



Growth Performance and Survival Rate of *Heterobranchus bidorsalis* Fed Diets Containing Graded Levels of Locust (*Kraussaria angulifera*) Meal

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ABSTRACT

The experiment was carried out at the Center for Applied Science and Technology Research (CASTER), Biochemistry Laboratory unit, Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria in year 2017. 120 juveniles of *Heterobranchus bidorsalis* juveniles were used for the experiment and were allocated into four treatments with triplicates (30 juveniles per treatment and ten juveniles per replicate). The study was conducted to evaluate the growth performance and survival rate of *Heterobranchus bidorsalis* fed diets containing graded levels of locust meal for 56 days. Four experimental diets were formulated at graded levels of inclusion Control T₁ (100% fish meal diet), T₂ (20% locust meal diet), T₃ (40% locust meal diet) and T₄ (60% locust meal diet) respectively. Twelve experimental culturing tanks of 60x 45x 30cm were used. Data were subjected to analysis of variance (ANOVA) to determine difference between the treatments, were differences existed, they were separated with Duncan multiple range test (DMRT) AT 0.05% according to procedure of steel and Torrie (1980). The research findings based on the growth performance and survival rate parameters which include feed conversion ratio, relative growth rate, specific growth rate, total body length, mean weight gain, survival and mortality showed significant differences (P < 0.05) except the mortality rate and survival rate had no significant difference (P > 0.05). The growth parameters measured during this study showed that, diets with inclusion levels of locust meal (T₄ and T₃) were utilized with better specific growth rate, feed conversion ratio, although T₄ was the best on the overall. All the graded levels (T₂, T₃ and T₄) of diets containing locust meal performed better than the 0% level of inclusion. These indicate that locust meal could be substituted with fish meal without negative effect on the fish..

Keywords: Locust meal, Growth, Survival, fish meal

INTRODUCTION

Aquaculture, the farming of aquatic organism which includes molluscs, fish, aquatic plants and crustaceans is essential to meet the protein requirement of Nigerians. After some time, there has been increment in fish production in Nigeria. Bello (2007) and FAO (2005). According to them, the artisan fish production level increases by 5.4%, industrial fishery through the use of trawlers by 12%, and aquaculture fish production by 43% over the earlier years. Despite the increment in production of fish, the desired outcome has not been accomplished. To completely upgrade aquaculture to its preferred level, four different production challenges have been recognized. These are the challenges of management of pond water quality and feeding the fish stock in the pond, pond establishment /construction and fish seeds provision. The first two challenges: water quality management and

fish feeding affect each other. The water quality is been affected by the level of feeding of the stocks, while the feeding performance of the fish in the pond is affected by the level of water quality (George, 2001).

Fish like other animals requires nourishment to have the capacity for normal metabolic processes. In aquaculture, feeding of fish is either complete or supplemented. Supplementary feeding is when the feeds are given to the animals at a limited level to add to the available feed in their natural environment. The natural food available for fishes in their natural environment includes zooplankton and

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phytoplankton. The complete feeding is the one in which the source of food fed to the fish is completely provided by the fish farmer. In whichever case, the kind of fish feeding system practiced relies upon the type of production in which the farmer is involved in and also the nature of the pond (Ezekiel, 2004).

The African catfish, *Clarias* and *Heterobranchus* species are considered as a highly priced fish in Nigeria and Africa at large (Diyaware and Onyia, 2014) Twelve experimental culturing tanks of 60x 45x 30cm were used. The reason for their suitability for culture include, their ability to withstand poor water quality, high stocking density, stressed condition and high feed conversion efficiency among others. This is presumably because of low protein digestion bringing about low feed proficiency. Hence, there is need to address the issue of faster growth rate performance so as to meet the high demand of fish and to favor high a shorter growth span. It has been recommended that the growth performance of cultured populations could be improved through the inclusion of grasshopper to the diet to increase feed efficiency, (Ezekiel, 2004).

Grasshopper are generally rich in CP (50-65%), however some with lower values (<30%) have been reported. The fat content is quite variable and ranges from relatively high value (>20%) to low values (<5%) to. The DM is 23-35%. Ca content is relatively reduced, compare to other insect species. The “fibre” content may be considerable and increases with age: adult grasshopper contain up to 22% neutral detergent fibre (NDF) vs 12% for the nymphs (Finke, 2002). Grasshopper could be used to replace up to 25% level of dietary protein in *C. gariepinus* juveniles without considerable reduction in growth. However, elevated inclusion rates decreases performance and digestibility (Alegbeleye *et al.*, 2012).

Locust could be used to supplement up to 25% level of dietary protein in *C. gariepinus* juveniles without a significant decrease in growth. Higher substitution rate will decrease performance and digestibility (Alegbeleye *et al.*, 2012, Johri *et al.*, 2010; Johri *et al.*, 2011).

Table: 1 Comparative amino acid profile of the proteins fish meal and grasshopper meal

Amino acid	Fish meal	Grasshopper meal
Lysine	7.85	5.87
Histidine	2.22	7.62
Arginine	5.82	9.32
Aspartic	9.35	4.08
Threonine	4.55	5.22
Serine	13.3	15.21
Glutamic	4.35	5.02
Proline	5.9	4.78
Glycine	6.34	5.29
Alanine	0.7	1.79
Cysteine	5.65	3.47
Valine	2.84	1.96
Methionine	4.85	4.21
Isoleucine	7.35	5.3
Leucine	3.45	2.88
Tyrosine	3.35	4.5
Phenylalanine	3.33	4.3

Source: Olaleye I.G (2015) Effects of Grasshopper Meal in the Diet of *C. gariepinus* Juveniles.

The purpose of the present study is to find cheaper of fish protein for fish feed as alternative to fish meal. Unlike fish consumption by man majority of people do not eat locust therefore, its demand as food is less than fish, consequently its price is lower.

Locust has approximately 24% crude protein which makes it a potential source of animal protein in formulation of fish diets (FAO, 2004).

METHODOLOGY

Study Area

The study was conducted at Center for Apply Science and Technology Research (CASTER), Biochemistry Laboratory, Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria which lies at longitude of 9.02 and latitude of 6.34 of the equator. The area is located in the vegetative Zone of guinea savannah middle belt of Nigeria. It has an average temperature of 23^{oc} -34.4^{oc} and a minimum rainfall of 107.3mm. The soil is litrate or ferruginous (Anonymous, 2001). The main of occupation citizens is farming, but minority engaged into trading.

Experimental Fish

Fishes were procured from Kuje Farms Abuja, transported to school in plastic containers. The fish were fed twice daily (8.00am and 17.00pm). The number of juveniles weighing between 8-10g and 12-15cm each and numbering one hundred and twenty were used and experiment lasted for 8 weeks.

Collections of Materials for Processing, Formulation and Preparation of Diets

Samples of Locust were purchased from local market in Lapai Local government area of Niger state. All the feed ingredients were collected, weighed with electronic weighing balance, dried, ground, mixed, made into paste, pelleted and sun-dried. The percentage inclusion of locust meal were 0% [Diet I], [Diet II], 20% [Diet III], 40% and [Diet IV], 60% respectively.

Experimental Setup and Management:

Twelve experimental culturing tanks of 60x 45x 30cm were used with 10 fish each. Fish were fed at 5% body weight twice daily. The fecal materials were siphoned and water completely changed every day. The fish were weighed at the beginning of the experiment and after every week for a period of 8 weeks. The quantity of feed was adjusted based on the new body weight of the fish in each in plastic containers. Mortalities were recorded accordingly.

Data Collection

Once in every week of the rearing period of 2 months, the growth parameters were taken with analytical weighing balance and ruler. Calculations were made with following formula (Sawhney and Gandotra, 2010, Paiboon Panase and Kriangsak Mengumphan, 2015)

$$\text{Increase mean weight(\%)} = \frac{\text{Final mean weight (g)} - \text{Initial mean weight (g)}}{\text{Initial mean weight (g)}} \times 100$$

(Paiboon Panase and Kriangsak Mengumphan, 2015)

$$\text{Specific growth rate(\%)} = \frac{\ln(\text{Final mean weight (g)} - \text{Initial mean weight (g)})}{\text{Time (days)}} \times 100$$

(Sawhney and Gandotra, 2010, Paiboon Panase and Kriangsak Mengumphan, 2015))

$$\text{Survival rate (\%)} = \frac{\text{Initial number of juvenile} - \text{Number of dead juvenile} \times 100}{\text{Initial number of juvenile}}$$

(Sabina Sultana, et al, 2013, (Paiboon Panase and Kriangsak Mengumphan, 2015, Sabina Sultana et al, 2013).)

$$\text{Feed conversion ratio} = \frac{\text{quantity of feed consumed (g)}}{\text{weight gain by the fish (g)}}$$

(Sawhney and Gandotra, 2010, Paiboon (Panase and Kriangsak Mengumphan, 2015)

Total body length gain= *Final length*–*initial length*

(Paiboon Panase and Kriangsak Mengumphan, 2015)

$$\text{Average mean body weight gain} = \frac{\text{final weight gain} - \text{initial weight}}{\text{number of fish}}$$

(Paiboon Panase and Kriangsak Mengumphan, 2015)

Table 2: Meal diet compositions of *Heterobranchus bidorsalis*

Ingredients (kg)	T ₁ [CONTROL	T ₂ [20%	T ₃ [40%	T ₄ [60%
Fish meal	2.55	2.04	1.53	1.02
Locust meal	0.00	0.51	1.02	1.53
Wheat flour	1.05	1.05	1.05	1.05
Fish oil	1.11	1.11	1.11	1.11
Bone meal	0.07	0.07	0.07	0.07
Vit. Premix	0.08	0.08	0.08	0.08
Lysine	0.05	0.05	0.05	0.05
Methionine	0.05	0.05	0.05	0.05
Antibiotics	0.03	0.03	0.03	0.03
Vitamin C	0.03	0.03	0.03	0.03
Yeast	0.02	0.02	0.02	0.02
TOTAL	5.04	5.04	5.04	5.04

RESULTS

Table 3. shows the result of the growth performance of *Heterobranchus bidorsalis* fed diets containing graded level of locust meal. There was no significant different ($p>0.05$) between the values of mortality and survival rate. However, there were significant different ($p<0.05$) between the values of specific growth rate, relative growth rate, mean body weight, feed conversion ratio and total body length across the four dietary treatments. For the values of SGR obtained T₄ had the highest value (56.91) while T₁ was the lowest (11.36). For the values of relative growth rate recorded, T₄ was

the highest value (371.71) while T₁ had the lowest (72.91). There was significant increase in the feed conversion ratio with increased in inclusion of locust meal. The least FCR was recorded in T₁ (20.20) and T₄ had the highest FCR value (32.30). The best total body length was recorded in fish fed diet 4 (5.20), followed by diet 3(4.67) and 2 (4.23), while the least value was recorded with fish fed control diet (1.90). The highest mean weight gain was recorded in diet 4 (3.20), T₁ was significantly different from other treatments regarding to the values of mean weight gain calculated (0.62).

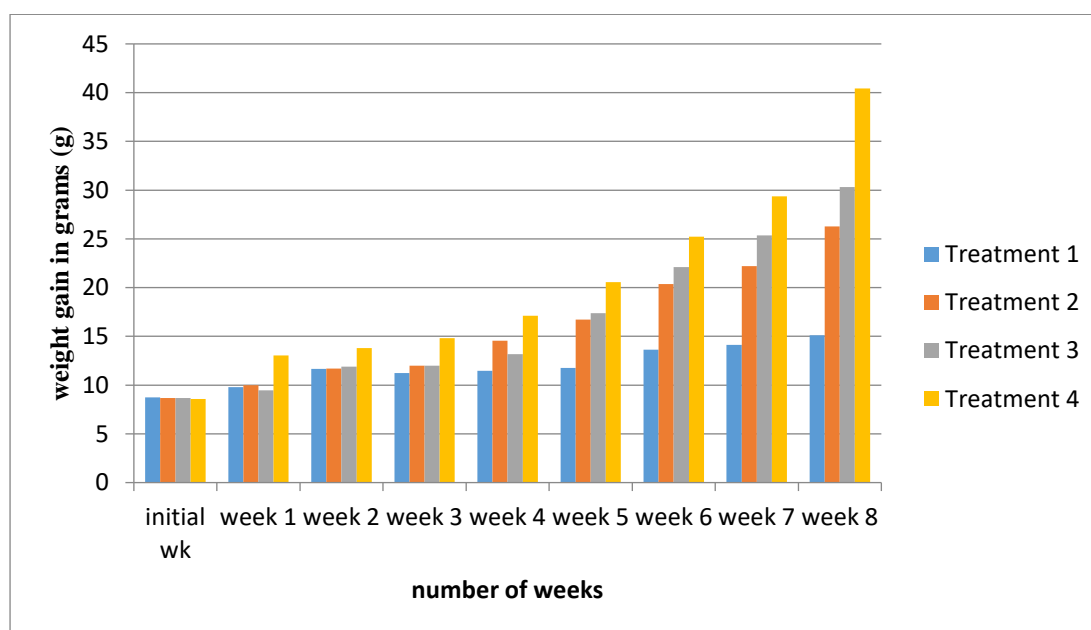


Figure 1: Chart showing the weekly average body weight gain of *Heterobranchus bidorsalis* fed diets containing graded level of locust (grasshopper) meal (g)

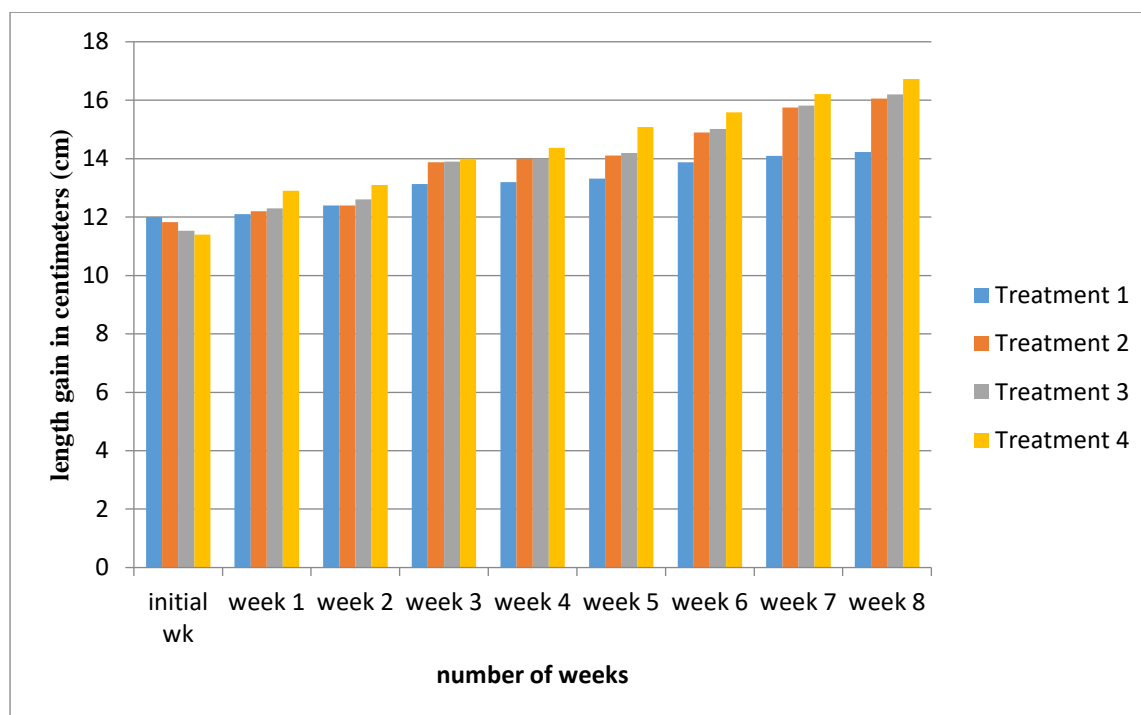


Figure 2: Chart showing the weekly average length gain of *Heterobranchus bidorsalis* fed diets containing graded level of locust (grass hopper) meal (cm)

Table 3: Showing the growth performance and survival rate of *Heterobranchus bidorsalis* fed diets containing graded level of locust (grass hopper) meal.

	T ₁	T ₂	T ₃	T ₄	LSD	SEM±	SEG
Parameters	0%L (control)	20%L	40%L	60%L			
SGR (%)	11.36 ^d	31.43 ^c	38.63 ^b	56.91 ^a	0.49	4.92	*
RGR (%)	72.91 ^d	203.23 ^c	205.55 ^b	371.71 ^a	10.89	32.42	*
FCR (g)	20.20 ^d	24.20 ^c	27.23 ^b	32.30 ^a	0.12	1.33	*
Mortality rate (%)	43.33	30.00	30.00	30.00	7.45	2.84	NS
Survival rate (%)	56.67	70.00	70.00	70.00	7.45	2.84	NS
TBL (cm)	1.90 ^d	4.23 ^a	4.67 ^a	5.20 ^a	0.89	0.47	*
MWG (g)	0.62 ^d	1.76 ^c	2.17 ^b	3.20 ^a	0.03	0.28	*

NS=not significant, *= significant, S.E.M: Standard error of mean, SEG=significant difference, LSD=least standard deviation, T₁= diet with 0% locust meal, T₂= diet with 20% locust meal, T₃= diet with 40% locust meal, T₄=diet with 60% locust meal, SGR=specific growth rate, RGR= relative growth rate, FCR= feed conversion ratio, TBL= total body length, MWG= mean weight gain

DISCUSSION

Protein whether from plant or animal source has been an important component of amino acid for the growth of living organism, such as fish. The role of locust as a cheaper source of protein for feed formulation has been identified, which is capable of replacing fish meal.

The study revealed that the inclusion of diets containing graded levels of locust meal in the feed of *H. bidorsalis* gave better growth in T₄, T₃ and T₂ both in terms of specific growth rate, relative growth rate, feed conversion ratio, total body length and mean body weight than the control (T₁), which differ significantly ($p < 0.05$) from others. Although T₄, T₃ and T₂ gave better

growth, T₄ with the highest level of inclusion performed best. Okoye and Nnaji (2004) reported 10% inclusion of grasshopper meal in the diet of *Oreochromis niloticus* to have given the best growth rate while Olaleye (2015) did report highest weight gain with 15% grasshopper meal in *Clarias gariepinus*; there was decreased in weight with increased grasshopper meal in diet. This contradicts the findings of this study. This may be due to difference in fish species because fish have different rate of feed conversion. The species of grasshopper as well as their sizes may also have contributed to these observations.

Specific growth rate of *H. bidorsalis* increased as the level of locust meal inclusion also increases. T₄ was highest and T₁ was lowest, which differ significantly ($p < 0.05$), an indication that the feed was converted into more flesh with increased inclusion. This was reflected in the body weight gain during the period of study.

Feed conversion ratio is an indicator that shows how efficient a feed has been utilized. It is reflected in the weight gain on the organism. The higher the value of FCR the higher the weights gain. FCR in this study was lowest in T₁ and highest in T₄, which differ significantly ($p < 0.05$). This indicates that locust meal becomes more palatable with increased levels of inclusion. Increase in FCR also results in increase of *H. bidorsalis* body weight gain, which shows better utilization of the meal.

The percentage survival of *H. bidorsalis* in T₄-T₃ diets was quite high throughout the period of study. This is an indication that feeding the fish with locust meal gave an excellent survival rate. These indicate that locust meal incorporated in the diet of *H. bidorsalis* does not have negative effects. Olaleye (2015) also reported high survival rate with *C. gariepinus* fed diet containing grasshopper meal..

Conclusion

This study has given insight on the growth performance and survival rates of *H. bidorsalis* fed diets containing graded levels of locust meal. The growth parameters measured during this study showed that, diets with inclusion levels of locust meal (T₄ and T₃) were utilized with better specific growth rate, feed conversion ratio, although T₄ was the best on the overall. All the graded levels (T₂, T₃ and T₄) of diets containing

locust meal performed better than the 0% level of inclusion.

Locust meal diet has the potential to substitute fish meal for *H. bidorsalis* to achieve optimal growth performance. There was high survival rate throughout the period of study, which did not show any significant difference ($p > 0.05$).

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