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OPTIMIZING CLARIAS GARIEPINUS JUVENILE GROWTH WITH LEMNA MINOR LEAF MEAL

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Abstract: This study investigated the effect of including Lemna minor (duckweed) in the diet of Clarias gariepinus juvenile on their viscerosomatic and hepatosomatic indices. A total of 225 juvenile fish were fed with five experimental diets containing varying levels of duckweed inclusion, from 0% to 100% inclusion. The feeding rate of the fish increased fortnightly based on 5% biomass. Results showed that the inclusion of duckweed had a significant effect on the weight gain and viscerosomatic and hepatosomatic indices of the fish. Fish fed with a diet containing 100% inclusion of duckweed had the highest weight of viscerosomatic and hepatosomatic indices. The study recommends the inclusion of L. minor leaf meal in the diet of Clarias gariepinus at 100% inclusion, which can enhance feed utilization efficiency and reduce the cost of conventional feedstuff.

Keywords: Clarias gariepinus juvenile, Lemna minor, viscerosomatic index, hepatosomatic index, alternative protein sources

Introduction

The inclusion of alternative protein sources in fish feeds has been a major focus in aquaculture due to the high cost and unsustainable nature of using conventional feedstuff. One such alternative is Lemna minor (duckweed) which has been reported to have a high protein content and can be sustainably cultured in fresh water bodies. This study aimed to investigate the effect of including Lemna minor leaf meal in the diet of Clarias gariepinus juvenile on their viscerosomatic and hepatosomatic indices.

A total of 225 juvenile fish were used in this experiment and were divided into five treatments, with different levels of duckweed inclusion in their diets. The feeding rate of the fish increased fortnightly based on 5% biomass. The fish were reared for 12 weeks and their viscerosomatic and hepatosomatic indices were measured.

The results showed that the inclusion of duckweed had a significant effect on the weight gain and viscerosomatic and hepatosomatic indices of the fish. Fish fed with a diet containing 100% inclusion of duckweed had the highest weight of viscerosomatic and hepatosomatic indices. This study highlights the potential of using alternative protein sources such as duckweed in fish feeds to enhance feed utilization

efficiency and reduce the cost of conventional feedstuff, while also improving the growth performance of the fish.

In conclusion, the study recommends the inclusion of L. minor leaf meal in the diet of Clarias gariepinus at 100% inclusion for optimal growth and improved viscerosomatic and hepatosomatic indices. This could be a sustainable and cost-effective alternative to conventional feedstuff.

MATERIALS AND METHODS

The study was carried out in the Aquaculture Unit of Fisheries Technology Department, Lagos State Polytechnic, and Ikorodu Campus for 12 weeks. Two hundred and twenty five (225) Catfish (*Clarias gariepinus*) juveniles purchased from reputable fish hatchery farm located at government assisted fish farm estate, Ikorodu Lagos were used as test animal. Feed ingredients sourced locally were used for the formulation of the practical diets. The facilities used for the experiment are; weighing scale (g) to the 2 decimal places, overhead plastic water tank, hand-held pH meter, hand net, thermometer, D.O meter, fifteen (15) rectangular plastic basins measuring 40cm x 28cm x 26cm each.

Fifteen (15) rectangular plastic basins were separated into 1 treatment and 3 replicate each using complete randomized design method (CRD). Each treatment and replicate was stocked with (45) juveniles that is, 15 numbers of *Clarias gariepinus* in each rectangular plastic. The experimental fish was acclimatized in a plastic tank for 24 hours before the start of the experiment. Fifteen numbers of catfish juveniles each was weighed to the nearest decimeter using a digital scale and stocked in each plastic tank and their replicates.

Biomass of *L. minor* was cultured in 4 circular plastic tanks of 2000 liters capacity situated in the aquatic ecology unit of Fisheries Technology Department. The *L. minor* was identified from other species by using taxonomy chart. The culturing of *L. minor* was carried out under the following limnological parameters; average pH values of 6.5 and temperature range of 30 ^{o}C - 33 ^{o}C. The harvested *L. minor* of 44kg collected from the plastic tank are spread between 14cm and 15cm thickness on a net (Kakaban) corresponding to a weight of 4 kg/m^2. *L. minor* was sundried for approximately 7 hours per day for two days to dry matter content of 240 g/kg to 250 g/kg for ease of grinding, mixing with other feed ingredients and as well as retaining the nutritive value. *L. minor* biomass are turned every 30mins during sun drying to avoid molds growth to attain low moisture content between 40% and 60% dry matter concentration. After the attainment of 40% to 60% dry matter, sun dried *Lemna minor* biomass was fine crushed in a grinder to form *Lemna minor* meal and mix with other ingredients based on calculated percentage in feed formulation. This method was described by Undersander *et al.,* (1993) and NCE STATE EXTENTION, (2013) then cited by Babalola *et al.,* (2019)

Thirty kilograms (30kg) of experimental diets was formulated for five treatment which include; maize, fish meal, premix, lysine, methonine, salts which was obtained from local market in Ikorodu, Lagos with the exception of duckweed (*Lemna minor)* biomass sample that was collected from natural freshwater body in Ikorodu and cultured in a plastic tank for multiplication. The wilted *L. minor* was grinded together with other feed ingredients based on calculated inclusion using Pearson Square method of feed formulation and subsequent pelletilization. The ingredients were used to formulate five different experimental diets using 35% crude protein requirement for *C. gariepinus* juvenile. The wilted *L. minor* was included with other feed ingredient at 0%, 25%, 50%, 75% and 100% levels of inclusion and proximate analysis of pulverized feed ingredients was conducted based on levels of inclusion of *L. minor* leaf meal as shown in Tables.1 and 2 respectively

Table 1: Composition of the experiment diet

Ingredient	Diet I (0 %)	Diet II (25 %)	Diet III (50 %)	Diet IV (75%)	Diet V (100 %)

Maize	10.845	18.856	16.102	13.483	11.601
Fish Meal	8.555	0.272	1.639	2.958	3.899
L. minor	0	0.272	1.639	2.958	3.899
Premix	1.5	1.5	1.5	1.5	1.5
Lysine	0.5	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5

** L. minor = Lemina minor*

Table 2: Proximate analysis of experimental diets

Ingredient	Diet I (0 %)	Diet II (25 %)	Diet III (50 %)	Diet IV (75%)	Diet V (100 %)
Moisture	83.50	72.50	94.00	93.00	93.50
C P	28.35	37.45	37.63	38.06	38.16
Lipid	14.00	16.50	17.00	17.50	17.55
Ash	5.50	6.00	6.50	8.00	9.00
Crude Fiber	3.50	4.00	4.50	4.55	5.00
NFE	19.94	23.15	28.87	31.44	32.05

The fishes were divided into five treatments which are replicated three times each and fed twice (7.00 hours and 16.00 hours) a day for 12 weeks at the rate of 5% fish body biomass. During the experiment, the water quality was monitored. The temperature of the water was measured with thermometer calibrated in degree centigrade (°C), the dissolved oxygen was determined by using the digital hand-held oxygen meter and pH of the water was measured with pH meter. The weekly weights recorded was used to compute the hepatosomatic index by HSI, % = [liver weight (g)/total body weight (g) x 100] and the viscerosomatic index by VSI, % = [viscera weight (g)/body weight (g) x 100]. All data was analyzed and calculated by one-way analysis of variance (ANOVA).

RESULTS

Viscerosomatic index (VSI) and Hepatosomatic index (HSI) from *C. gariepienus* Juvenile fed with *Lemina minor* leaf meal for 12 weeks was recorded (Table 3). The highest Viscerosomatic index (VSI) was recorded in juvenile fish fed with Diet V 22.77%. Moreover, the same trend of result was obtained from Hepatosomatic index (HSI) with the highest value of 2.90% index from diet V (100%). Conversely, the lowest percentage indices Viscerosomatic (VSI) and Hepatosomatic (HSI) was recorded in juveniles feed diet (I) containing 0% inclusion of *L. minor* leaf meal as graphically represented in Fig.1&2

Table 3: Viscerosomatic index (VSI) and Hepatosomatic index (HSI) of *C. gariepienu* Juvenile

Parameters (%)	Diet I (0 %)	Diet II (25 %)	Diet III (50 %)	Diet IV (75%)	Diet V (100 %)	SEM
Viscerosomatic index (VSI)	3.01± 0.79	6.75± 2.69	6.92± 0.79	10.40± 3.94	22.77± 8.20	0.510
Hepatosomatic index (HSI)	2.23± 0.61	2.47± 0.62	2.72± 0.62	2.80± 0.62	2.90± 0.62	0.018

Statistical analyses show that at 95% confidence level (P value = 0.000), there is a significance difference in the weight of liver as a result of different diets at 5% level of significance. This shows that the experimental

diets increase the liver weight with the increase in the level of inclusion of *Lemina minor* leaf meal at 95% confidence level.

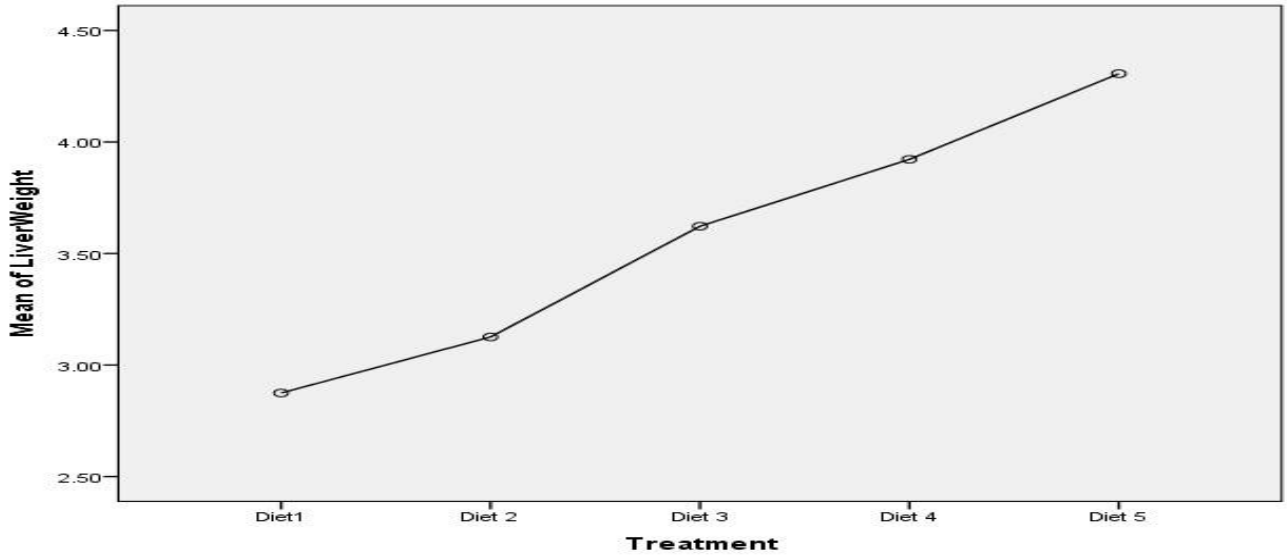

Figure 1. Graph showing increase in liver weight with increase in *Lemna minor* leaf meal. Also, there is a significance difference in the weight of intestine as a result of different diets at 5% level significance. This implies that the inclusion of *L.minor* in the diet affects or improves the intestinal weight of the fish with the increase in the level of inclusion of *Lemna minor* leaf meal at 95% confidence level.

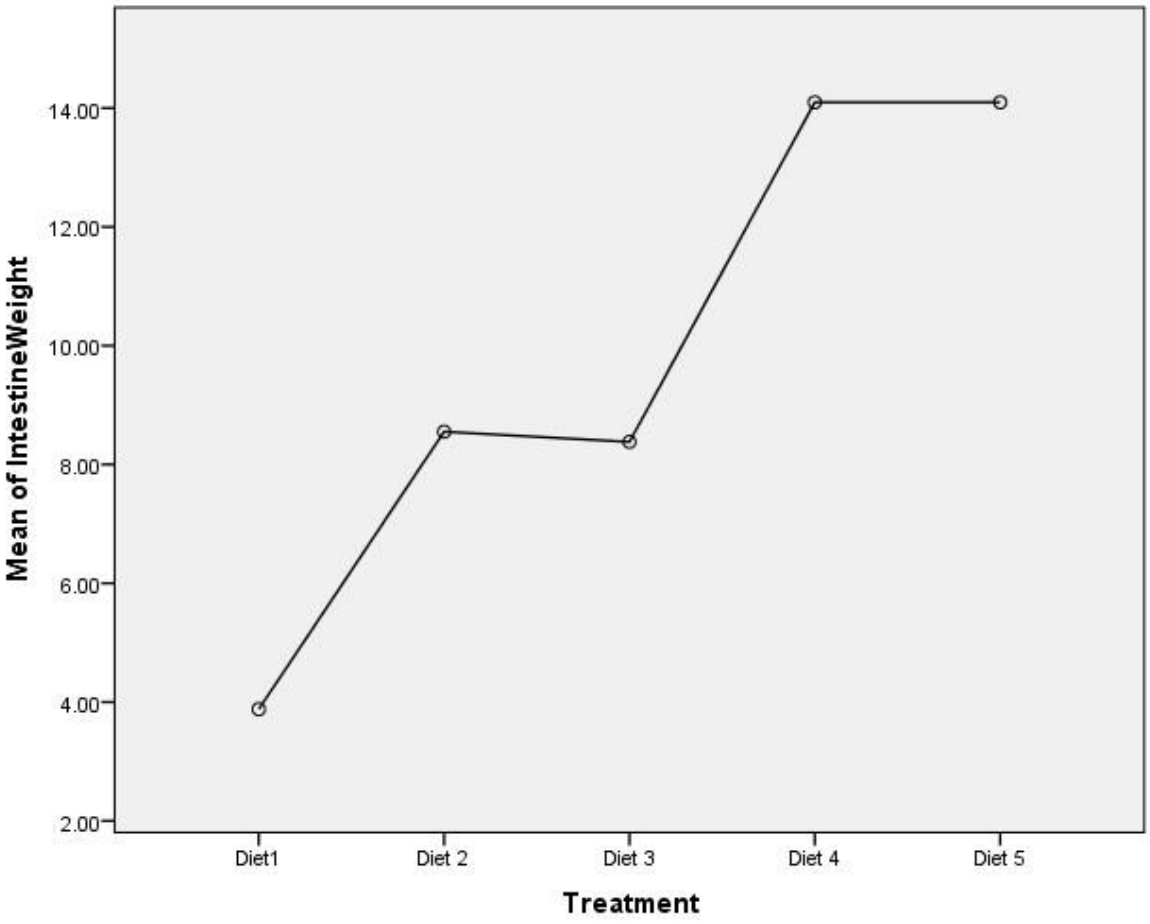

Figure 2. Graph showing increase in intestinal weight with increase in *L. minor* leaf meal There is high significance correlation between liver growth and intestinal growth in the test fish at 0.860 (Correlation is significant at the 0.01 level (2-tailed)). Hence there is a strong positive correlation between the growth of the liver and intestine of *Clarias gariepinus* juvenile fed with diet that contained *Lemna minor* leaf meal.

DISCUSSION

In fish feed formulation there are some essential things that need to be put into consideration for optimum utilization of nutrients from the feed stuff by fish. Those essentials are, the fish species, the nutrient requirements of the specie of the fish, the age/size of the fish, the composition and availability of nutrients in various feed ingredients, and the cost and processing of all the ingredients used in formulation of the feedstuff. The assessment of nutritional utilization and biochemical composition in the feedstuffs can be carried out using mophometric characterization of the fish as described by Vatandoust *et al.,* (2014) using organ and tissue indices of a particular fish. The organ indices commonly used are hepatosomatic index (HSI), viscerosomatic index (VSI), spleenosomatic index (SSI) and gonadosomatic index (GSI) as cited by Sudaporn *et al.,* (2010). The mean of viscerosomatic index and hepatosomatic index of *C. gariepinus* juvenile fed with the experimental diets increases with increase in dietary leaf meal intake, this shows that the fish were able to make use of the dietary leaf meal in feed by converting it into muscle as reported by Marroh and Ekelemu (2016) and Sogbesan *et al.,* (2016) on leaf meal nutrient utilization and performance characteristics of *Clarias gariepinus*. However, the results from this experiment disagreed with the report of Keri *et al.,* (2014) on utilization and dietary intake of varying level of maltose by *Oreochromis niloticus.* This perhaps might be due to differences in the biochemical composition in both practical diets (FAO, 2013) and in the food and feeding habits of the two fishes (Oribhabor and Ogbeibu, 2012)

The different level of inclusion of leaf meal and the corresponding increase in viscerosomatic index and hepatosomatic index shows that *C. gariepinus* juvenile respond positively to changes in nutritional and energy status of the practical diets as reiterated by Ahmad, (2008) on response of *Clarias gariepinus*, to diverse dietary protein and lipid levels in the feeding trial. There is positive correlation between increase in crude protein levels in the practical diet and the increase in viscerosomatic and hepatosomatic indices of the test animal which indicate that the inclusion of *L. minor* leaf meal in the diet of *C. gariepinus* juvenile enhances the bioavailability of the nutrients to the fish as shown in Table 3. This corroborates the report of Schonfeldt *et al.,* (2016) on bioavailability of nutrients.

The corresponding increase in weight of organs and tissue in the *C. gariepinus* juvenile is an indication that *C. gariepinus* juvenile fed with *L. minor* leaf meal is healthy with moderate energy reserve status. This result agreed with the reports of Sashi and Patra (2013) and Ajay Kumar (2015) on the utilization of *L. minor* leaf meal in practical diet for fish. The observable shape and colour of the liver of *C. gariepinus* juvenile fed on this practical diet is like a cone with a dark reddish-brown colour as described by Faccioli *et al.,* (2014) indicated that the. *C. gariepinus* juvenile is in good nutritional status and also, in normal health

The strong positive correlation between the growth of liver and intestine of *C. gariepinus* juvenile fed with *L. minor* leaf meal (Duckweed) cannot be over emphasized because Flávia *et al.,* (2008) reported that the crude protein content of the dried duckweed ranged between 30% and 40% and the crude protein requirement of *C. gariepinus* juvenile is 35% as reported by Aderolu *et al.,* (2018) which falls between the range of crude protein requirement for *C. gariepinus* juvenile and that of formulated practical diet which is between 37.45% CP and

38.16% CP (Table 2). These aforementioned could be the factor that is responsible for the positive correlation between the growth of liver and intestine of *C. gariepinus* juvenile. Conclusively, the utilization of *L. minor* (Duckweed) leaf meal in the formulation of diet for
C. gariepinus juvenile has a strong positive correlation in the performance characteristics of *C. gariepinus* juvenile as shown in the weight gain in the liver, intestine weight ratio and health status of the organ and tissue. It is therefore recommended that *Lemna minor* leaf meal be included in the diet of *Clarias gariepinus* juvenile in order to enhance good growth and reduction in the cost of feed ingredients. This experiment should be repeated in the ponds to see if better results could be obtained from other culturable fish species.

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