Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2018, 5(8):211-216**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Replacement of Soyabean Meal with Dietary Lablab Bean Meal (*lablab purpureus*) in the Diet of Clariid Catfish (*Clarias gariepinus*) Fingerlings

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Abstract This study examined the replacement of soyabean meal with lablab bean meal (LBM) in the practical diets of Clariid catfish (*Clarias gariepinus*). Five Iso-nitrogenous diets containing varying levels of ground toasted lablab bean were formulated accordingly; T_1 (10% LBM), T_2 (20% LBM); T_3 (30% LBM); T_4 (40% LBM) and T_5 (50% LBM) as a replacement for soyabean meal and were fed to three replicate of *Clarias gariepinus* fingerlings with an initial mean weight of 1.65±0.01g. T_1 (10%LBM) recorded the best growth rate ($p<0.05$) as it had the highest value of weight gain (1.79), feed intake(2.75), feed conversion ratio (1.54), relative weight gain of 7.29, specific growth rate of 1.69, protein efficiency ratio (57.61) and survival rate (97.33%). As the concentration of LBM in the diet increased, growth parameters decreased markedly, and this was attributed to the build-up of antinutrient factors which rendered the diet unpalatable and reduced its efficiency. Therefore, Lablab bean meal can partially replace soyabean and will be best at 10% level of replacement in diets of *Clarias gariepinus* without compromising the growth and carcass composition.

Keywords Lablab meal, replacement of soyabean, lablab vs soyabean and non-conventional feedstuff

Introduction

The nutritional benefits of fish and fish oil consumption on human health are vast and include the prevention of cancer, diabetes and heart diseases [1,2]. As public awareness about the health benefits of fish consumption continues to increase, the global demand for aquatic foods is also expected to continue to rise [3]. Aquaculture is recognized as the only way to meet these increasing demands for aquatic foods [4]. As a result, world aquaculture production has increased steadily from 49.9 million tonnes in 2007 to 73.8 million tonnes in 2014 [5]. Although aquaculture activities in Nigeria started about 50 years ago [6], the country still has not succeeded in attaining fish–food sufficiency [7]. Several factors are responsible for this slow growth of aquaculture in the country with high cost of feed being a major constraint as many farmers are still reliant on the "costly, mostly imported, pelleted, floating feed" as reported by [8]. Utilization of such commercially formulated feeds increases the cost of production thereby reducing the profit margin of fish farmers, thereby making aquaculture less desirable. This has led to local feed formulation by farmers. In Nigeria, some of the alternative plant protein sources that have been extensively investigated for possible use as ingredients in fish feed formulation are legumes which include; Jackbean [9]; Bambara nut [10]; Lablab bean [11]; Senna seed [12] and Locust bean [13] Fish of the species *Clarias* belongs to the catfish family Clariidae which is widely distributed in Africa and parts of Asia. There are about 13genera in this family [14]. *Clarias* species are among the well-priced and most accepted culturable fish species because of their good taste, fast growth and ability to withstand adverse conditions in shallow ditches and small ponds [15]. *Clarias* species has advantages over *Hetorobranchus* species as they mature earlier (5 – 9 months) and have higher fecundity [16]. *Lablab purpureus* is a species of bean in the family Fabaceae. It is native to Africa and it is cultivated throughout the tropics for food. Common names include hyacinth bean lablab-bean, bonavist bean/pea, dolichos bean, seim bean, lablab bean, Egyptian kidney bean, Indian bean, bataw and Australian pea. It is the only species in the monotypic genus Lablab. The plant is variable due to extensive breeding in cultivation, but in general, they are annual or short-lived perennial vines. The wild species is perennial. The main purpose of this research therefore, was to investigate how the legume, *Lablab* bean can be used as a good replacement for soybean in the diet of C*larias gariepinus* fingerlings.

Materials and Methods

The research work was carried out at the laboratory of the Department of Aquaculture and Fisheries Management, Faculty of Agriculture, University of Benin, Benin-city, Edo State.

Experimental Diets

The lablab beans (LB) were toasted for about 25 minutes to destroy the presence of the anti-nutritional factors (such as tannins, phytate and trypsin inhibitor), which are readily destroyed by heat. The toasted beans were then ground and sieved finely to yield the lablab bean meal. Fishmeal, soybeans cake, corn meal, palm oil, Vitamin E-gel and bone meal were purchased from a retail outlet at Murtala Mohammed Way in Benin City. The composition of the experimental diets is shown in Table 1.

Table 1: Composition of the Experimental Diets

Ingredients	T_1	T_2	T_3	T_4	T_5
% replacement of Lablab	10%	20%	30%	40%	50%
LBM	10.00	20.00	30.00	40.00	50.00
Fish crumbs (50% CP)	25.40	25.40	25.40	25.40	25.40
SBC (48.0% CP)	42.00	32.00	22.00	12.00	2.00
Yellow maize (9.5% CP)	10.00	10.00	10.00	10.00	10.00
Palm oil	8.00	8.00	8.00	8.00	8.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Vitamin premix	0.60	0.60	0.60	0.60	0.60

The feed ingredients with the LBM were milled, mixed, the maize was gelatinized and used as binder, then pelleted and stored the feed in a cool, dry place.

Feeding Trial

Five fishes were weighed into each of the experimental units replicated thrice for each treatment. They were fed twice daily to satiation to ensure maximum growth between 08:00hrs and 16:00hrs. Feeding was monitored for each unit to ensure that fishes were not underfed or overfed. The experimental units were cleaned by total changing of the water daily. All fishes tanks were weighed and counted weekly to determine growth and survival, also the weekly weighing of feed was also carried out.

Data Analysis

The data obtained from the feeding trials were tested for significant differences using one way Analysis of Variance (ANOVA) test and the means were separated using Duncan's Multiple Range Test, all at 5% level of significance.

Parameters Monitored

Data on feed consumed and weight gain were collected weekly for each unit from which the following performance parameters were evaluated.

1. Weight gain (WG) = $W_2 - W_{1\,(g)}$ Where; W_1 = initial weight
   W_2 = final weight
2. Feed intake = Initial weight of feed – Final weight of feed
3. Specific growth rate per day (SGR) % = $\frac{\text{Loge W2} - \text{loge W1}}{\text{T2} - \text{T1}}$ X 100
   Where: T_1 and T_2 are time of experiment in days.
   W_2 = final weight at T_2

W_1 = initial weight at T_1
Loge = natural logarithm.

4. Relative weight gain (PWG) % = $\frac{\text{Weight Gain}}{\text{Initial Weight}}$ X 100
5. Food conversion ratio (FCR) = $\frac{\text{Feed Intake (g)}}{\text{Wet Weight Gain (g)}}$ X 100
6. Protein efficiency ratio (PER) = $\frac{\text{Weight Gain (g)}}{\text{Protein Intake}}$ X 100
7. Survival rate % = $\frac{\text{Initial stocked} - \text{mortality}}{\text{Initial stocked}}$ X 100

Result

Result showed that Weight Gain by *Clarias gariepinus* fingerlings after ten weeks was significantly higher ($P<0.05$) in T_1 (1.79) while T_5 (0.35) recorded the least value and was significantly depressed ($P<0.05$).

Table 2: Growth performance and feed utilization of Clariid catfish, (*Clarias gariepinus*) to lablab meal (LBM) based diet

Parameters	T_1 (10% LBM)	T_2 20% LBM)	T_3 (30% LBM)	T_4 (40% LBM)	T_5 (50% LBM)	SEM
Weight Gain(g)	1.79^a	1.24^b	1.02^{bc}	0.41^c	0.35^c	0.14
Specific Growth Rate (%/day)	1.69^a	1.16^b	0.80^c	0.32^d	0.27^d	0.31
Relative Weight Gain (%)	7.29^a	3.34^b	0.62^{bc}	0.54^{bc}	0.08^c	1.87
Protein Efficiency ratio	57.61^a	54.17^a	46.15^b	16.90^c	16.23^c	12.22
Feed Intake (g)	2.75^a	2.23^b	2.19^b	1.51^c	1.53^c	0.16
Feed Conversion Ratio	1.54^a	1.80^a	2.15^b	3.68^c	4.37^d	1.94
Survival Rate (%)	97.33^a	83.33^b	88.66^b	68.66^c	54.03^d	3.53

N/B: Mean Values with the same superscript on the same row are not significantly different, ($P> 0.05$)

The Specific growth rate was significantly higher ($P<0.05$) in T_1 (1.69). There was no significant difference ($P>0.05$) between T_4 (0.32) and T_5 (0.27). The Relative Weight Gain of fish fed with 10% LBM (7.29) was significantly superior ($P<0.05$) among all treatments. There was no significant difference in fish fed 30% LBM (0.62) and 40% LBM (0.54), while fish fed with 50% LBM (0.08) recorded the least value for relative weight gain and was significantly depressed ($P<0.05$).

The Protein Efficiency Ratio value for T_1 (57.61) and T_2 (54.17) were not significantly different from each other while T_4 (16.90) and T_5 (16.23) had the least ratio and thus were significantly depressed ($p<0.05$). Feed Intake by fish fed 10% LBM was significantly higher ($p<0.05$) than all other treatments. T_2 and T_3 were not significantly different from each other. However, Fish fed with 40% and 50% LBM recorded the least amount of feed intake and was significantly decreased ($p<0.05$)

The Feed Conversion Ratio (FCR) was highest in Diet containing 50% LBM with a value of 4.37 while T_1 which is fed 10% LBM (1.54) recorded the least FCR value and thus had the best feed to flesh conversion.

Table 3: Carcass composition of the experimental fish (%)

Diets	Crude protein	fat	ash	MC	NFE
Fish (initial)	64.17	14.27	10.21	5.14	6.20
D1 (Control)	61.25	15.12	10.24	5.34	6.10
D 2	68.83	13.47	10.12	5.11	2.46
D 3	61.83	14.57	9.76	5.34	8.50
D 4	67.68	13.73	9.86	5.24	3.50
D 5	68.83	13.76	10	5.22	2.18

MC= moisture content, NFE= nitrogen-free extract

Table 3 above shows the carcass composition of test fish after ten weeks of feeding with LBM. It was observed that the crude protein of the fish introduced to various Diets varied; and there was an increase in the crude protein content of the fish in all the Diets except from the control diet and $T_{3.}$

Discussion

The crude protein content of the LBM before incorporation into various treatment was 24.19% and was similar to the value of 29.20% reported by [17] and 23.33% by[18]. The fat content of 9.54% was found to be in accordance with the 9.22% reported by [11], and the 9.62% reported by [18] but in contrast to the value of 2.99-5.87% reported [17]. This may have led to a higher concentration of fat in the test fish carcass as the fat exceeded the maximum inclusion level of 8% in the diet if catfish.

There was a reduction in feed intake as the percentage of LBM in the diet increased with T_1 having the highest feed intake value and T_5 recording the least feed intake value. This is in line with the findings of [18] in broilers, and [19] in pullets and layers fed on hyacinth bean. [20] reported similar reduction in feed intake with increased levels of legume concentrates. This reduction was elucidated by the authors to be related to unpalatable residual effect of anti-nutritional factors, which were increasingly accumulated as the dietary level of test feedstuff (Hyacinth bean) increased.

The growth response also decreased significantly as the levels of inclusion increased from 10% to 50% with T_1 (1.79g) having the highest weight gain value and T_5 (0.35g) having the least weight gain value. This reduction in weight gain as the levels of inclusion of LBM increased was also reported by [18] on broiler chicks. The decrease in weight gain as the dietary level of LBM raised could be attributed to several factors, such as the reduction in feed intake due to residual toxic components affecting palatability [21]. Tannins are known to bind dietary proteins and digestive enzymes into complexes, which are then not readily digestible [22]. Phytin as well is thought to chelate certain macro and micro minerals; it can form complexes with divalent cations, thereby reducing bioavailability of Ca, Cu, Fe, Mg and Zn [23]. This in turn might distress different metabolism processes due to lack of minerals, resulting in a consequential growth depression [21].

There was an increase in FCR level as level of LBM inclusion levels of increased. This could be attributed to low feed consumption or low digestibility of these diets. It was stated by [24], that better utilization of feeds (FCR) depends on its digestibility, which rely mainly on its chemical composition. The effect might be explained on basis of low feed utilization at 50% level, due to decreased digestibility caused mainly by increased cumulative residual effect of anti-nutritional factors (ANFs), as reported earlier with soybeans by [25].

The protein efficiency ratio (PER) also decreased with increase in LBM inclusion. This could be interpreted, as reported earlier by [26, 27]. These authors showed that, toxic components, mainly anti-trypsin and chymotrypsins inhibit protein and energy utilization. They are protease inhibitors, in the efficient utilization of legumes proteins.

The Lablab seeds were toasted to denature the anti-nutrients present in them. This method of processing is not as efficient as other methods like cooking or fermentation [11]. This could have led to an increased residue of anti-nutrients in the feed which would negatively affect feed consumption, digestibility and utilization of the nutrients and the overall growth performance of the fish fed diets with high inclusion levels of lablab bean.

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