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Replacement Value of Soybean Meal with Luffa cylindrical in Diet of Clarias gariepinus Fingerlings

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Abstract

The study investigated the effects of replacing soybean meal with Luffa cylindrical seed meal on the growth performance of Clarias gariepinus fingerlings. Five isonitrogenous diets containing soybean meal which was replaced by Luffa cylindrica at a rate of 15, 30, 45 and 60% levels were formulated. The diets without Luffa cylindrical seed meal served as the control. Experimental diets were assigned randomly to the fish in tanks and each group of fish was fed at 5% of body weight in equal proportions twice daily. There were significant (P,0.05) decreases in growth and nutrient utilization parameters of fish fed different dietary treatments containing 30 to 60 % levels of Luffa cylindrical seed meal. However, there were no significant (P>0.05) variations in growth and nutrient utilization parameters of fish fed the control diet and those fed diet containing 15% Luffah cylindrica.

Keywords:

Introduction

Oilseed cake and legume seeds are considered suitable as alternative dietary protein sources for fish feed and are available in sub-saharan Africa on a large scale (Fagbenro *et al.*, 2003). Soybean meal (SBM) is one of the most nutritious of all plant protein sources (Lovell, 1988). Due to its high protein content, high digestibility and relatively well balanced amino acid profile, it is widely used as feed ingredient for many aquaculture species (Storebakken *et al.*, 2000). Currently, it is the most commonly used plant protein source in fish feed (El-sayed, 1999). Lim and Akiyama (1992) reported that soybean products have been used to replace a significant portion of fish meal in fish feed with nutritional, environmental and economic benefits. However, wider utilization and availability of this conventional source for fish feed is limited by increasing demand for human consumption and by other animal feed industries (Siddhuraju and Becker, 2001), This phenomenon, according to Balogun (1988), has hindered the expansion and profitability of aquaculture enterprises in many developing countries. This has encouraged the need to look for cheaper alternative protein sources for the development of low- cost feeds that can replace the conventional ones without reducing the nutritional quality of the diets. Hence the need to focus on using less expensive and readily available plant protein sources to replace soybean meal without reducing the nutritional quality of fish feeds (Barros *et al.*, 2002). Researchers have mostly focused on the under-utilized plant protein sources in fish diet. Prominent among these, are Lima bean (Adeparusi and Ajayi, 2004), Pigeon pea (Adeparusi, 1994), jackbean (Fagbenro *et al.,* 2007; Jimoh *et al.*, 2010) sunflower and sesame (Fagbenro *et al.*, 2010 a; b and c);

Smooth luffa syn. Dishrag gourd (*Luffa cylindrica* L. syn. *Luffa acgyptica*) is a family of Cucurbitaceae. It is a tropical running vine with rounded leaves and yellow flowers. It is a herbaceous plant and thrives commonly with twinning tendrils (Ajiwe *et al*., 2005).They have nutritional quality comparable to other oilseed proteins, including soybean and other conventional legumes (Oshodi e*t al.*, 1993; Sanchez-Vioque e*t al.*, 1998). However, there is paucity of information on the use of *Luffa cylindrica* seeds as dietary protein source of fish meal. This work therefore examined the use of *Luffah cylindrical* seedmeal as a soybean meal replacer in diet for fingerlings of African catfish, *Clarias gariepinus.*

Materials and Methods

The experiment was conducted in the Fish Nutrition Laboratory of Federal College of Animal Health and production Technology, Ibadan.

Sources and Processing of Ingredients.

One (1) kg samples of matured dried *Luffa cylindrica* were collected from one uncompleted building at Ijebu-ode, Ogun State, Nigeria. They were cooked in boiling water for 10 minutes and ground in a hammer mill. The oil was removed using the pressure generated from locally made screw press (cassava-presser type). The cakes were thereafter analyzed for their proximate composition (AOAC, 1990). Fish meal, soybean meal and other feedstuffs obtained from commercial sources in Nigeria were separately milled, and triplicate samples were analyzed for their proximate composition (AOAC, 1990). Based on the nutrient composition of the feedstuffs (Table 1), a control diet and four test diets (40% crude Protein, 12% crude Lipid) were formulated. The control diet contained soybean meal, providing 50% of the total protein which was replaced by cooked *Luffa cylindrica* seed meal. The levels of substitution of soybean meal were 15, 30, 45, and 60 %.

Table 1: Proximate composition of the feed ingredients

Parameter	Fish meal	Soybean Meal	LCM	Corn Meal
Moisture	9.75	10.70	9.69	10.48
Crude protein	72.4	45.74	38.17	9.87
Crude lipid	10.45	9.68	13.64	4.28
Crude fibre	-	5.10	1.95	5.78
Ash	8.32	4.48	8.88	6.73
NFE	-	30.00	28.68	62.35

LCM = *Luffah cylindrica* meal

Table 2: Gross compositions of experimental diets (g/100g) containing *L. cylindrical* seed-meal fed to *Clarias gariepinus* fingerlings

	D1	D2	D3	D4	D5
Fishmeal (72%)	26.10	26.10	26.10	26.10	26.10
Soybean meal (45%)	44.45	37.80	31.10	24.44	17.78
LCM(38%)	0	7.90	15.80	23.70	31.60
Corn meal (10%)	12.00	12.00	12.00	12.00	12.00
Fish Oil	5.00	5.00	5.00	5.00	5.00
*Vit/min premix	5.00	5.00	5.00	5.00	5.00
Starch	7.45	6.20	5.00	3.76	2.52

***** *Specification: each kg contains: Vitamin A , 4,000,000IU; Vitamin B, 800,000IU; Vitamin E, 16,000mg, Vitamin K_3, 800mg; Vitamin B_1, 600mg; Vitamin B_2, 2,000mg; Vitamin B_6, 1,600mg, Vitamin B_{12},8mg; Niacin,16,000mg; Caplan, 4,000mg; Folic Acid, 400mg; Biotin, 40mg; Antioxidant 40,000mg; Chlorine chloride, 120,000mg; Manganese, 32,000mg; Iron 16,000mg; Zinc, 24,000mg; Copper 32,000mg; Iodine 320mg; Cobalt,120mg; Selenium, 800mg manufactured by DSM Nutritional products Europe Limited, Basle, Switzerland.*

Culture Condition

Clarias gariepinus fingerlings were acclimatized to experimental conditions for 7 days prior to the feeding trial. Groups of 10 catfish fingerlings, weighing 9.55±0.008g each on the average, were stocked into aquaria comprising of 60 litre-capacity rectangular plastic tanks. Each diet was fed to the catfish in triplicate tanks twice daily (09.00h, 16.00h) at 5% of body weight for 56 days. Fish mortality was monitored daily, total fish weight in each tank was determined at two week-intervals and the amount of diet was adjusted according to the new weight. Growth response and feed utilization indices were estimated following the method of Jimoh and Aroyehun (2011). Water temperature and dissolved oxygen were measured using a combined digital YSI dissolved oxygen meter (YSI Model 57, Yellow Spring Ohio); pH was monitored weekly using pH meter (Mettler Toledo – 320, Jenway UK). Eight catfish and 6 catfish per treatment were respectively sacrificed at the beginning and end of the feeding trial respectively and analyzed for their carcass composition (AOAC, 1990).

Statistical analysis

Data obtained from the experiment were subjected to one way Analysis of Variance (ANOVA) using SPSS 16.0 version. Where the ANOVA revealed significant differences ($P<0.05$), Duncan's New Multiple Range Test was used to compare differences among individual treatment means.

Results

Table 3 shows the proximate composition of the experimental diets. The diets were isonitrogenous and isolipidic as there they contained comparable crude protein and crude lipid levels. The respective protein and lipid requirements of 40 and 12% for *Clarias gariepinus* fingerlings were met by the protein and lipid levels in the experimental diets. All the fish responded well to the dietary treatments given to them.

Table 3: Proximate contents (±SD) of the experimental diets containing *L. cylindrical* seed-meal fed to *Clarias gariepinus* fingerlings

	D1	D2	D3	D4	D5
Moisture	9.17±0.09	9.64±0.52	9.17±0.85	9.35±0.19	9.30±0.27
Crude protein	40.15±0.05	40.15±0.02	40.13±0.02	40.16±0.09	40.13±0.04
Crude lipid	12.09±0.01	12.07±0.05	12.19±0.05	12.09±0.02	12.23±0.028
Crude fibre	5.54±0.71	5.04±0.04	5.06±0.02	5.31±0.04	5.57±0.30
Ash	4.99±0.02	5.17±1.33	5.76±0.66	5.54±0.35	5.54±0.41
NFE	28.06±0.68	27.64±2.39	27.79±0.84	27.56±0.31	27.24±0.73

^{abc}Means with different superscripts along the same row are significantly different (P<0.05)

Carcass Composition of the fish

Table 4 shows the carcass composition of *Clarias gariepinus* after being fed diets containing various levels of *Luffa cylindrica* seed meal for 56 days. Diet 1 produced the highest carcass protein while fish on the control diet had the lowest carcass protein, which was significantly lower (P<0.05) than the values for the other dietary treatments. However, there was no significantly difference (P>0.05) between fish fed diet D1 and fish fed diet D2. There was also no significantly difference (P>0.05) existed between fish fed diets diet D4 and diet D5.

Table 4: Carcass Composition of *Clarias gariepinus* fed diets containing *Luffah Cylindrical* seedmeal.

	Initial	**D1**	**D2**	**D3**	**D4**	**D5**
Moisture	77.01±0.01	75.50±1.69	75.80±0.85	76.40±1.69	77.25±0.49	76.90±0.14
Crude Protein	15.11±0.14^{C}	17.09±0.30^{a}	16.87±0.78^{a}	16.20±0.31^{b}	16.16±0.33^{b}	15.89±0.06^{b}
Crude lipid	3.13±0.18	3.29±1.27	3.14±0.69	3.11±1.44	3.67±0.98	4.20±0.14
Ash	4.89±0.15^{a}	4.12±0.13^{b}	4.20±0.08^{b}	4.29±0.05^{b}	2.93±0.63^{c}	3.02±0.64^{c}

^{abc}Means with different superscript along the same row are significantly different (p<0.05) from one another

Growth and nutrient utilization

The growth and nutrient utilization of *Clarias gariepinus* fed diets containing *Luffa cylindrica* seed meal are shown in Table 5. Significant variations (P<0.05) existed in all the parameters that were considered across all the dietary treatments. There were however no significant differences (P>0.05) in the weight gain, percentage weight gain, specific growth rate, feed intake, feed conversion ratio between the fish fed control diet (D1) and the fish fed diet D2. A decrease in growth and nutrient utilization parameters of fish fed various dietary treatments was observed as the level of *Luffa cylindrica* seed-meal increased.

Table 5: Growth and nutrient utilization of *Clarias gariepinus* Fed Diets Containing *Luffa cylindrical* Seedmeal.

	D1	D2	D3	D4	D5
Initial Weight	9.54±0.014	9.56±0.0071	9.55±0.021	9.55±0.0071	9.54±0.014
Final Weight	16.51±0.18[a]	16.38±0.071[a]	15.41±0.35[b]	14.55±0.18[c]	14.19±0.049[d]
Weight Gain	6.97±0.16[a]	6.82±0.064[a]	5.86±0.057[b]	5.01±0.18[c]	4.66±0.035[d]
Percentage Weight Gain	73.01±1.59[a]	71.43±0.62[a]	61.39±0.73[b]	52.44±1.82[c]	48.79±0.30[d]
Specific Growth Rate	0.98±0.014[a]	0.97±0.0071[a]	0.86±0.0071[b]	0.756±0.21[c]	0.71±0.00[d]
Feed Intake	8.61±0.25[a]	8.33±0.71[a]	7.59±0.11[b]	6.28±0.16[c]	6.36±0.049[c]
Feed Conversion Ratio	1.24±0.0071[c]	1.24±0.028[c]	1.29±0.0071[b]	1.30±0.14[b]	1.37±0.21[a]
Protein Intake	3.44±0.99[a]	3.33±0.028[a]	3.04±0.049[b]	2.51±0.071[c]	2.55±0.21[c]
Protein efficiency ratio	202.49±1.096[a]	204.95±0.169[a]	193.090±1.29[ab]	199.59±12.66[a]	182.92±2.91[b]
Net Protein utilization	0.58±0.064[a]	0.53±0.064[ab]	0.36±0.057[bc]	0.42±0.064[abc]	0.31±0.078[c]
Percentage survival	100.00±0.00[a]	100.00±0.00[a]	99.00±1.41[a]	96.00±1.41[b]	94.00±1.41[b]

[abc]Means with different superscript along the same row are significantly different ($p<0.05$) from one another

Discussion

The results of the proximate analysis of the diets showed that the diets were iso-nitrogenous. The protein and lipid requirements of *Clarias gariepinus* were met by the quantities provided in the diet. Uys and Hecht (1985) reported that the best growth rate and feed conversion efficiency in juvenile and sub-adult *Clarias gariepinus* are achieved with diets containing 38 - 42% crude protein and lipid content of 10 -11%. The values of the physico-chemical parameters of the water used for the experiment were within the optimum range for the normal physiological functioning of not only *Clarias gariepinus* but all warm water fishes (Lazo and Davies, 2000). These researchers reported that experimental culture system must be suitably designed to allow maximum growth of fish and provide adequate water quality throughout the experiment.

A reduction in growth and feed conversion ratio as the *Luffa cylindrical* seed meal increased beyond 25% was observed. This growth reduction observed at higher inclusion levels of *Luffa cylindrical* seed meal could be related, not only to dietary amino acid profile, but also to the presence of anti-nutritional factors or high fibre levels. This observation agrees with the findings of Jimoh and Aroyehun (2011) for *Clarias gariepinus* fed sesame seedmeal-based diet. Davies *et al.*, (1999; 2000) reported that higher inclusion levels of certain oilseed meals resulted in poor growth and nutrient utilization by *Oreochromis niloticus.* Francis *et al. (*2001) explained that at a lower level of inclusion, a physiological mechanism exists in fish that could compensate for the presence of the anti-nutrients; hence their negative effect may not be felt. However, at higher levels of inclusion, when the limit might have been exceeded, the negative effects of the anti-nutrients would manifest. This possibly explains why at lower levels of inclusion of these meals, the growth and nutrient utilization of fish fed this cooked *Luffa cylindrical* seedmeal were comparable to that of control.

Conclusion

The results of this strudy showed that it is possible to replace soybean meal in the diet of *Clarias gariepinus* fingerlings with cooked *Luffa cylindrical* seed meal, with optimum growth response at a 15% replacement level.

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