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GROWTH PERFORMANCE AND FEED UTILIZATION OF *CLARIAS GARIEPINUS* (BURCHELL, 1822) FED DIETS CONTAINING SUN-DRIED LOCUST MEAL (*SCHISTOCERCA GREPARIA*) AS REPLACEMENT FOR DIETARY FISH MEAL

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ABSTRACT

This study was conducted to evaluate the effects of replacing fish meal with sun-dried locust meal in the diet for *Clarias gariepinus.* Juveniles. Juveniles(20.0±0.02g) were stocked in improvised non-recirculatory and semi-flow through indoor plastic tanks (52x34x33cm) and fed diets (40% crude protein) containing sun-dried locust meal (SDLM) at levels of 0%, 25% 50% and 75% inclusion (Diets I, II, III and IV respectively) with two diets acting as control and reference (Diets (I and V). At the end of the 84 days feeding trials, diets with higher inclusion levels of SDLM (Diets III and IV) significantly depressed growth performance of fish. The variations observed in the Specific Growth Rate (SGR), Fed Conversion Ratio (FCR), Feed Efficiency Ratio (FER) and Protein Efficiency Ratio (PER) were associated with the chitin present in the diets, these parameters reduced with increasing levels of SDLM in the diets of fish. The results suggested that SDLM can be used to substitute up to 25% levels of dietary protein in *C. gariepinus* juveniles without significant reduction in growth.

Keywords: Growth, Feed utilization, *Clarias gariepinus*, sun-dried locust meal

INTRODUCTION

The high cost and fluctuating price of fish meal as well as its uncertain availability and high demand has led to the need to identify alternative protein sources for fish feed (Al-Thobaiti *et al.*, 2018, Sumon *et al.*, 2023). Numerous emphases have been directed at the use of conventional plant protein sources mostly soybean (Meng *et al.*, 2020) and Pervin *et al.* (2020). However, the scarcity of these plant sources and competition from other sectors for them make their costs too high and places them far beyond the reach of fish farmers or producers of aqua-feeds (Radhakrishna *et al.*, 2016). Therefore, in an attempt to attain a more economically sustainable and viable production, research interest has been directed towards the evaluation and use of unconventional or lesser utilized plant and animal protein sources which are available (Sahito *et al.*, 2015)

This research gives an account of the potentials of using graded levels of locust meal as replacement for fish meal in the diets of *C. gariepinus.*

MATERIALS AND METHODS

Experimental Site and Fish

The experiment was conducted under laboratory conditions at the Department of Biological Sciences, Ahmadu Bello University (ABU), Zaria. It lies between latitudes 10 and 11^{o}N and longitudes 7 and 8^{o}E at an altitude of 645m above sea level. The annual rainfall averages around 1, 200mm, while the mean monthly temperature generally varies between 26^{o}C and 34^{o}C (Bununu *et al*., 2015).

C. gariepinus used in the experiment were obtained from Bagiwa farms, Katsina State.

Three hundred and fifty (350) *Clarias juveniles* were transported in two (50 litres) containers between 0700 and 0800 hours to an outdoor concrete tank (100x150x120cm) of the Department of Biological Sciences, Ahmadu Bello University (ABU), Zaria to acclimatize for 14days prior to feeding trials.

During acclimatization, fish were fed with 42% crude protein at 5% body weight twice daily. The water temperature, pH and dissolved oxygen (D.O) were monitored. Water in the outdoor concrete tank was replaced every two days.

Experimental Diet

The feed ingredients used in the feed formulation were maize, soya bean cake, wheat offal, palm oil, bone meal, cassava, fish meal, locust, salt, vitamin and mineral premixes and were purchased from Samaru market, Zaria. Thereafter, they were processed, grinded into meal, stored and pelletized using a pelletizer after appropriate weighing and thorough mixing of ingredients. The feed was formulated based on 40% crude protein.

Experimental Design

At the end of the acclimatization period, the fish were introduced into indoor plastic tanks (52x34x33.5cm). The experimental design was a completely randomized design. A total of one hundred and fifty (150) juvenile fish (20.0±0.02g) were randomly distributed into the tanks at a stocking rate of 20 fish per tank. The fifteen (15) tanks were assigned to five (5) treatments (control and reference inclusive) at the rate of one treatment per experimental diet with three replicates per treatment. The experimental design was a completely randomized design. Sundried locust meal was used as protein source that progressively replaced fish meal on an isonitrogenous (40% crude protein) basis at graded replacement levels of 0% (diet I), 25% (diet II), 50% (diet III), 75% (diets IV) in the ration formulated and Coppens commercial diet (diet V) was reference diet. Fish were fed twice daily (manually) at 5% of their body weight and were weighed biweekly until the experiment terminated at 84 days. The biweekly weighing allowed for adjustment of feeding levels for the subsequent weeks.

Physicochemical Parameters of Water

Water temperature, pH and dissolved oxygen (DO) were recorded weekly using HANNA instruments Model: HI-98129, HI-987130 and HI-3810. Unconsumed diets and faecal matter were siphoned off daily.

Proximate Compositions of Experimental Diet

Prior to the onset of the experiment and on completion of the experiment, fish samples from each of the treatment were collected for proximate analysis according to the standard methods described by AOAC 2004. Nitrogen free extracts in samples were determined by difference.

Statistical Analysis

Data obtained were subjected to One-way Analysis of Variance (ANOVA). Least Significant Difference (LSD) was used to separate means manually at 5% confidence level ($p \leq 0.05$).

Table 1: Gross Compositions of Experimental Diets

Dietary Ingredients	**Locust meal replacements levels (%)**				
%	**0**	**25**	**50**	**75**	**Reference diet (Copens)**
	Diet I	**Diet II**	**Diet III**	**Diet IV**	**Diet V**
Maize	25.00	17.45	12.00	6.00	
Soyacake	12.00	19.00	26.45	35.45	
Wheat offal	5.95	5.00	2.00	0.00	
Palm Oil	4.00	5.00	4.00	3.00	
Bone meal	1.00	1.00	1.00	1.00	
Cassava	2.00	2.00	2.00	2.00	
Fish meal	44.00	33.00	22.00	11.00	
Locust	0.00	11.00	22.00	33.00	
Salt	0.30	0.30	0.30	0.30	
Premix	0.25	0.25	0.25	0.25	
DL-Methionine	2.00	2.20	2.50	2.50	
Lysine	3.50	4.00	4.50	4.50	
Total	100.00	100.00	100.00	100.00	
Calculated nutrient compositions analysis					
Crude Protein	40.00	40.00	40.00	40.00	
Metabolizable Energy	3212	3235	3225	3226	
Ether Extract %	4.69	3.60	3.55	3.45	
Crude Fibre %	2.52	2.97	3.21	3.40	
Calcium %	1.82	1.52	1.31	1.28	
Phosphorus %	1.27	1.06	0.96	0.85	
Lysine %	5.09	3.05	3.05	3.01	
DL-Methionine %	3.05	5.05	5.00	5.02	

Composition per 25kg of Bio premix is Vitamin A, 400iu; Vitamin D 800.00iu; Vitamin E1 500mg; Niacin 10, 000mg; Panthotenic acid 3, 500mg; Biotin 5mg; Vitamin B10mg; Folic acid 200mg; Chloric chloride 130,000mg; Manganese 60,000mg; Iron 15, 000mg; Copper 800mg; Iodine 400mg, Cobalt 80mg, Selenium 400mg; Antioxidant 40, 000mg.

RESULTS

The proximate composition of the locust meal diet shown in Table 2 indicated that the mean crude protein content of the locust meal (diet V) had the highest crude protein content while diet IV had the least crude protein content. There was significant difference ($p<0.05$) in the crude protein contents in diets I to V.

Table 2: Proximate Composition of Experimental Diets

Nutrients	Locust meal levels replacing fishmeal				
	Diet I (0%)	**Diet II (25%)**	**Diet III (50%)**	**Diet IV (75%)**	**Diet V (Reference Diet)**
Dry Matter (DM)	93.89	94.20	93.71	92.37	93.79
Ash (ASH)	4.90	4.45	4. 17	4.99	5.85
Crude Protein (CP)	40.00^{c}	41.26^{d}	39.70^{a}	39.58^{a}	42.09^{c}
Ether Extract (EE)	8.67	8.64	7.39	7.54	8.99
Crude Fibre (CF)	2. 16	3.91	3.98	4.25	2.50
Nitrogen Free Extract (NFE)	38.16	35.94	38.47	36.01	34.36

Values with the same superscripts in the same row are not significantly different (P>0.05) LSD.

The growth performance and feed utilization of *C. gariepinus* fed varying replacement levels of locust meal as shown in Table 4 reveals that fish fed diet V had the highest weight gain (92.43g), then diet I (81.46g) while diet IV gave the least mean final body weight of fish fed the various diets.

Fish fed the control diets I and V attained better weight gain compared to the rest of the diets, there was significant (P<0.05) in mean weight gain (MWG) between diets I and V. Similar observations were recorded for diets II (21.20g) and diets III (12.53g). Diet IV had the least mean weight values (12. 17g).

Diet I and V had the highest PLWG 306.69% and 370.08% respectively. These diets were significantly different (P<0.05) from diets II, III and IV (Table 4).

Based on the mean values, the highest SGR values were obtained in the control diets, diets I and V respectively. Diet I had the SGR value of 1.67 while diet V had 1.84. The least SGR value was obtained in diet IV (0.56) followed by diet III (0.57), (Table 4). The specific growth rate (SGR) of all the experimental diets were not significantly different (P>0.05).

Diet III had the highest FCR value of 3.48, followed by diets IV (3.24) and diet II (1.45) respectively (Table 4). The best FCR results were obtained in the control diets I and V (100% fish meal and 100% coppens) with mean values of 0.62 each, which represented the least FCR values in this experiment.

Diets I and V gave the highest FER values of 1.62 and 1.63 respectively followed by diet II (0.69). The least FER value was obtained in diet III (0.29) (Table 4.23). The best diet in terms of FER was the control diet, diet V (100 coppens) followed by diet 1 (100% fish meal). This had a similar trend with the FCR (Table 4).

Diets I and V (control and reference diets) had the highest PER values of 4.04 and 3.88 respectively, followed by diet 2 (1.67) while the least PER value was obtained in diets III (0.72) and IV (0.78) (Table 4). The best diet in terms of PER was diet I followed by diet V (Table 4). Protein efficiency ratio (PER) values of fish fed diets I and V are significantly different (P<0.05) compared to fish fed diets II, III and IV.

Table 4: Growth Performance and Feed Utilization Parameters of Juvenile *C. Gariepinus* Fed Locust Meal as Replacement for Fishmeal

Locust Meal Replacement Levels (%)	M.I.B.W.	M.F.B.W	M.W.G.	P.L.W.G	SGR	FCR	FER	PER
Diet I (100% fishmeal)	20.03	81.46^{d}	61.43^{d}	306.69^{d}	1.67	0.62^{a}	1.62^{c}	4.04^{e}
Diet II (75% fishmeal 25% Locust)	20.40	41.60^{c}	21.20^{c}	103.92^{c}	0.85	1.45^{b}	0.69^{b}	1.67^{c}
Diet III (50% fishmeal 50% locust)	20.40	32.93^{b}	12.53^{b}	61.42^{b}	0.57	3.48^{d}	0.29^{a}	0.72^{a}
Diet IV (25% fishmeal 75% locust)	20.20	32.37^{a}	12. 17^{a}	60.25^{a}	0.56	3.24^{c}	0.31^{a}	0.78^{b}
Diet V (100% coppens)	19.63	92.43^{e}	72.8^{e}	370.08^{e}	1.84	0.62^{a}	1.63^{d}	3.88^{d}
SED ±	0	0.01549	0.0126	0.0173	0.015	0.0126	0.0154	0.0154
LSD (P=0.05)	0NS	0.04300	0.0351	0.0480	0.043NS	0.0351	0.043	0.0430

Values with the same superscripts in the same column are not significantly different (p>0.05) LSD. Superscript ^{a} stands for the lowest value, while superscript ^{e} stands for the highest value.

Key: SED=Standard Error of Deviation, LSD=Least Significant Difference

DISCUSSION

The growth performance of the diets in terms of mean weight gain (MWG) and PLWG indicated that there were positive and significant growth in fish fed the reference diet 5 (72.80g; 370.08%) and control diet I (61.43g; 306.69%) respectively and this was a reflection of the superiority of these diets over the experimental diets. The most superior diet in terms of MWG and PLWG among the experimental diets was diet II (21.20g; 103.92). The gradual trend of reduced values of MWG and PLWG observed with increased inclusion levels of the sun dried locust meal diet III (12.53g; 61.42%) and diet IV (12. 17g; 60.25%) respectively in *C. gariepinus* fed graded levels of sun-dried locust meal were below expectation, in spite of the conductive physicochemical parameters of water recorded. This could probably be attributed to the presence of chitin in locust. Similarly, Michael and Kolapo (2017) reported that negative effects of growth indices with an increase in

grasshopper meal (GHM) replacing fish could be due to presence of chitin in grasshopper. Wang *et al.* (2006), Sogbesan and Ogunba (2008) made similar observations when non-conventional animal protein feed stuffs were fed to fish and livestock.

The high SGR values, high FER, high PER and low FCR values of fish fed diet II confers it with better advantages for growth and efficiency of feed utilization over the rest of the experimental diets. This result agrees with the assertion of Olaniyi (2009a&b) and Solomon et al. (2016) who reported that a lower FCR value implies efficient feed utilization by fish.

The performance in terms of growth and other feed utilization indices of *C. gariepinus juveniles* fed 50% locust meal and 75% locust meal were observed to be poor compared with the juveniles fed 25% locust meal. The result therefore indicated that up to 25% locust meal could replace fish meal in the diet of African catfish fingerlings without any adverse effect on the growth performance.

CONCLUSION

The decreased trend in growth performance and feed utilization of the experimental diets with increased inclusion levels of locust meals in the study suggests that sun-dried locust meal have the potential of replacing fish meal in fish feed formulations provided they are utilized at low levels of inclusion in circumstances where fish meal is not available.

REFERENCES

Al-Thobaiti, A., Al-Ghanim, K., Ahmed, Z., Suliman, E.M., and Mahboob, S. (2018). Impact of Replacing Fishmeal by a Mixture of Different Plant Protein Sources on the Growth Performance in Nile Tilapia (*Oreochromis niloticus L.)* Diets. *Brazilian Journal of Biology,* 78(3): 525-534

AOAC (2004). *Official Methods of Analysis* 15th Edition. *Association of Official Analytical Chemists* Washington DC

Bununu, Y. A., Ludin, A. N. M. and Hosni, N. (2015). City Profile: Kaduna. *Elsevier,* 49: 53-65

Michael, K.G and Kolapo, A. (2017). Effects of Replacing Fish Meal with Grasshopper Meal in the diet of *C. gariepinus* (Burchell, 1822) Fingerling, *Nig. J. Fish. Aqua 5(*1*): 1-9*

Meng, F., Li, B., Xie, Y., Li, M., Wang, R. X. (2020). Substituting Fishmeal with extruded Soybean Meal in diets did not the growth performance, hepatic enzyme activities, but hypoxia tolerance of Dolly Varden (*Salvelinus malma)* juveniles. Aqua. Res. 5(1): 379-388

Pervin, M. A.., Jahan H., Akler R., Omri A., Hossain Z. (2020). Appraisal of different levels of soybean meal in diets on growth, digestive enzyme activity, antioxidation and gut histology of tilapia (Oreochromis niloticus) *Fish Physiol.* Biochem, 46(4): 1397-1407

Olaniyi, C. O., Bini Omote, T. and Gbadamasi, M. (2009a).*Growth Performance and Nutrient Utilization of Clarias gariepinus fed processed Macuna feed meal* . In: Proceeding 34 Annual Conference. Nigerian Society for Animal Production. pp. 222-225

Olaniyi, C. O., Aderinola, O. A., Rafiu, T. A. and Okunola, D. O. (2009b).).*Growth Performance and Nutrient Utilization of Clarias gariepinus fed locust bean seed meal* . In: Proceedings of 14 Annual Conference. Animal Science Association of Nigeria (ASAN) pp. 550-552.

Radhakrishnan, S., Bhavan, P. S. Seenivasan, C and Muralissnankar, T. (2016). Impact of Fishmeal Replacement with Arthrospira

Platensis on Growth Performance, Body Composition and Digestive Enzyme Activities on the Freshwater Prawn, Macrobrachim rosenbergii. Aquaculture Research Vol. 3, pp 35-44.

Sahito, M. A., Ansari, I. B., Narejo, N. T., Suheryan, I., Waryani, B., Ansari, Z. A. and Noor-ul-Ain, N. (2015). Comparative Study of Biochemical Properties of Non-Conventional Plant Sources to Prepare Low Cost Fish Feed. *Pakistan Journal of Nutrition* 14 (7): 431-435.

Sogbesan, A. O., and Ugunba, A. A. A. (2008). Nutritional values of some non-conventional Animal protein feed stuffs used as fishmeal supplements in Aquaculture practices in Nigeria. *Turkish Journal of Fisheries and Aquacultural Scientist;* 8:159-164

Solomon, S. G., Okomoda., V. T. and Torkor, E.F. (2016). Growth Performance of Clarias gariepinus Fingerlings fed Jathropa Curcas Kernel Meal. International Journal of Aquaculture Vol. 6, No.1

Sumon, H., Kanij R. S., Subroto, S., Sheikh, M. B., Mohammed L.A., Jewel H., Shahjahan, M.D. (2023). Effects of dietary replacement of fish meal by soybean meal on growth, feed utilization and health condition of stinging catfish, *Heteropneustes fossilis.* Saudi J. Biol Sci. Mar, 30(3) 103601

Wang, D., Zhai, S. W., Zhang, C. X. Zhang, Q and Chen, H. (2006). Nutritional value of Chinese grasshopper Acrida cinera (Thumberg) for broilers. Animal Feed and Technology. 135, 66-74.