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VISCEROSOMATIC AND HEPATOSOMATIC INDICES OF CLARIAS GARIEPINUS JUVENILE FED WITH LEMNA MINOR LEAF MEAL

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Abstract: The study was carried out to determine the effect of *Lemna minor* leaf meal (Duckweed) on viscerosomatic and hepatosomatic of *Clarias gariepinus* juvenile. Two hundred and twenty-five juvenile of *C. gariepinus* was stocked at rate of fifteen fish per unit and reared for twelve weeks. Five experimental diets containing maize, fishmeal, lysine, methonine, vitamin premix, and salt was formulated at varying level of inclusion of *L. minor* leaf meal of 0% (T1), 25% (T2), 50% (T3), 75% (T4) and 100% (T5) respectively. The feeding rate of the fish increases fortnightly based on 5% biomass. *C. gariepinus* with 100 % inclusion of *L. minor* had the highest weight of VSI with mean value of 22.77g and HSI with mean value of 2.90g. Result shows that there are significant differences ($p<0.05$) among all the treatments in the VSI and HSI respectively. This shows that there is better utilization of *L. minor* in the diet of *C. gariepinus* juvenile. The weight gain and length of the intestine and liver at 100% level of inclusion is a true reflection of this. Therefore, *L. minor* leaf meal is hereby recommended to be included in the diet of *C. gariepinus* at 100% inclusion.

Keywords: Viscerosomatic, hepatosomatic, indices, *Clarias gariepinus* juvenile

INTRODUCTION

The geometric increase in world population and the need to sustain this enormous population in terms of animal-source protein intake is imperative. Fish supply from the wild which contributed to about 55% protein intake of Nigerians cannot meet the demand this teaming population that require an average of 65g/output/day (Adewuyi *et al.,* 2010) unless it is augmented with the commercial aquaculture practices which, according to Mohapatra *et al.,* (2013) depend mainly on the availability of feed ingredients with required nutrients for optimum growth at cheaper cost. One of the recurrent expenditure in aquaculture is the purchase of fish feeds that usually comes with high cost. This may not be unconnected with the competition between man and animals in the processing and consumption of these ingredients for food, and also crop failure as a result of climate change as well as pest and disease infestation that usually affect the wholesomeness of these crops on the farm and at storage. Ibiyo *et al*., (2015) reported that the low profit margin after the sales of fish by fish farmers is the high cost of feed ingredients. The high cost and insufficiency of fish feed ingredients especially fishmeal has increased the awareness to seek substitute for animal

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protein source in formulating fish feed. Effiong *et al.,* (2009) mentioned that using animal and plants by-products in fish farming in Nigeria has been the main focus of animal nutritionist which centers on those non-conventional feeds supplement such as Duckweed that can supply optimum protein, essential amino and fatty acids required by the rearing animals.

Duckweed (*lemna minor)* is small floating aquatic plant known to contain 43% protein and 5% fibre (Nekoubin *et al.,* 2013). The nutritive value of Duckweed meal has been known to be high with approximately 40% crude protein depending on the culture system. In terms of Nutrient value, duckweed meal has been found to be a good replacement for soybean meal and fish meal in fish feeds (Nweke, 2005). Duckweed, as a natural protein source, has a better array of essential amino acids than most other vegetable proteins and more closely resembles animal protein (Leng *et al.,* 1995).

According to Gumus (2009), the assessment of viscerosomatic and hepatosomatic indices plays a significant role in the secretion of digestive enzymes, digestion and absorption of food items as well as metabolism in fishes. Giullo and Hinton, (2008) described viscerosomatic and hepatosomatic (organosomatic indices) as the ratio of organs to body weight measured in relation to body mass which can be used as indices of changes in nutritional and energy status.

African catfish *Clarias gariepinus* is an aquaculture species preference is largely distributed and globally known (Nyina-wamwiza *et al.,* 2007). The African catfish is an omnivorous fish species, hardy and is of good economic important for aquaculture (Rad *et al.,* 2003). The feeding habit of *Clarias gariepinus* has been shown to be an omnivore (Olojo *et al.,* 2005).

The use of Duckweed as phytodietary in the feed of fish is to enhance the efficiency of feed utilization and reduce the cost on using conventional feed stuff. Consequently, considering the less expense, availability and nutritive value of *lemna minor* (Duckweed), it could be used as an alternative protein dietary source in *Clarias gariepinus* feeding to determine the nutritional effect on the fish visceral parts.

MATERIALS AND METHODS

The study was carried out in the Aquaculture Unit of Fisheries Technology Department, Lagos State Polytechnic, 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 (^{o}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.

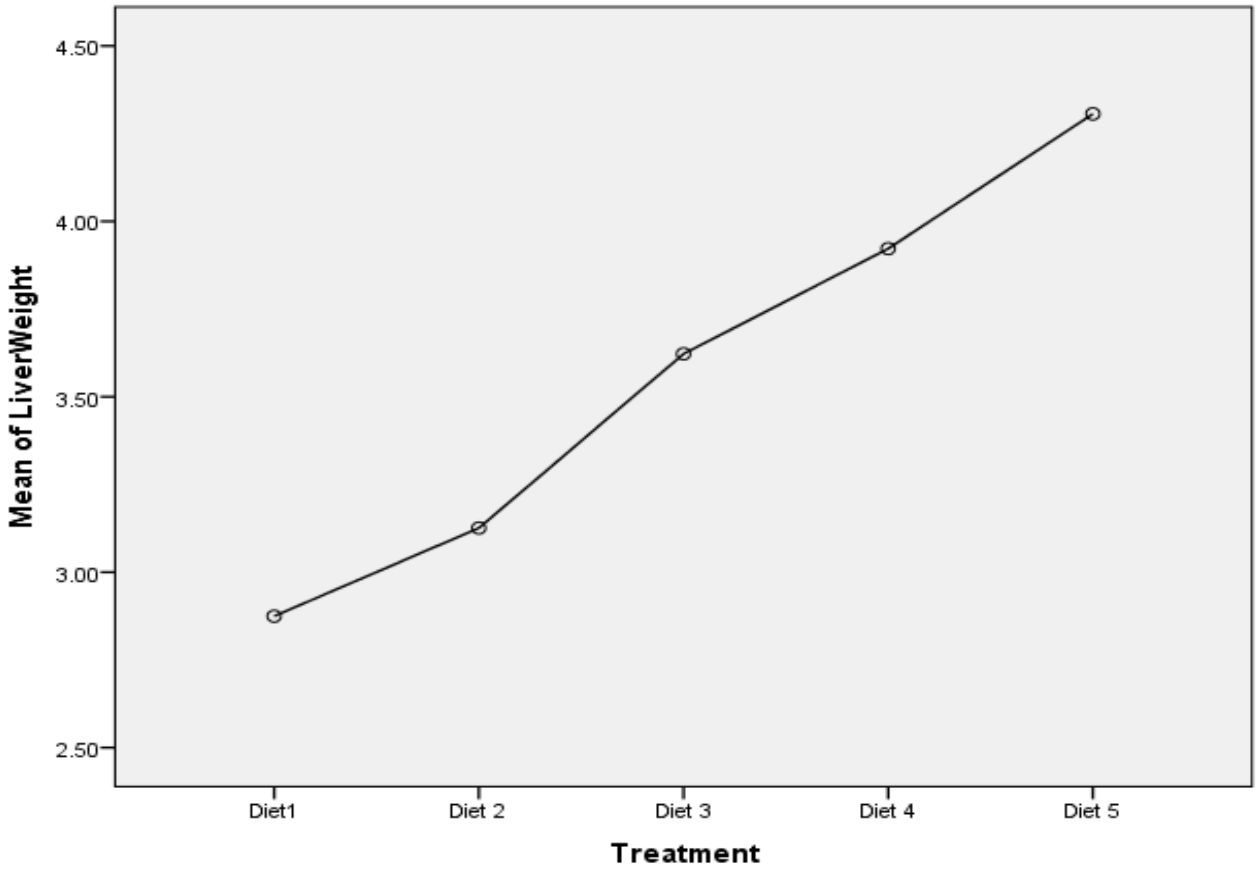

Figure 1. Graph showing increase in liver weight with increase in *Lemna minor* leaf meal.

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.

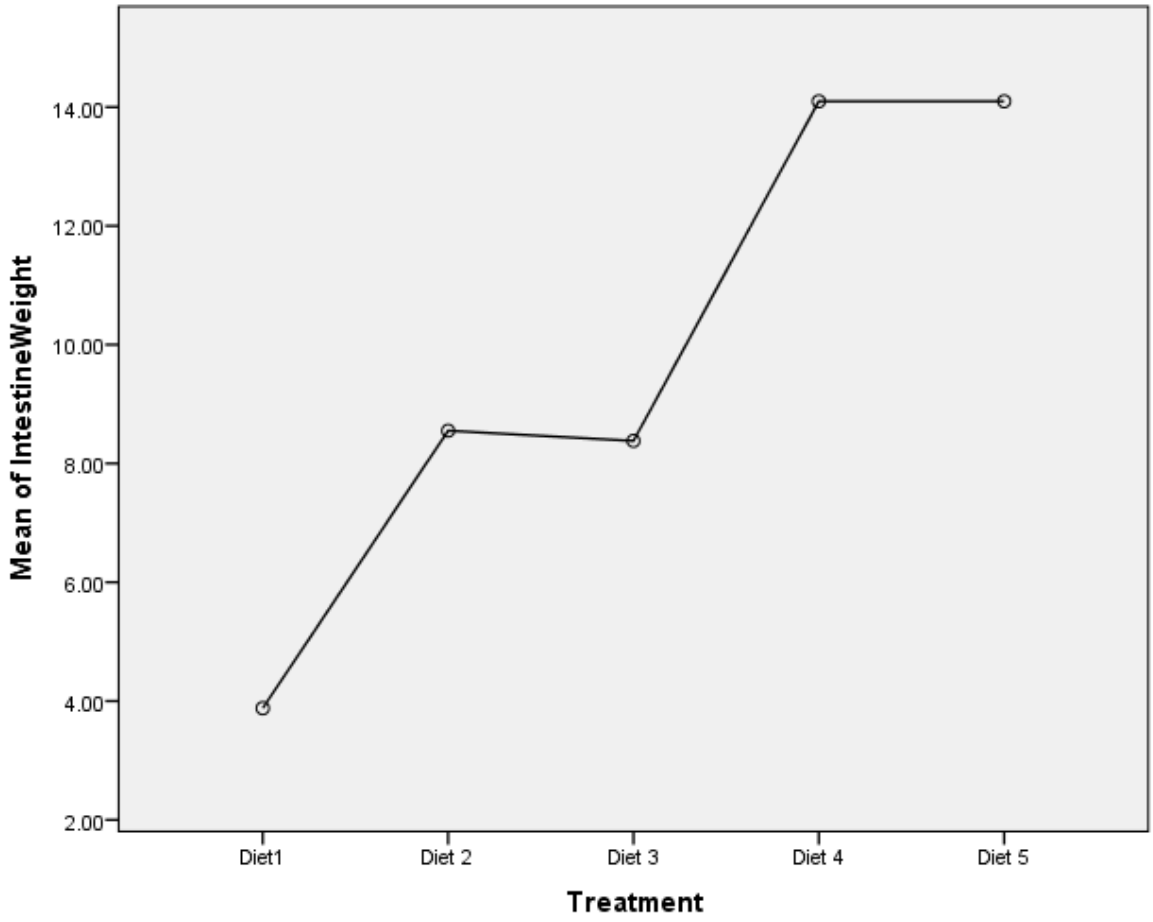

Figure 2. Graph showing increase in intestinal weight with increase in *L. minor* leaf meal

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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