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SCREENING OF LEAF MEALS AS FEED SUPPLEMENTS IN THE CULTURE OF *OREOCHROMIS NILOTICUS*

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ABSTRACT

Three leaf meals, *Gliricidia sepium*, cassava (*Manihot esculenta*), and *Stylosanthes humilis* were screened as feed supplements in the culture of the Nile Tilapia, *Oreochromis niloticus*. The experiment had four treatments. Treatment A had *S. humilis* leaf meal incorporated in the feed while treatment B had cassava leaf meal in the feed. Treatment C had *Gliricidia* leaf meal incorporated in the feed while treatment D was made up of feed formulated without leaf meal (control). Proximate analysis of these leaf meals showed that Cassava leaf meal had the highest crude protein content (26.3%) followed by *Gliricidia* leaf meal (22.9%) and *Stylosanthes* leaf meal (19.5%). All the four diets (A – D) were formulated with maize flour, soybean, fish meal, blood meal and the respective leaf meals and crude protein content ranged from 30.57 – 36.42 %. The diets were distributed randomly to twelve experimental units containing *Oreochromis niloticus* fingerlings with mean weight range of 2.40-2.55g and fed for twelve weeks. The feed containing cassava leaf meal (Treatment B) gave the best mean weight gain of 3.50 ± 0.01g followed by the feed with *Gliricidia* leaf meal with a mean weight gain of 2.21 ± 0.06g while the feed with *Stylosanthes* leaf meal and the control gave mean weight gains of 2.05 ± 0.25g and 1.06 ± 0.03g, respectively. Mean weight gain in treatment B (cassava leaves) was significantly higher ($P<0.05$) than mean weight gain in other treatments. Mean growth rate ranged from 0.01 ± 0.006 g/day for the control treatment to 0.04 ± 0.001 for the fish fed Cassava leaf meal diet. Specific growth rate (SGR) was also highest in the treatment with cassava leaf meal (1.07 ± 0.11%/day) and lowest in the control. Protein efficiency ratio (PER) was 0.11 ± 0.004 in Treatment B, 0.07 ± 0.001 in Treatment C, 0.06 ± 0.009 in Treatment A and 0.03 ± 0.001 in the control. The food conversion ratio (FCR) was best with cassava leaf feed (3.71 ± 0.19) followed by *Stylosanthes* (5.51 ± 0.27), *Glyricidia* (6.17 ± 0.22) and the control (9.48 ± 0.58). FCR, SGR and PER for treatment B (cassava leaves) were significantly better ($P<0.05$) than the values for other treatments. Percentage survival ranged from 92% with *Stylosanthes* to 100% with cassava leaf feed. The study showed that leaf meals can be effectively used in the diet of *Oreochromis niloticus*.

Key words: *Gliricidia*, cassava, *stylosanthes*, *Oreochromis*, survival

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INTRODUCTION

Investigations by FAO/WHO have revealed that infant mortality in developing countries, including Nigeria, is as a result of protein deficiency [1]. A possible solution that quickly comes to mind is the exploration of all means for producing cheap and adequate quantity of animal protein at affordable price. Fish has been shown to be the cheapest source of animal protein in Third World Countries [2, 3].

Fish culture is assuming greater popularity as an alternative means to capture fisheries for increasing fish supply due to habitat degradation, over-exploitation and pollution of natural water bodies in developing countries including Nigeria [4, 5, 6].

However, the scale of commercial fish culture is hampered by, among other factors, the non-availability of suitable and cost-effective supplementary feed. Consequently most small-scale and homestead fish farmers resort to the primordial practice of feeding with single ingredient feeds which are usually in meal or bran form. The use of well-compounded pelleted feed considerably increases the profit margin of fish production. However, fish feeds are expensive and can account for over two-thirds of the variable costs in fish culture operations [7]. The demand for the protein components of fish feed for human consumption and for feeding monogastric animals makes the use of non-conventional feedstuff such as farm and industrial by-products to assume greater roles as feed for livestock and fisheries. *Stylosanthes humilis* (common name – Townsville stylo) is used as a cover legume to control weeds and fix nitrogen to the soil in agriculture [8]. It serves as a forage crop for animals like goats, sheep and cattle and has no recorded toxicity. Cassava (*Manihot esculenta*) is a staple food in the tropics and its leaves also serve as forage for animals due to its palatability and high protein content [9]. *Gliricidia sepium* is a fast growing, perennial leguminous tree that supplies year round fodder for animals. It is one of the most popular fodder plants but palatability of the leaves is reduced because they contain anti-nutritional factors like tannins and cyanide coumarins [10]. This experiment is aimed at assessing these leaf meals for use in *Tilapia* feed production.

MATERIALS AND METHODS

The study was conducted at the indoor hatchery complex of National Institute for Freshwater Fisheries Research (NIFFR), New Bussa, Nigeria.

Experimental Unit and Design

Experimental flow-through plastic bowls were used for this study, which lasted twelve weeks. Twelve bowls were used and each was filled with water to a volume of 30 litres. The flow-through system ensured regular supply of filtered water which flushed off some metabolites. The escape of the experimental fish through the system was prevented by covering the bowls with nets of fine mesh size. The bowls were allocated to four treatments in three replicates in a completely randomized design.

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Experimental diet

The three leaf meals used for this study are: *Gliricida*, Cassava and *Stylosanthes*. These were collected around the premises of the Federal College of Freshwater Fisheries Technology and National Institute for Freshwater Fisheries Research, both in New Bussa.

Feed formulation

Fresh leaves of *Stylosanthes humilis*, *Gliricidia sepium* and Cassava (*Manihot esculenta*) were all rinsed with distilled water and dried at 60°C in a drying oven. The dried leaves were finely ground and sieved with a sieve of 0.5mm mesh size. The other feed ingredients were also ground and all the ingredients were subjected to proximate analysis. Each leaf meal was then mixed with other ingredients and put into a manual pelletizer where they were pelletized into feed pellets. The pellets were oven dried at 80°C, allowed to cool and then stored in dry plastic gallons with screw caps after proximate analysis was carried out on each diet.

The compositions of the four experimental diets for the four treatments are shown in table 1.

Stocking and other management procedures

Fingerlings of *O. niloticus* with mean weight range of 2.40g to 2.54g were collected from the integrated poultry-cum-fish culture unit of the institute and acclimated in one of the indoor hatchery tanks for three days. After three days, 30 fingerlings were weighed and stocked into each of the 12 experimental flow-through plastic bowls, which had been filled with clean water to a volume of 30 litres. The treatments and their replicates were randomized to the experimental units (bowls) and the fingerlings were fed at 5% of their body weight, twice daily (7.00 a.m – 8.00 a.m. and 6.00p.m – 7.00 p.m) and seven times a week. Sampling was done weekly to determine the new feeding rate and during sampling, all the fish in each bowl were weighed. The sampling also afforded the opportunity to clean the bowls and remove any uneaten food and other waste materials.

The following water quality parameters were analysed during the experiment: Temperature, pH and dissolved oxygen (DO). Temperature and pH were measured with ATC portable temp/pH meter (model PH-009 III) while DO was measured with HACH dissolved oxygen meter (model 50175). The experiment lasted twelve weeks.

RESULTS

Table 2 shows the results of proximate analysis of fish feed ingredients used in the experiment while table 3 shows the proximate analysis of the fish feed treatments A to D. The growth performance indices, feed utilization parameters and survival of the fingerlings fed the four different diets are shown in table 4. Treatment B (cassava leaves) had the best mean weight gain (3.40g), followed by treatment C (*Gliricidia*) with 2.20g, treatment A (*Stylosanthes*) with 2.05 and lastly the control with mean weight gain of 1.06g. Mean weight gain in treatment B (cassava leaves) was

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significantly higher ($P<0.05$) than mean weight gain in other treatments. While treatments A and C had similar mean weight gains ($P>0.05$), that of treatment D was significantly lower ($P<0.05$). The food conversion ratio (FCR) for the four treatments was least with cassava leaves (3.71), followed by *Stylosanthes* (5.1) and *Gliciridia* (6.17) and highest with the control (9.48), which had no leaf meal. Values for FCR, specific growth rate (SGR) and protein efficiency ratio (PER) for the treatment B (cassava leaves) were significantly better ($P<0.05$) than the values for other treatments. The survival rate of the fingerlings as shown in table 4 is high in all the treatments. It ranged from 92% with *Stylosanthes* to 100% with cassava leaves.
The mean of the water quality parameters for the treatments is shown in Table 5. The water temperature had a narrow range (25.5–26.0 ^{o}C) while the pH ranged from 7.3 to 7.4. Because of the flow-through system, the dissolved oxygen was relatively high in this study (5.3-5.8mg/lit).

DISCUSSION

Results show that fish in treatment B (cassava leaves) had the highest growth rate and this cannot be unconnected with the high percentage protein (about 23.0%) recorded in the young buds of cassava leaves. Fish in treatment B also had the lowest food conversion ratio and this means that they utilize the cassava leaf diet better than the other diets. The control had the highest amount of blood meal and crude protein but gave the least growth. Blood meal is poor in minerals and lysine [11]. However, blood meal is good food for fish if mixed with vegetable meal [12]. The results also show that protein fed in excess of animal needs is deaminated and does not contribute to animal growth [13]. The study seems to confirm that the feed containing the highest amount of blood meal gave the poorest performance in terms of growth and feed conversion ratio [14].

Water temperature was within the range (25-33^{o}C) recommended for optimal growth and survival of Tilapia [15]. The pH was also within the optimum range of 6.5-.9.0 recommended for warm water fish culture [16]. Dissolved oxygen was higher than the lowest recommended level of 1mg/litre for *Tilapia* culture [17]. The high survival could be attributed to good management procedures during the study, proper handling during sampling and conducive physico-chemical parameters within the culture system.

CONCLUSION

In this study, leaf meals were incorporated into the diet of Tilapia (*Oreochromis niloticus*) and tested against the conventional feed (without leaf meal). The leaf meal diets were shown to be acceptable to fingerlings of *Oreochromis niloticus* under laboratory conditions.

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Table 1:Composition of the experimental diets, A –D (g/100g of feed)

INGREDIENTS	A	B	C	D
Fixed ingredients	65.19	65.19	65.19	65.19
Blood meal	23.81	23.81	23.81	33.81
Stylosanthes	10.0	--	--	--
Cassava	--	10.00	--	--
Gliricidia	--	--	10.00	--
Vitamin Premix	1.00	1.00	1.00	1.00

Fixed ingredients consisted of 55.19g maize flour, 3g fish meal and 7g soya bean meal
Treatment D served as the control since it had no leaf meal.

Table 2:Proximate analysis of fish feed ingredients (%)

Parameters	*Stylosanthes*	Cassava	*Gliricidia*	Maize bran	Soybean	Fish meal	Blood meal
Moisture	7.82	5.50	6.7	8.9	6.5	5.7	2.6
Crude protein	19.5	26.3	22.9	10.2	42.3	60.7	82.0
Crude fibre	24.4	19.7	17.15	3.9	7.7	4.4	1.9
Ash	9.6	8.9	6.2	2.3	7.3	18.6	2.2
Crude fat	10.5	7.3	8.8	4.1	8.4	5.9	8.5
NFE	28.18	32.3	31.6	70.6	27.8	4.7	2.8

NFE = Nitrogen free extracts – these are mainly digestible carbohydrates, vitamins and other non-nitrogen soluble organic compounds in feed of feedstuff

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Table 3:Proximate analysis of experimental diets, A-D (%)

Parameters	**A (*Stylosanthes*)**	**B (Cassava)**	**C (*Gliricidia*)**	**D (control)**
Moisture	9.73	8.67	7.77	10.61
Crude protein	30.57	31.25	30.91	36.42
Crude fibre	7.06	5.96	8.40	6.45
Ash	12.30	10.70	11.40	9.10
Crude fat	13.86	14.30	13.94	16.55
NFE	26.48	29.12	27.58	20.87

Table 4: Mean (±SD) growth, feed utilization parameters and survival of fingerlings fed the four different diets for 84 days

TREATMENTS				
Parameters	**A (*Stylosanthes*)**	**B(Cassava)**	**C (*Glircidia*)**	**D (Control)**
Mean initial wt.(g)	2.43 ± 0.03	2.40 ± 0.009	2.55 ± 0.01	2.51 ± 0.07
Mean final wt. (g)	4.48 ± 0.05	5.90 ± 0.02	4.76 ± 0.13	3.57 ± 0.06
Mean wt. gain (g)	2.05 ± 0.25	3.50 ± 0.01	2.21 ± 0.06	1.06 ± 0.03
Food conversion ratio (FCR)	5.51 ± 0.27	3.71 ± 0.19	6.17 ± 0.22	9.48 ± 0.58
Mean Growth Rate, MGR (g/day)	0.02 ± 0.005	0.04 ± 0.001	0.03 ± 0.001	0.01 ± 0.006
Specific growth rate (%/day)	0.73 ± 0.03	1.07 ± 0.11	0.74 ± 0.08	0.42 ± 0.03
Protein efficiency ratio	0.06 ± 0.009	0.11 ± 0.004	0.07 ± 0.001	0.03 ± 0.001
Survival rate (%)	92	100	93	92.3

Food conversion ratio (FCR) = food eaten/weight gain
Mean growth rate (MGR) = weight gain/Time (days)
Specific growth rate = (ln final weight – ln initial weight/84 days) x 100
Protein efficiency ratio = weight gain/crude protein fed

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Table 5:Summary of Water quality parameters during the study period

Parameters	Minimum	Maximum	Mean ± SD
Temperature (^{o}C)	25.5	26.0	25.7 ± 0.54
Ph	7.3	7.4	7.3 ± 0.84
DO (mg/lit)	5.3	5.8	5.6 ± 0.33

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