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COMPARATIVE STUDY ON THE EFFICIENCY OF LOCUST BEAN AND IMPORTED FEED ON THE GROWTH OF AFRICAN CATFISH C*LARIAS GARIEPINUS* (BURCHELL, 1822)

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ABSTRACT
Locally prepared feed and coppens feed (imported) were used to feed Clarias gariepinus juveniles, of mean weight 19.4g – 20.5g was evaluated for 8 weeks. Three experimental diets were formulated at 0% (control), 25% and 50% inclusion levels of locust bean treatment, while the coppens was bought directly from the market. Eighty juvenile C. gariepinus were used for the experiment. The experiment was carried out in the laboratory of Biological Sciences, Bayero University, Kano in 25-litre plastic containers. Randomization of 10 fishes per container was used in selecting the samples in order to determine the growth performance. The fish were fed twice daily (8.00am – 6.30pm) at 10% body weight. Their final weight and standard length were recorded. Also temperature, pH, dissolve oxygen and mortality rates were recorded weekly. The result showed that the fish fed imported coppens feed gave the best mean body weight gain, mean standard length gain, specific growth rate and no mortality occurred. While the fish fed 50% locust bean treatment also showed increments in mean body weight gain, mean standard length, specific growth rate and 20% mortality rate. There was also growth performance in 0% (control), while those fed with 25% locust bean treatment gave the least growth performance. There was significant difference between all the experimental diets (P > 0.05). The study demonstrated that locust bean meal can be included in diets of C. gariepinus at inclusion levels of up to 50% in addition to coppens feed. Therefore, it was recommended that locust bean meal could be used partially to replace the expensive and imported fish feed.

Key words: Clarias gariepinus, locust bean, coppens feed, growth performance.

INTRODUCTION

Fishes are highly proteinous and can only be fed on feed which has a measurable percentage of high quality protein. In Nigeria today, fish farmers are faced with the problem of providing high quality protein to the fish and also a problem of getting sufficient supply of protein, which has led to the extinction of some fish species (Eyo, 2003). According to FAO (1999), Nigeria has a potential of producing 0.65-12 million metric tones of fish from aquaculture but produces only 20,000-24,000 tonnes annually because the potential is hardly tapped due to several limiting factors. Fish farming as an industry is faced with some problems which include feed formulation that enhances early maturity of fish juveniles to table size (FAO, 1999).

The insufficiency of animal protein has also arose the need for aquaculture because fish contain almost the highest quality protein (Eyo,2003), which can be found in animals and it (fish protein) is very important in the growing child and adult. This is perhaps among the reasons why government is advising every body to go into fish farming no matter how small; hence, the vision 2010 “fish for all”.

Many feed manufacturers have made several attempts to come up with well formulated feed in order to meet up with the feed demand of aquaculture. Some of the feeds are imported and are competing with the locally manufactured feed. Fish farmers are being faced with the problem of identifying the feed that is the best for fish rearing in terms of efficiency and cost so as to realize maximum benefit for their investment (Eyo, 2003). Therefore, there is need for comparative study on the efficiency of locally prepared and the imported feed on the growth of catfish (*Clarias gariepinus*). Hence, it is in line with this that efforts are being made to produce a suitable fish feed that would not only be efficient but cheap. The success of the above will go a long way in addressing the periodic scarcity and high cost of feed ingredients that partly causes a dramatic increase in cost of fish. This research was aimed at comparing and assessing the efficiency of locally prepared (locust bean) and imported (coppens) feed on the growth of juveniles of *C. gariepinus*.

MATERIALS AND METHODS

Preparation of Diets

Fish meal, toasted soya bean, raw locust bean, ground nut cake, yellow maize, vitamin premix, vegetable oil, starch, iodize salt, were obtained locally from Yankura market, Kano. All ingredients were ground into powdery form using a milling machine and they were weighed according to their percentage composition and mixed properly in a bowl, with the aid of starch solution as a binding agent (Fagbenro, 1999; Olaniyi *et al.*, 2009).

Three isonitrogenous diets containing different level of locust bean (*Parkia biglobosa*) meal (0%, 25% and 50%) were prepared (Table 1). The ingredients were then thoroughly mixed together by hand. Warm water was added to the premixed ingredients and homogenized to a dough and pelleted form with the aid of improved pelleting machine. The diets were sun – dried for 4 days and packaged into polythene bags (Alegbeleye *et al*., 2001; Amisah *et al*., 2009). Each diet was further analyzed (A.O.A.C, 1990) to determine its moisture content, crude protein, crude ash and crude fat (Table 2). While the coppens feed was brought directly from the market.

Experimental Design

The experimental set up consisted of 8 plastic containers of 25-litre capacity each, thus replicated and labelled Ia, Ib; IIa, IIb; IIIa, IIIb; IVa, IVb (i.e. 0% LBT, 25% LBT, 50% LBT and coppens feeds respectively). Each of the two containers above was assigned to each of the four experimental diets from which average values were recorded and used for analysis. Test water was completely replaced every two days, to remove the food particles and faecal materials (Madu and Akilo, 2001) that can otherwise contaminate the water.

Collection and Transportation

One hundred (100) experimental fish i.e. *Clarias gariepinus* juveniles were obtained from Saumar Farm Panshekara, Kumbotso local Government Area, Kano. The fish had an initial weight of 19.4g-20.5g, and transported in a fifty (50) litre half filled jarican to the aquarium in the Department of Biological Sciences, Bayero University, Kano and acclimatized for one week. During this period, they were fed with pelleted compounded fish containing 40% crude protein (Bichi and Haruna, 2007).

Stocking of the Experimental Fish

After the acclimatization period, the *C. gariepinus* juveniles were selected randomly and stocked at a rate of 10 fish per 25-litres container. The four (4) diet treatments were allocated randomly to the 8 plastic containers in two replicates giving a total of 80. The initial body weight of the fish were recorded using a Top Loading Balance. Their initial, total and standard length were measured using a graduated ruler (Alegbeleye *et al*., 2001).

Feeding the Juveniles

The juveniles were starved for a period of 24 hours before the feeding started. This was done so as to empty their gut and increase their appetite and thus, reception for the new diets (Madu and Akilo, 2001). The fishes were fed twice daily for a period of eight (8) weeks between 8:00 – 9:00am and 5:30 – 6:30pm with the experimental diets containing 30 – 42% of crude protein at 10% body weight per day (Bichi and Haruna, 2007).

Water Quality Analysis

Temperature, pH and dissolved oxygen were determined weekly in the experimental containers between 11:00am – 12:30pm with the aid of a thermometer (Ademoroti, 1996). Dissolved oxygen (DO) was determined using the Jenway meter (model 9071) while the pH was measured using Jenway pH meter (Model 3150, England) as described by Madu and Ufodike (2001).

Growth Parameters and Mortality Rate

The growth parameters of *C. gariepinus* juveniles in the various experimental growth (Table 6, Figures 1 and 2) were measured weekly as described by Adikwu (2003). These parameters include initial, final and mean body weight gain, and initial, final and mean standard length gain as well as daily specific growth rate as shown in equations 1-3.

Mean Body Weight Gain (g) = $W_2 - W_1$ ---------- Equation 1

Where W_1 = Initial body weight, W_2 = Final body weight

Mean Standard Length (cm) = $L_2 - L_1$ ---------- Equation 2

Where L_1= Initial Standard Length, L_2 = Final Standard Length

Specific Growth Rate as % Body Weight Per Day(SGR)

$SGR = 100 (\ln W_2 - \ln W_1) / T$ ---------- Equation 3

Where W_1 = Initial body weight, W_2 = Final body weight

T = Duration of experiment in days

Ln = Natural Log

Similarly, the mortality rate (%) was determined in accordance with Amisa *et al*. (2009) procedure shown in equation 4.Thus,

$$M = \frac{NO - NT}{NO} \times 100\%$$

Where : M = Mortality, NO = Number of the fishes at the start of the experiment,

NT = Number of the fishes at the end of the experiment

RESULTS

The gross composition of the experimental diets are shown in Table 1. Thus, 0% column indicated the composition of the control diet per 100g, where no locust bean was added, while the 25% and 50% columns indicated the composition of the two diets prepared with varied concentration of the locust bean. The composition of fish meal and toasted soya bean were also varied in the different experimental diets (Table 1). Proximate Composition of the Experimental Feeds and Control are presented in Table 2.

Table 1: Gross Composition of the Experimental Diets (% Weight)

Ingredients	0%	25%	50%
Fish meal	15	10	10
Toasted Soya Bean	15	15	10
Locust Bean (raw)	-	5	10
Groundnut Cake	13	13	13
Maize (Yellow)	50	50	50
Vitamin Premix	2.0	2.0	2.0
Vegetable Oil	2.5	2.5	2.5
Starch	2.0	2.0	2.0
Iodized Salt	0.5	0.5	0.5
Total Weight (g)	**100**	**100**	**100**

Table 2: Proximate Composition of Experimental Feeds and Control

	0% (Control)	25% LBT	50% LBT	Coppens Feed
Moisture	7.5%	9.67%	7%	4
Crude Protein	30%	32.0%	35%	42%
Lipids				
Crude Fibre	10.0%	10.02%	10.03%	1.9%
Ash	6.0%	5.5%	7%	8.9%
Phosphate				1.1%
Crude Fat	22%	24%	21%	13%
Vitamin A	-	-	-	15000mg /Kg
Vitamin C	-	-	-	150mg/Kg
Vitamin D	-	-	-	2000mg/Kg
Vitamin E	-	-	-	200mg/kg
Copper	-	-	-	5mg/kg
Preservatives	-	-	-	E280
Antioxidants	-	-	-	E321

Water Quality Parameters

Hydrogen Ion Concentration (pH)

Table 3 shows the hydrogen ion concentration (pH) as recorded throughout the eight weeks feeding trial. The pH ranged from 6.80 – 8.08.

Table 3: Mean Weekly pH Values From Different Feed Designated Containers Stocked with Juveniles of *C. gariepinus*

Feed Designation	Week								Mean
	1	2	3	4	5	6	7	8	
I (0% control)	7.46	7.0	7.0	7.0	6.99	8.08	7.30	7.25	7.26
II (25% LBT)	7.36	6.9	7.0	6.8	7.33	7.89	7.25	7.34	7.23
III (50% LBT)	7.37	7.1	7.3	7.3	7.23	7.75	7.69	7.10	7.36
IV (CPF)	7.60	7.0	7.3	7.0	6.93	7.59	7.0	7.22	7.19

N.B.: LBT = Locust Bean Treatments, CPF = Coppens Feed

Table 4: Mean Weekly Dissolved Oxygen From Different Feed Designated Containers Stocked with Juveniles of *C. gariepinus*

Feed Designation	Week								Mean (mg/L)
	1	2	3	4	5	6	7	8	
I (0% control)	4.5	6.3	7.0	7.0	7.0	8.0	8.5	7.0	6.88
II (25% LBT)	3.8	6.3	6.5	7.2	7.2	9.0	8.0	6.5	6.81
III (50% LBT)	4.0	6.5	6.0	7.4	7.0	9.0	9.0	7.0	6.98
IV (CPF)	4.0	6.4	7.0	7.5	7.0	9.3	7.6	6.5	6.91

Table 5: Mean Weekly Temperature Values From Different Feed Designated Containers Stocked with Juveniles of *C. gariepinus*

Feed Designation	Week								Mean (°C)
	1	2	3	4	5	6	7	8	
I (0% control)	22.5	24.0	24.0	24.0	27.0	30.0	29.0	29.0	26.18
II (25% LBT)	20.0	22.0	23.0	22.0	27.0	27.0	29.0	29.0	24.87
III (50% LBT)	22.5	23.5	24.0	23.0	28.0	27.0	28.0	28.0	25.50
IV (CPF)	22.0	24.0	24.0	23.0	25.0	32.0	30.0	30.0	26.25

Growth Performance of *C. gariepinus*

Table 6 and Figures 1 - 2 show the growth performance of the juveniles of *Clarias gariepinus* fed with locally and imported feed for a period of 8 weeks.

Mean Body Weight Gain (MBWG): Table 6 revealed that the fish weight increased with increase in percentage crude protein, present in the diet. Thus, 25% locust bean treatment with 32% crude protein level in the diet had the lowest mean fish body weight gain (16.1g) followed by 0% locust bean treatment with 30% crude protein and mean fish body weight gain of 22.7g. On the other hand, 50% locust bean treatment with 35% crude protein had the highest fish body weight among locally prepared feeds of 39.7g. However, the imported feed which is the coppens feed with a crude protein level of 42% had the highest mean fish body weight gain of 72.05g.

Table 6: Growth performance Indices of *C. gariepinus* Juveniles Fed Different Levels of Locust Bean and coppens Feed

Growth Performance	Diets			
	0% (Control)	25% LBT	50% LBT	Coppens Feed
Crude protein (%)	30	32	35	42
Initial Body Wt (g)	19.5	19.4	20.0	20.5
Final Body Wt (g)	42.2	35.5	59.7	92.55
Mean Body Wt Gain (g)	22.7	16.1	39.7	72.05
Body Wt Gain (%)	116.41	82.99	198.5	351.46
Initial Standard Length (cm)	10.0	9.4	10.2	10.6
Final Standard Length (cm)	13.9	12.3	14.5	18.3
Mean Standard Length Gain (cm)	3.9	2.9	4.3	7.7
Standard Length Gain (%)	30.85	39.00	42.16	72.64
Specific Growth Rate (per day)	1.37	1.07	1.94	2.67
Mortality Rate (%)	10	20	20	0

Standard Length Gain (SLG)

Table 6 shows the mean standard length gain, which are 3.9cm, 2.9cm, 4.3cm and 7.7cm for diets 0%, 25%, 50% and coppens feed representing 30.35%, 39.00%, 42.16% and 72.64% respectively.

Specific Growth Rate (SGR) and Mortality Rate (MR)

Table 6 also shows the specific growth rate and mortality rate of the experimental fish fed different inclusion levels of locust bean treatment and coppens feed. The fish fed coppens feed (Diet IV) had the highest specific growth rate of 2.67 and 0% mortality rate while those fed 25% locust bean treatment (Diet II) had the lowest specific growth rate of 1.07 and 20% mortality rate. The control diet (0% locust bean treatment (Diet I)) had specific growth rate of 1.37 with 10% mortality rate, the SGR for 50% locust bean treatment (Diet III) had specific growth rate of 1.94 with 20% mortality rate.

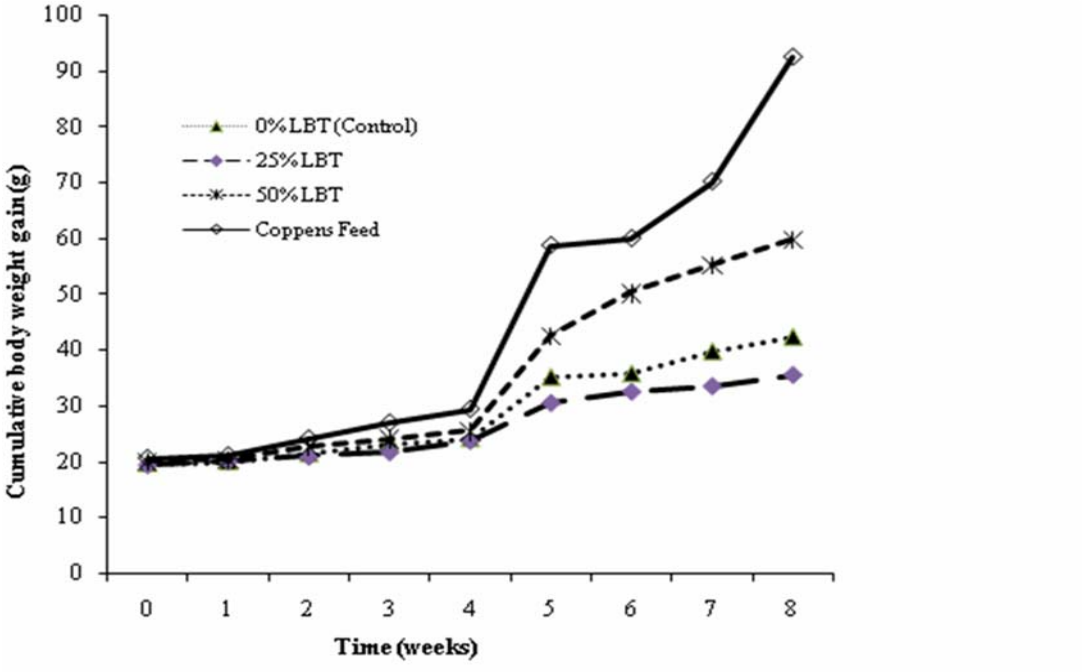

Figure 1: Cumulative body weight gain of *Clarias gariepinus* fed different levels of locust bean compared with a control over a period of eight weeks

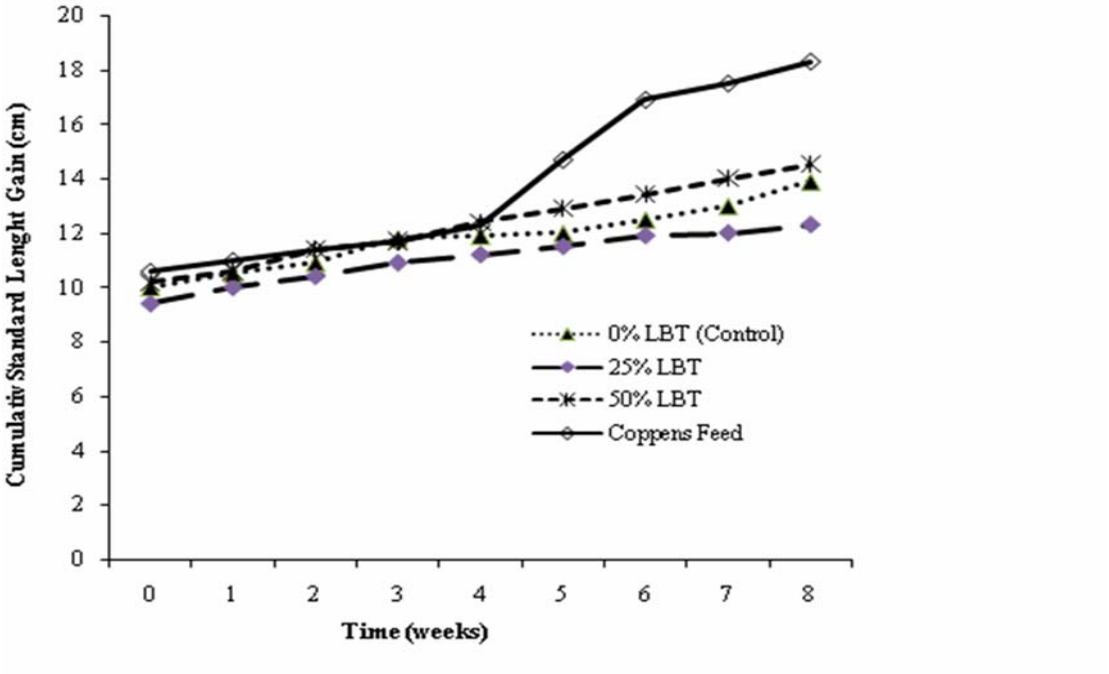

Figure 2: Cumulative standard length gain of *Clarias gariepinus* fed different levels of locust bean compared with a control over a period of eight weeks

DISCUSSION

For optimum growth to be achieved in fishes there has to be an appropriate range of water quality parameters such as temperature, pH and dissolved oxygen among others (Balogun *et al.*, 2004). Observations from the results of water quality parameters, revealed that the pH ranged from 6.80-8.08 (Table 3). Similarly, DO ranged from 3.8 mg/l – 9.3 mg/l (Table 4) while the temperature ranged from 20.0- 32.0^{o}C (Table 5), which were similar to the values obtained by Auta (1993), who reported a temperature range of 25^{o}C – 30^{o}C, pH 6.70 – 9.00 and dissolved oxygen of 5.00mg/l – 8.4 mg/l in a similar research carried out in tanks. The pH value found in this study was higher than pH 6.00- 6.88 and temperature of 19.7 – 20.8^{o}C reported by Bichi and Haruna (2007). Similarly, Olaniyi *et al.* (2009) reported a temperature range of 27.0 - 29.0^{o}C, pH of 6.4-7.0 and dissolved oxygen of 7.5-10.0mg/l on growth performance of catfish fed locust bean meal (*Parkia biglobosa*). Also, Duniya (2006) reported a temperature range of 25.0 - 27.20^{o}C, pH of 6.50- 7.50 and dissolved oxygen of 6.00- 9.00 mg/l for the growth of *C. gariepinus* cultured in plastic tanks. Since the values obtained in this study were within the recommended ranges (pH 6.80- 8.08, Dissolved oxygen 3.8mg/l- 9.3mg/l and temperature 20.0 ^{o}C - 32.0^{o}C). this indicated that the water quality parameters remained fairly favourable for the survival and growth of the *C. gariepinus* used in this study.

When alternative food sources such as plant protein are used in the fish diet, one of the common problems encountered is the acceptability of the feed by fish, and this frequently relates to the palatability of the diet (Rodriguez *et al.*, 1996). In this study, all the experimental diets were accepted by *C. gariepinus* juveniles, indicating that the levels of incorporation of locust bean meal did not affect the palatability of the diets. This might be attributed to the processing techniques which involved boiling, fermentation and drying that might have reduced the anti-nutrient components in locust bean meal (*P. biglobosa*), thereby increasing its palatability for *C. gariepinus.* This observation corroborates with the works of Fagbenro (1999) and Olaniyi *et al.* (2009), who reported that reduction in anti-nutrient by different processing techniques, resulted in better palatability and growth in fish.

The result of proximate composition of locust bean meal in this study revealed that the crude protein content was 35%, fibre (10.03%) and ash (7%) as shown in Table 2; which was closely related to the values obtained by Olaniyi *et al.* (2009) of crude protein (35.9%), fibre (16.7%) and ash (6.3%). The protein content found in this study was higher than 32.0%, fibre (1.32%) and ash (8.33%) reported by Alegbeleye *et al.* (2001), which was probably why the specific growth rate found in this study of 1.37, 1.07, 1.94 and 2.67 for 0% LBT, 25% LBT, 50% LBT and coppens feed respectively (Table 6) were higher than the ones found by these researchers of 0.915. Similarly, the protein content found in this study was higher than 29% reported by Fetuga *et al.* (1974). However, the crude fibre of 10.03% found in this study at 50% LBT was lower than 36% reported by Fetuga *et al.* (1974), and 16.7% reported by Olaniyi *et al.* (2009). This could probably be as a result of local variation in the fibre content of the plant used.

The initial body weight gain, final body weight gain, mean body weight gain, final standard length gain, mean standard length gain and specific growth rate significantly increased ($P < 0.05$) with those fed coppens feed and also at various inclusion levels of locust bean treatments of 0 - 50%, meaning that *P. biglobosa* could replace up to 50% of the fish meal component in the diets for the African catfish used in this study. This is a bit higher than the finding of Fetuga *et al.* (1974) who reported 40% replacement level of locust bean meal as the optimum in the diets of laboratory rat (monogastric).

The result obtained in this study was also in line with the result obtained by Duniya (2006) on the same species in a similar study where mortality did not have any deleterious effect on the fish.

The mortality rate showed no significant difference (P = 0.05). This indicated that *C. gariepinus* is able to convert, very efficiently plant protein such as locust bean meal into fish biomass, thus agreeing with the report of Machiels (1987), who fed *C. gariepinus* with diets containing different plant protein sources (ground nut, cotton seed and soya bean) and also Ganchero and Chiu (1990), in the evaluation of nutritive value of four legume seeds; Pigeon pea (*Cajanus cajan),* Mungo *(Phasellus radiates),* Kidney bean *(Phaseallus vulgaris)* and Soya bean *(Glycine max)* as protein sources for milkfish *(Chanos chanos).*

Since the best growth for all the treatments were record in catfish fed with coppens feed and also at 50% LBM replacement value, therefore, this study suggest that African catfish can utilize efficiently a diet with an equal share of locust bean meal and coppens feed. The study therefore indicated that locust bean meal can be included in diets of *C. gariepinus* at inclusion level of up to 50% in addition to coppens feed. Thus, to improve the growth and economic returns of catfish farmers, it was recommended that 50% locust bean treatment could be mixed with coppens feed.

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