiency compared favourably with those obtained by Jauncey (1982) for *S. mossambicus* and Omoniyi (1995) for *O. niloticus* and *S. galilaeus* and also those reported for Tilapias' by Falaye and Akinbode (1998). The low values of protein efficiency ratio, apparent net protein utilization and digestibility were at low protein levels were equally reported by Hanley (1987); Siddiqui *et al.* (1988) and Omoniyi (1997). The gross body composition of initial and final analyses are shown in Table 5.

Table 5. Carcass proximate composition of *O. niloticus*

Component g/100g dry wt.	Initial composition	Final Composition				
		1(raw)	2(20min)	3(40min)	4(60min)	5(80min)
Ash	28.30	21.41^{a}	25.26^{b}	21.59^{a}	20.11^{a}	17.62^{c}
Lipid	15.70	4.82^{a}	4.96^{a}	3.45^{b}	3.04^{b}	3.45^{b}
Protein	51.21	61.90^{a}	65.22^{b}	64.49^{b}	61.16^{a}	64.19^{b}
Carbohydrate	4.79	11.87^{a}	14.56^{b}	10.47^{a}	15.69^{b}	14.74^{b}

Values with same superscript in the same row are not significantly different ($p > 0.05$) Duncan's test.

The gradual increase in the ash protein and lipid contents indicated utilization of the nutrient contents of the diets. There was a significant decrease ($p < 0.05$) in the ash content with increased boiling period. The minerals probably leached out of the seeds during the boiling. The decrease in the lipid content could be attributed to its being metabolized for energy while the protein and carbohydrate were used for tissue synthesis (Ipinjolu, 200).

CONCLUSION

The results of the growth performance of *O. niloticus* fed varied *D. regia* seed meal indicates that the fish utilized the meal efficiently. *D. regia* seeds could be a good substitute for the cereals which are highly consumed by human. The overall cost of culturing *O. niloticus* can therefore be reduced when *D. regia* seeds are used in feed formulation.

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