Effect of Partial Replacement of Soya bean (*Glycin max*) with African Locust Bean (*Parkia biglobosa*) on the Growth Performance and Carcass of *Clarias gariepins* Fingerlings

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Abstract:- **This study aims to evaluate the effect of utilizing Locust Bean (*Parkia biglobosa*) Seed Meal (LBSM) as an alternate protein source for *Clarias gariepinus*. The study was conducted in Nwochas Farm, Maiduguri. The experimental diets were formulated to contain LBSM at levels of 25%, 50%, 75% inclusions and were labelled as T_2, T_3, T_4 respectively with diet T_1 acting as control. All diets were formulated isonitrogenously using pearson square method with 35% Crude Protein. A 56 days feeding trial was conducted using *Clarias gariepinus* fingerlings which were randomly distributed in a 2m x 2m^{2}hapas in earthen ponds in triplicates at a stocking rate of 20 fish per hapa. The experimental design was completely randomized. The fish were fed at 5% body weight twice daily. The proximate analysis of the diets and carcass composition of the diets and water quality parameters were determined. Data of each parameters were subjected to ANOVA while means of various results were compared at 5% level of significance. The results showed that there was no significant different ($p<0.05$) in Weight gain, Specific growth rate, Feed conversion ratio, Protein conversion rate and Conditional factor of fish fed LBSM diets. But there was significant different between fish fed with control and LBSM in percent survival value. This study indicate that LBSM can replace soya bean up to 50% in the diets of *Clarias gariepinus* for optimum growth performance and nutrient utilization.**

Keywords: **Growth, Nutrient, LBSM, Feed, Protein**

I. INTRODUCTION

For optimal health, fast growth and sustainable production of farmed fish, a balanced feed with a good physical and chemical characteristic (Eze and Eyo, 2018). Every living organism including fish requires food for growth, reproduction and maintenance of tissues. To sustain fish under culture, supplementation diet must be provided to complement natural feeds supply (Karapan Agbottidis, 2002). Fish is a reliable source of thiamine, riboflavin, vitamins A and D, phosphorus, calcium and iron (Eyo and Ekanem, 2011). One of the important factor to be considered by fish folks is to minimize expense and maximize profit at all level of production.

Feed is one of the major thing to be considered in aquaculture production and fish feed Technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the World (Gabriel et al, 2007). Feed has been reported to account for 40-60% of the total recurrent cost of production (Falaye, 1992).

The culture of fish is receiving a lot of attention in Nigeria with the result that new cultivation techniques are being introduced and adopted. Over the last decade, spectacular growth has taken place in the aquaculture sector in Nigeria. Fish farming activity in Nigeria started about 50 years ago (Olagunju *et al.*, 2007) and as at now aquaculture in the country is in the developing stage, because it has not been able to meet the demand of the ever increasing population (Ojutiku, 2008). Fish feeds are used in aquaculture to increase production and maximize profit. Feeds in intensive fish culture consume about 60% of the capital cost (Eyo, 2001).

African catfish (*Clarias gariepinus*)is a very popular fresh water fish in Nigeria (Eyo *et al.*, 2012). African mud catfish, *Clarias gariepinus* (Sotolu, 2010), a member of the *Clariidae* family is one of the hardy and simplest fish to propagate. This species is scale less with rounded caudal fin and poorly developed eyes. It is regarded as one of the most important aquaculture candidates because of its ability to tolerate a wide range of environmental conditions, high stocking densities under culture conditions, fast growth rate, high yield potential, high fecundity, air breathing characteristics and high market value (Hetch,2007; Babalola and Apata, 2006).

Adebisi and Anthony (2010) reported that evaluation of growth parameters and nutrient utilization of fish was based on weight gain, protein intake, protein efficiency ratio, specific growth rate, nitrogen metabolism and carcass analysis.

African locust bean (*Parkia biglobosa*) is a multipurpose tree legume found in many African countries. The seeds, the fruit pulp and the leaves are used to prepare numerous foods and drinks, and to feed livestock and poultry.

It is a medium-sized legume tree that reaches 20-30 m high. It has a dense, widely spreading umbrella-shaped crown and a cylindrical trunk that can reach 130 cm in diameter, often branching low. The bark is longitudinally fissured, scaly between the fissures, thick, ash-grey to greyish-brown in colour. It exudes an amber gum when cut. The leaves are alternate and bipinnately compound, 30-40 cm long, bearing up to 17 pairs of pinnae. The seeds are globose-ovoid, 5-15 mm, smooth and glossy dark in colour. There are about 2800-6700 seeds/kg. The seeds are hardcoated and can remain viable up to 8 years (Orwa *et al.*, 2009; NRC, 2006; Sina *et al.*, 2002; Hopkins, 1983).This mealy pulp is traditionally consumed as fresh food by local African populations (Campbell-Platt, 1980; Felker, 1981).

Fruit pulp, foliage and seeds of the African locust bean (*Parkia biglobosa*) can be used to feed livestock and poultry. The fruit pulp and the seeds, once processed to remove antinutritional factors, can be included in livestock feed (Orwa *et al.*, 2009; Sina *et al.*, 2002).

Feed trials have been carried out on *Clarias gariepinus* to evaluate their growth response to different readily available local plant and animal protein sources (Otubusin *et al.*,2009; Amisah *et al.*,2009; Sotolu 2009; Fagbenro,1995; Achionye-Nzeh *et al.*,2002, 2003, Ayinla, 1988).The rapid increase in high cost of protein based fish feed ingredients in the market is of great concern to fish farmers (Eze and Avwemoya, 2018). This study aims to evaluate the effect of replacing soya bean with African locust bean in the growth performance and carcasss analysis of *Clarias gariepinus* fingerlings fed at varying inclusion levels.

II. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Nwochas fish farm, hausari road, Maiduguri, Borno State.

2.2 Preparation of the Experimental diets

Fishmeal, soyabean, maize and vitamin premix were procured from Maiduguri Monday Market. Soya bean was toasted in other to remove some anti-nutritional factors. Various ingredients were grounded separately using hammer miller. The ingredients were weighed, mixed and pelleted using using pelletizer into 2mm size.

2.3 Collection and Processing of African Locust Bean (Parkia biglobosa) seeds

Four (4) kg of dried African Locust Bean (*Parkia biglobosa*) Seedswere procured from Maiduguri Monday Market and was identified by a botanist. The seeds were soaked in tap water for 24 hours to remove the thin layer of the pulp and any inhibitory materials then later boiled for 12 hours with constant topping of water. After cooling, the pulps were removed by washing the seeds with several changes of water. The testa were separated from the cotelydon by pounding in a mortar and washed severally and the cotelydon were sun dried for 24 hours to almost constant weight before milling using the hammer miller to pass through 1mm mesh sieve. The powdered form of the seeds was kept in an air tight container prior to usage.

2.4 Experimental Design

Fourty percent (40%) Crude protein diet was formulated using the Pearsons Square method. Four (4) experimental diets were formulated and labelled using T_1, T_2, T_3, T_4. Locust Bean *Parkia biglobosa* Seed Meal (LBSM) was included at 0%, 25%, 50% and 75% respectively. Two hundred and fourty (240) *Clarias gariepinus* fingelings with an average weight of 4.0g were procured from a reputable farm in Maiduguri. Twenty (20) fingerlings each were stocked in a 2 x 2 m^2 hapa in earthen ponds in triplicates in a Randomized Completely Blocked Design (RCBD). The *Clarias gariepinus* fingelings were fed with the experimental diets at 5% of there body weight in split doses twice daily for 56 days except for sampling days where they were fed after weighing. All fish were collectively weighed at the start of the experiment (day 1) and at 14 day intervals (14, 28, 42, and 56 days).

Table 1: Percentage composition of the experimental diets

Locust Bean (*Parkia biglobosa*)Seed Meal (LBSM) inclusionlevels				
Ingredients	**T_1 (0%)**	**T_2 (25%)**	**T_3 (50)**	**T_4 (75%)**
LBSM	0.00	7.82	15.62	23.43
Soya Bean	31.25	23.43	15.62	7.82
Fish meal	31.25	31.25	31.25	31.25
Maize	34.5	34.5	34.5	34.5
Premix	0.5	0.5	0.5	0.5
Methionine	1.0	1.0	1.0	1.0
Oil	0.3	0.3	0.3	0.3
Lysine	0.5	0.5	0.5	0.5
Salt	0.2	0.2	0.2	0.2
Starch	0.5	0.5	0.5	0.5
Total	100	100	100	100
Proximate Composition				
Dry matter	97	98	98	94
Protein	36.09	34.73	35.78	35.69
Fibre	13.00	8.66	10.66	9.00
Fat	8.00	9.00	8.00	9.00
Ash	3.33	3.83	3.66	2.66

2.5 Growth Parameters and nutrient utilization

Growth Performance and Nutrient Utilization Parameters where estimated as; Mean body Weight Gain (WG) (g) = final body weight – initial body weight as described by Ogunji and Wirth (2001). Specific Growth Rate (SGR) (SGR (% day-1) = [ln (final body weight) – ln (initial body weight)]× 100/

number of day) as described by (Somsueb and Boonyaratpalin, 2001) and (Tamburawa, (2010). The Feed Conversion Ratio (FCR)= total weight of feed consumed (g)/ wet biomass gain (g). Protein Efficiency Ratio (PER) = wet weight gain/ protein fed),Survival rate (SR) (%) = (final number of larvae/initial number of larvae)×100were calculated as reported by Arunletaree and Moolthongnoi (2008), Vadivel and Pungalenthi (2007) and Madu *et al.* (200 I).

Condition Factor (K)= 100W/ L3 where W = Final mean body weight (g); L = Mean standard length (cm) was calculated, Adukwu (1992).

2.6 Biochemical analysis

The proximate composition of the carcass and experimental diets were determined according to AOAC(1999) methods. Dry matter (DM) was determined after oven drying at 105°C for 24 hours until constant weight; crude protein (% N x 6.25) was determined using kjeldahl method; crude lipid by Soxhlet extraction with hexane; Ash was measured by incineration at 550°C in a muffle furnace for 24 hours; crude fibre were measured by acid digestion following by ashing the dry residue at 550°C in a muffle furnace for 4 h, while nitrogen-free extract (NFE) was calculated by difference.

III. RESULTS

Table 2: Growth performance (±SEM) of *C. gariepinus* fed with varying inclusion levels of Locust bean

Locust bean inclusion level (%)				
Parameters	**T_1 (0%)**	**T_2 (25%)**	**T_3 (50%)**	**T_4 (75%)**
Initial Length (cm)	6.20±0.40[a]	5.03±0.29[a]	5.06±0.23[a]	5.16±0.44[a]
Final Length (cm)	10.20±0.30[a]	11.06±0.72[a]	10.70±0.30[a]	6.76±2.42[c]
Initial Weight (g)	3.53±0.30[a]	3.91±0.06[a]	3.25±0.14[a]	3.71±0.35[a]
Final Weight (g)	12.53±2.41[a]	12.55±2.78[a]	12.89±0.57[a]	7.85±1.24[a]
Weight Gain	8.82±2.26[a]	8.82±2.26[a]	9.61±0.58[a]	4.60±1.55[a]
Specific Growth Rate	0.94±0.14[a]	0.94±0.14[a]	1.07±0.04[a]	0.98±0.44[a]
Feed Conversion Ratio	2.00±0.56[a]	2.00±0.56[a]	1.55±0.09[a]	1.54±0.29[a]
Protein Efficiency Ratio	1.41±0.32[a]	1.41±0.32[a]	1.61±0.09[a]	1.50±0.50[a]
Percentage Survival	73.33±3.33[a]	73.33±3.33[a]	63.33±6.66[a]	30.00±15.27[b]
Condition factor	1.13±0.41[a]	1.13±0.41[a]	1.06±0.12[a]	0.98±0.64[a]

Locust bean inclusion level (%)				
Parameters	**T_1 (0%)**	**T_2 (25%)**	**T_3 (50%)**	**T_4 (75%)**
Initial Length (cm)	6.20±0.40[a]	5.03±0.29[a]	5.06±0.23[a]	5.16±0.44[a]
Final Length (cm)	10.20±0.30[a]	11.06±0.72[a]	10.70±0.30[a]	6.76±2.42[c]
Initial Weight (g)	3.53±0.30[a]	3.91±0.06[a]	3.25±0.14[a]	3.71±0.35[a]
Final Weight (g)	12.53±2.41[a]	12.55±2.78[a]	12.89±0.57[a]	7.85±1.24[a]
Weight Gain	8.82±2.26[a]	8.82±2.26[a]	9.61±0.58[a]	4.60±1.55[a]
Specific Growth Rate	0.94±0.14[a]	0.94±0.14[a]	1.07±0.04[a]	0.98±0.44[a]
Food Conversion Ratio	2.00±0.56[a]	2.00±0.56[a]	1.55±0.09[a]	1.54±0.29[a]
Protein Efficiency Ratio	1.41±0.32[a]	1.41±0.32[a]	1.61±0.09[a]	1.50±0.50[a]
Percentage Survival	73.33±3.33[a]	73.33±3.33[a]	63.33±6.66[a]	30.00±15.27[b]
Condition factor	1.13±0.41[a]	1.13±0.41[a]	1.06±0.12[a]	0.98±0.64[a]

Mean with same superscript are not significantly different at $p<0.05$

Table 4.3: Carcass analysis of *Clarias gariepinus* fed with the experimental diets

Locust bean inclusion level (%)					
Parameter	Initial	**T_1 (0%)**	**T_2 (25%)**	**T_3 (50%)**	**T_4 (75%)**
Moisture	2.33±0.49	5.66±0.33	3.33±0.33	3.66±0.33	3.33±0.33
Crude Protein	49.66±0.33	53.33±0.33	54.33±0.33	56.00±0.57	55.00±0.57
Fiber	9.33±0.88	16.00±0.33	16.66±0.33	14.16±0.00	13.33±0.44
Fat	9.66±0.88	8.33±0.57	9.33±0.33	9.00±0.60	8.16±0.44
Ash	3.00±0.57	2.50±0.28	2.33±0.33	2.16±0.16	1.83±0.44
NFE	26.02±0.23	14.18±0.54	14.02±0.53	15.02±0.16	18.35±0.44

Table 4.4: Mean water Physico-Chemical paraameters

Parameters	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)
pH	7.20±0.06[a]	7.25±0.43[a]	7.15±0.20[a]	7.28±0.12[a]
Temp (^{0}C)	28.01±0.39	27.17±0.33[a]	27.37±0.7[a]	28.98±0.73[a]
DO (mg/l)	6.17±0.03[a]	6.25±0.33[a]	6.23±0.14[a]	6.30±0.20[a]

Mean with same superscript are not significantly different at p<0.05

The mean initial weight from all the treatments range from 3.25±0.14 to 3.91±0.06g while the final weight range from 7.85±1.24 to 12.89±0.57g. It was observed that T_3 had the highest weight gain of 9.61±0.58 followed by T_1 (8.82±2.26), T_2 had 8.64±2.76 and T_4 had the lowest (4.60±1.55) weight gain. There was no significance difference (p<0.05) in weight gain among the experimental treatments. The Specific Growth Rate was recorded highest (1.07±0.04) for fish fed with T_3, followed by 0.98±0.44, 0.94±0.14, 0.85±0.20 for fish fed with T_4, T_1, and T_2diets respectively. No significant difference (p<0.05) was observed among all the treatments.

Similarly, the same highest Feed Conversion Ratio (FCR) was recorded in fish fed with T_1 and $T_2$with same value of 2.00±0.56followed by $T_3$and T_4, with values of 1.55±0.09 and 1.54±0.29 respectively. They were significantly not different.

The Protein Efficiency Ratio (PER) was recorded highest (1.61±0.09) in T_3 followed by T_4 (1.50±0.05) and T_2 (1.47±0.41) with the lowest value (1.41±0.32) recorded in T_1. They were significantly not different.

The mean survival rate of fingerlings fed with the experimental diets range from 30% to 73%. T_1 had the highest survival rate of 73% followed by T_2 and T_3 with 63.33% each. T_4 had the least survival value of 30% as shown in Table 2. There was significance (p>0.05) difference observed between T_4 and the other treatments.

The conditional factor of the experimental fish was highest (1.13±0.41) on fish fed with diets T_1 followed by T_3, T_4, and T_2 with values of 1.06±0.12, 0.98±0.64, 0.94±0.27 respectively. There was no significance difference (p<0.05) among the experimental treatments.

Physico-chemical parameters

The result of the physico-chemical parameters as given in Table 3 reveals that the mean water temperature in the experimental earthen ponds ranges from 27.17±0.33[a] to 28.29±0.73[a], mean dissolved oxygen varied from 6.17±0.03[a] to 6.30±0.20[a], pH value range between 7.15±0.20[a] and 7.28±0.12[a].

Carcass analysis

Table 4, shows the results of the carcass analysis of *C. gariepinus* fingerlings fed with the experimental diet for a period of 56 days. T_1 had the highest (5.66±0.33) moisture content and the least was recorded in T_2 and T_4 with same value of 3.33±0.33. The highest (56.00±0.57) crude protein was obtained in T_3 while the initial had the lowest (49.66±0.33) crude protein. The ash content was highest (3.00±0.57) in the initial and the least (1.83±0.44) was recorded in T_4. The least fat value (8.16±0.44) was observed in T_4, while the highest value (9.33±0.33) was observed in T_2.

IV. DISCUSSION

This finding reveals the possibility of utilizing Locust Bean *Parkia biglobosa* Seed Meal (LBSM) to partially replace soya bean in the diet of *Clarias gariepinus*. The use of *Parkia biglobosa* in the diet of *Clarias gariepinus* at 50% partial inclusion level showed significant improvement on the growth performance and nutrient utilization of the fish. This may be as a result of high nutritional content of the *P. biglobosa seed* contents.

The best feed conversion ratio (FCR) was recorded on fish fed with T_3 (1.55±0.09) diet which indicated a superior level of utilization of the diet by the fish. Adikwu (2003), documented that the lower the value of the FCR, the better the feed utilization by the fish. In this present study, the lowest value of FCR indicated better feed utilization by the fish and this accounted for better growth performance of *C. gariepinus* fed at 50% inclusion level among other diets. This results supports the observation made by Shabbir *et al.*,(2003) and Jabeen *et al.*, (2004) in related studies.

The condition factor ranged between 0.94 to 1.13 in all treatments. However the robustness and general well-being of the fish fed with graded levels of Locust Bean *Parkia biglobosa* Seed Meal (LBSM) diets are expressed by the condition factor (K), which did not significantly differ from the control. The result of the study supports the findings of Lagler (1956), who reported a range of 0.5 to 1.0 for healthy fish. Survival rate was highest in diet T_1 and the least was recorded in diet T_4. Fish mortality recorded in the treatments might be attributed to the presence some extraneous factors in the diets. This observation is in agreement with that of Alebeleye (2005), who reported that mortality might not be attributed to the presence of anti –nutrients in the diets alone but also to some extraneous factors such as stress resulting from handling.

The Protein Efficiency Ratio (PER) was significantly not different in all the entire treatments as it ranged from 1.41 – 1.61. These values were inconsonance with the reports of Erfanullah and Jafri (1998). Abdul *et al.*, (2009) and Schuchardt *et al.*, (2008) and Schuchardt *et al.*, (2008) in their various studies of growth and nutrient utilization of fingerlings of some species of fish. The importance of energy in fish nutrition as discussed by NRC (1993) and Bakke-

Makellep *et al.,* (2007). The low energy in the ration means that protein may not be fully utilized to the fullest potentials. This may however account for the little variations in the performance of the experimental fish fed with the dietary treatments. A deleterious effect of the dietary level of LBSM on fingerlings of *C. gariepinus* was observed. The trend of the observation of the study is in contrast with the findings of trial reports on indigenous fresh water species of fish (Alegbeleye *et al.,* 2001;Babalola and Apata, 2006; Oyelese, 2006). Besides, it reveals that despite the limitations of LBSM as with other seed meals for their content of toxic substances, its dietary levels up to 50%, nutritionally measured well in improving the performance of the fish. This may have been possible partly due to the employed cracked, soaked and cooked processed technique of the LBSM in line with Udebide and Carlini (1998b), which would have been removed to a very good extent some of the anti-nutritious limitations of the meal. The result also agrees with the findings of Ugwumba and Abumoye (1998) who obtained the best growth performance, food conversion and survival rate of *C. gariepinus* fingerlings when maggot was fed as a supplemental food (maggot and artificial feed). The increase in the lipid deposits in the carcass of the fish fed experimental diets of Africa locust bean may be responsible for the better growth in terms of weight rather than the crude protein. It has also been reported that the Africa locust bean is rich in essential amino acids necessary for growth and development. Protein requirements is given high priority in any nutritional study because it is the single nutrient that is required in the largest quantity for growth and development and also the most expensive ingredient in the diet formulation (Lovell, 1989; NRC, 1993). Dietary lipids function as a ready source of energy for fish and also provide essential fatty acids which are added for fish growth and survival. Fish generally require omega-3 fatty acids rather than omega-6 fatty acids in contrast with terrestrial animals which require omega-6 fatty acides (Kanazawa, 2000). Previous work of Audu *et al.,* (2004), showed the need to use plant meal in the combined form of produce the cheapest and required nutrients for fish and this formed the basis of the research work. The partial replacement of protein by alternate source of protein has met with the varied degree of success, depending on the nature and the composition of ingredients inclusion level and method of processing. The study agrees with the findings of Audu *et al.,* (2004) who conducted a study on the effect of substituting soyabean diets with varying quantity of ensiled parboiled bean seed and raw Africa locust bean on the growth response and food utilization of Nile tilapia

V. CONCLUSION

From the experiment, 50% inclusion of PBSM in the diet of *Clarias gariepinus* was highly utilized for growth. This indicates that LBSM if thermo-treated for anti-nutrition factors such as tannin could replace soya bean up to 50% in the diet of fish feed composition. This level would be significantly replace expensive soya bean in the fish feed manufacturing industries since locust bean is an agriculture product with no direct competition with man.

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