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A COMPARATIVE STUDY OF *VIGNA UNGUICULATA* BEAN MEAL WITH TWO LEGUME LEAF MEALS AS PARTIAL SUBSTITUTES FOR GROUNDNUT CAKE IN *CHRYSICHTHYS NIGRODIGITATUS* FEED

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ABSTRACT

To find the best substitute for groundnut cake in feed for *Chrysichthys nigrodigitatus* (Lacépède), the fish were fed with control feed which contained 40% groundnut cake, and their performances were compared to those fed with three different feeds in which one half of the quantity of groundnut cake in the control was substituted respectively with *Vigna unguiculata* bean meal, *Calapogonium mucunoides* leaf meal and *Centosema pubescens* leaf meal. Even though there was no significant difference among feeds ($P > 0.05$), the feed with *C. mucunoides* leaf meal induced 23.7% weight gain, 0.70% specific growth rate and gave 2.18 feed conversion rate which were superior to those obtained from the others, including the control feed. It is, therefore, recommended that farmers incorporate *C. mucunoides* leaf meal in feeds for *C. nigrodigitatus* to enhance its growth.

Keywords: Groundnut cake, substitutes, bean meal, leaf meals, catfish feed.

INTRODUCTION

Groundnut (*Arachis hypogaea* Linn) cake and soyabean (*Glycin max*) meal provide the bulk of protein and energy in feeds (Oyenuga 1968). Increasing demand for these conventional feed components had rendered them scarce and expensive, creating a need for cheaper substitute. Ipil-ipil leaf meal, used as a substitute for rice bran in fish feed increased both the growth rate and muscle protein content of *Tilapia mossambica* proportionally as the level of the leaf meal increased in the diet (Plantastico and Baldia 1979). Similarly, Johansson *et al* (1991) reported improved meat quality and greater growth of rainbow trout on addition of leaf nutrient concentrate to its diet. This background information points to the fact that the local leaf products can successfully substitute groundnut cake. Cowpea (*Vigna unguiculata*) meal, *Calapogonium mucunoides* and *Centrosema pubescens* leaf meals are readily available for such studies.

The cowpea seed is cultivated in Nigeria primarily for human consumption but a good proportion of it is used as concentrate to supplement groundnut cake in live-stock feeds (Oyenuga 1968) because of its high nutritive value. Cowpea contains 24.67% crude protein, 60.62% carbohydrate and 2.46% lipid (Oyenuga 1968). This bean seed contains all the essential amino acids in sufficient amount to enhance growth (Oyenuga 1968). Cowpea also has a fair amount of thiamine, niacin, riboflavin and carotine (Oyenuga 1968). It is fairly rich in phosphorus, calcium, and iron while majority of trace elements are present (Oyenuga 1968).

The legumes *Calapogonium mucunoides* and *Centrosema pubescens* are cover crops which grow luxuriantly in Southern Nigeria where they are used in feeding rabbits and other ruminants. *Calapogonium mucunoides* is also used as supplement in poultry feed (personal observation). Apparently, the nutritional values of these leaves have not been investigated but proximate analysis in the course of this present study shows that *C. mucunoides* contains 28.35% crude protein and 5.92% ether extract, while *C. pubescens* contains 28.7% crude protein and 4.98% ether extract.

Highly valued as food fish, the silver catfish, (*Chrysichthys nigrodigitatus*) is gaining attention as an aquaculture material in West Africa (Ezenwa 1982; Obiekezie and Enyenihi 1988; Ekanem 1992). Even though Ezenwa (1982) obtained a satisfactory result when he used only groundnut cake to feed the fish, the growth of this species could be enhanced by using a more economical and efficient feed. It was for this reason that this study was undertaken to determine the effects of partial substitution of groundnut cake with cowpea meal, *C. mucunoides* and *C. pubescens* leaf meal on the growth and development of *C. nigrodigitatus*.

MATERIALS AND METHODS

This study was conducted in earthen freshwater ponds at the Institute of Oceanography, Aquaculture Unit, in the University of Calabar, Nigeria. Three ponds were used for the study. Each pond was stocked with fish at the rate of 9444 fish/ha (i.e. 33 fish were stocked in 4m x 9m pond). The mean weight of the fish was 163.5g. The fish were bought from local fishermen and acclimatized in freshwater pond for one month before use in the experiment.

The control feed was compounded as follows: 40% groundnut cake, 29% maize meal, 14.7% fish meal, 4.0% palm oil, 9.0% blood meal and 3.3% mineral/vitamin premix. In the substitute feeds, 20% of groundnut cake in the control feed was replaced each with *Vigna unguiculata* bean meal, *C. mucunoides* leaf meal and *C. pubescens* leaf meal. The cowpea bean meal was obtained from beans cooked for 50 minutes,

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washed and mashed into meal and oven-dried at 30°C. Cooking and washing of the beans were done to remove anti-nutrients or growth inhibitors (Ogun *et al* 1989). To obtain each leaf meal, the leaves were sun-dried and ground into powder. All components of each feed were mixed together and sufficient water was added till a paste of workable consistency was obtained. After mixing thoroughly, the dough was spread on aluminum foil and dried in the oven at 30°C for 12 hours before being used to feed the fish. A new batch of feed was prepared fortnightly.

Each feed was fed separately to each pond containing 33 fish. Feeding commenced a day after stocking and ceased a day before the termination of the experiment. The experiment lasted for 60 days. The fish were fed at the rate of 5% of their body weight once every other day at 10 a.m. This feeding schedule was found to be best for the fish in terms of water quality (Ekanem 1996).

Total length and weight of individual fish were measured at the commencement and at the end of the experiment, and the data obtained were used in calculating the initial and final Fulton's condition factor (F), percentage weight gain, daily weight gain, specific growth rate, as well as feed conversion rate for each treatment.

The formula used for calculating Fulton's condition factor (F) was:

$$F = \frac{100\ W}{L^3} \quad \text{(Ricker 1975)}$$

where W and L are weight (g) and length (cm) of the fish respectively.

Percentage weight gain was obtained as:

$$\frac{\text{Weight gained} \times 100}{\text{Initial weight}}$$

Daily weight gain per gram weight of fish was obtained from the formula:

$$DW = \frac{W_t - W_o}{W_o\ (t)}$$

where DW is the average daily weight gain in live weight per gram of fish expressed as gram/gram (gg^{-1}).

W_t and W_o are final and initial live weight of the fish.

Specific growth rate (SGR) was calculate with the formula:

$$SGR\ (\%) = \frac{\ln W_t - \ln W_o \times 100}{t} \quad \text{(Viola } et\ al \text{ 1988)}$$

where ln is the natural logarithm, W_t and W_o are final and initial weights, respectively; t represents the 60 days the experiment lasted.

Feed conversion rate (FCR) was calculated thus:

$$FCR = \frac{\text{Total weight of dry feed offered (g)}}{\text{Total live weight gained by fish (g)}}$$

Analysis of variance was conducted to determine if there were significant differences in growth among treatment at 5% level.

RESULTS

Table 1 shows the initial and final conditions, growth and feed conversion rates of fish fed with feeds which contained groundnut cake and its partial substitutes. Improved conditions were noted in all treatments. Fish fed on feed which contained *C. mucunoides* exhibited the best growth as evidenced by 23.7% weight gain and 0.70% specific growth rate. This feed was superior to the others by producing the best feed conversion rate and the highest condition factor, while feed with *C. pubescens* was the worst in these aspects. The control feed and feed with *V.unguiculata* were similar in many aspects.

Although no significant difference ($P > 0.05$) was detected in growth among treatments, feed with *C. mucunoides* was outstanding in aspects mentioned above. Compared to the control feed which stimulated 17.85% weight gain and 0.53% specific growth rate, feed with *C. mucunoides* leaf meal was superior (Table 1).

DISCUSSION

Improved condition noticed in all treatments which was derived from length and weight of fish at the beginning and end of the experiment, showed that every feed supported growth but at varying rates. A superior growth was obtained from the feed which contain *C. mucunoides* contrary to expectation. The crude protein content of 51.4% and 10.16% ether extract found in groundnut cake (Oyenuga 1968) gives the control feed more energy that should make it stimulate greater growth than any food with the partial substitute. *C. mucunoides* contains 28.35% crude protein and 5.92% ether extract, *C. pubescens* contains 28.70% crude protein and 4.98% lipid (Ekanem unpublished), while *V. unguiculata* meal contains 24.67% crude protein and 2.46% ether extract (Oyenuga 1968), all of which are less in energy content than groundnut cake. For a food of less energy value to stimulate greater growth as in the case of feed with *C. mucunoides*, it must contain other growth stimulating substance which needs to be identified.

This study has demonstrated that C. mucunoides leaf meal can be used as a partial substitute for groundnut cake to stimulate the growth of *C. nigrodigitatus* and reduce cost of feed production. *C. mucunoides* leaf meal has done more to *C. nigrodigitatus* than ipil-ipil leaf did to *Tilapia mossambica* (Pantastico and Baldia 1979) by improving the food conversion rate in addition to stimulating its growth.

A feed conversion rate of 4.23 obtained from the feed which contained *C. pubescens* was the highest, but considering specific growth rate and percentage weight gains, this feed was superior to the control, suggesting that the leaf can be used as a substitute for groundnut cake in the absence of *C. mucunoides* since it also reduces the quantity of groundnut cake needed.

Poor growth obtained from feed with *V. unguiculata* bean meal could have been caused by growth inhibitors found in beans (Udedibie 1990). Although cooking

TABLE 1: EFFECTS OF FOUR FEED MEALS ON THE GROWTH, CONDITION AND FEED CONVERSION RATE OF *C. NIGRODIGITATUS*

Feed meal	Mean Condition Factor		Weight Gain (%)	Daily Weight Gain (gg^{-1})	Feed Conversion Rate	Specific Growth Rate (%)
	Initial	Final				
20% Groundnut cake plus 20% *Vigna unguiculata* beans meal	1.32	2.19	16.62	0.0055	3.92	0.51
20% Groundnut cake plus 20% *Calapogonium mucunoides* leaf meal	1.32	2.26	23.70	0.0079	2.18	0.70
20% Groundnut cake plus 20% *Centrosema pubescens* leaf meal	1.32	2.03	18.44	0.0061	4.23	0.56
Control with 40% Groundnut cake	1.32	2.12	17.85	0.0063	3.90	0.53

No significant difference ($P > 0.05$).

might have removed the thermolabile growth inhibitors, thermostable anti-nutritional agents could still remain to hinder nutrient absorption and utilization and hence, depress growth of the fish on this feed. *Vigna unguiculata* should therefore be avoided in the formulation of feed for this species.

Findings from this study indicate that farmers can obtain greater growth of *C. nigrodigitatus* by incorporating *C. mucunoides* leaf meal into feed for this species.

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