Hepatosomatic index, intestinal length and condition factor of *Clarias gariepinus* fed M*oringa oleifera* leaf meal diets.

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Abstract: The study investigated the effect of *Moringa oleifera* leaf meal diets on the liver size, intestine length and the robustness of *Clarias gariepinus*.This was done to fill the knowledge gap on the effect of this leaf on the liver, intestine and condition factor of C.oleifera.The information obtained will help to reduce cost of feeding in the culture of this fish. *M. oleifera* leaf meal substituted fish meal at 0% (control), 30% (raw) and 30% (steam heated) in the three different diets. A total of 180 *C. gariepinus* fingerlings (mean weight 9.60 $\pm$ 0.06) were randomly distributed into Nine plastic aquaria tanks at 20 fish per tank in triplicate treatments and were fed twice daily at 9.00 hrs and 17.00 hrs for 12 weeks. The results showed that hepatosomatic indices were not significantly different ($p > 0.05$) while those fed with 30% steam heated *M. oleifera* had highest intestine length and was significant ($p < 0.05$). The condition factor was 1.00, 0.94 and 0.92 for 0% (control), 30% (steam heated) and 30% (raw) respectively. The study showed that *M.oleifera* leaf meal has good potential for use as fish meal substitute in *C. gariepinus* diet since it does not have significant negative effect on the liver, intestine and the condition of the fish. Also, it was shown that the processed *M. oleifera* leaf meal provided better condition than the raw *M.oleifera* leaf meal.

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Key words: Hepatosomatic index; relative intestinal length; condition factor; *Moringa oleifera; Clarias gariepinus*

1. Introduction

The African catfish *(Clarias gariepinus)* is appreciated by customers for the quality of its meal (Pruszynski, 2003). The African catfish is an excellent species for aquaculture as it is omnivorous, grows fast, and tolerates relatively poor water quality (Rad *et al*., 2003).A number of plants continue to be investigated for their potential in supplementing or even replacing fish meal in the diet of fish.

Organ indices have been used as indicators of change in nutritional and energy status of fish (Adams *et al.,* 1996). Commonly used organ indices include: hepatosomatic index (HSI), viscerosomatic index (VSI), spleenosomatic index (SSI) and gonadosomatic index (GSI). Intestine length has been determined in Mekong Giant catfish fed *Spirulina* (plant protein). The highest intestine length was recorded in fish fed with 5% *Spirulina* which replaced fish meal (Sudaporn *et al.,* 2010). The feeding habit of *C. gariepinus* has been shown to be an omnivore (Olojo et al., 2005). Fish is known to quickly change morphology to variation in habitats and food availability (Olsson et al., 2007). Kumar *et al.* (*2010*) reported that the relative intestine length of fish fed with *Jatropha carcas* karnel (as plant protein) was significantly higher than the control groups. Gabriel *et al*. (2010) also showed that the hepatosomatic index was higher in fish fed with local extrudes of *Lepidagatis alopecuroides* than the control.

Condition factor is used to compare the wellbeing of fish; it is also a useful index for monitoring the feeding intensity in fish (Abowei, *et al.,* 2010; Ndimele *et al*., 2010). Condition factor is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal *et al*., 1978).

2. Materials and methods

Study location: The study was conducted at the hatchery of the Department of Environmental Biology and Fisheries, Adekunle Ajasin University, Akungba, Akoko, Ondo State between August and November, 2012.

Sources of ingredients and diets preparation: Fishmeal, yellow maize, cassava, premix and vegetable oil were obtained locally from the market while *Moringa* leaves were freshly plucked from their branches at Akungba, Ondo state. The *Moringa* leaves were divided into two portions, the first portion was steam heated at the temperature 80°C after which the water was drained away and was air dried and milled to powdery form. The steam heated *Moringa* leaf was used to formulate treatment B. The second portion, raw *Moringa* leaf was air-dried and milled. Three diets were prepared, diet one has no *Moringa* leaf and this represent the control diet. Treatment A contains 30% raw leaf of *Moringa* while treatment B contains 30% steam heated leaf of *Moringa*, as shown on table 1.

TABLE 1: Composition of the experimental diets

Ingredients	control 0% MLM	TRT A 30% RMLM	TRT B 30% SHMLM
Moringa leaf meal	0	30	30
Fish meal	57	33	33
Yellow maize	35	29	29
Cassava	4	4	4
Premix	3	3	3
Vegetable oil	1	1	1

MLM = *Moringa* leaf meal; RMLM = Raw *Moringa* leaf meal; SHMLM = Steam heated *Moringa* leaf meal

Experimental procedure: A total of 180 *Clarias gariepinus*, fingerlings with average weight of 10g were randomly allotted at the rate of 20 fingerlings per tank into each of the 9 experimental plastic tanks. The fish were allowed to acclimatized 14 days prior to the start of the experiment. The fish were fed 3 times daily, between 8:00-9:00am, 12:00-1:00pm and 3:30-4:00pm at 7% bodyweight throughout the experiment. The ration was adjusted every two weeks when new weights of fish for the various experimental units were to be determined. Left over feed and faeces in each tank were siphoned out every morning. The water in the tank was partially flushed every morning while total changing was done every week.

Data collection and analysis: The fish were weighed; the total and standard body lengths were measured and humanely immobilized by stunning. The liver and digestive tracts were dissected out, the liver weighed and the intestine lengths measured.

Relative intestine length, hepatosomatic index and condition factor were determined as follows:

Relative intestine length (RIL) = intestine length (mm) / body mass (g)

Hepatosomatic index (HSI) = 100 x liver mass (g) / body mass (g)

Condition factor (CF) =$100W/L^3$ where W= Weight in grams (g)

L = Total length (cm).

Data were analyzed statistically using one-way analysis of variance. Duncan's multiple range test was used to separate variant means, and significance was accepted at $p < 0.05$.

1. Results

The effect of *Moringa oleifera* leaves meal on intestine length and hepatosomatic index is shown in table 2. The group fed with 30% inclusion level of steamed heated *Moringa oleifera* have the highest ($p< 0.05$) relative intestine length while the hepatosomatic index of group fed with 30% raw *Moringa leaves* was not significantly higher ($p> 0.05$) than the other groups. The condition factors were 1.00, 0.919 and 0.938 for control, 30% raw and 30% steam heated *M.oleifera* inclusion levels.

TABLE 2: Hepatosomatic index, Relative intestine length and Condition factor of C*larias gariepinus* fed 0%, 30% raw and 30% steamed heated M*oringa oleifera* diets (Mean ± SE)

Indices	Control (0%)	Treatment A (30% raw)	Treatment B (30% steam heated)
Body mass (g)	171.10± 17.89[a]	120.81±23.59[a]	134.98± 2.08[a]
Intestine length (mm)	204.66± 5.48[a]	286.66± 21.85[b]	366.66± 23.33[c]
Liver mass (g)	1.86 ± 0.38[a]	1.63 ± 0.25[a]	1.71 ± 0.43[a]
Relative intestine length	1.22± 0.14[a]	2.56 ± 0.55[b]	2.72 ± 0.20[c]
Hepatosomatic index	1.06 ± 0.35[a]	1.38 ± 0.15[a]	1.28 ±0.34[a]
Condition factor	1.003	0.919	0.938

*Mean values in the same row with different superscript are significantly different ($p<0.05$).

2. Discussion

The observation on the intestine length showed that the relative intestine length was higher in the fish fed diets containing plant material than the control. It is known that carnivorous and omnivorous fish requires longer time to digest plant protein--based diets (Buddington *et al.,* 1997). C. gariepinus, though an omnivore prefers animal content in diet, hence tending towards a carnivore (Smith, 1988). Plant is made up of cellulose which takes longer time to digest, during the process of digestion, the intestine tends to adapt by increasing in length. Direct relationship between the amount of dietary-plant protein and relative intestine length has been reported earlier in fish (German and Horn, 2006; Kramer and Bryant, 1995). This relationship is believed to reflect the greater digestive processing time required by primary consumers due to the lower nutrient content and greater resilience to digestion of plant tissue compared with animal tissues (Horn, 1989). Hence, in fish species that eat only algae or higher plants- herbivores, tend to have longer relative intestinal length (RIL) values than species that eat both plants and animals (omnivores), and these in turn tend to have higher RIL than species that eat only other animals- carnivores (Al-Hussaini, 1947; Fryer and Iles, 1972; Kapoor *et al*., 1975). Kumer *et al.,* (2010) reported that Detoxified *Jatropha curcas* karnel meal when used as dietary protein to feed common carp fingerlings, plant fed group exhibited longer intestine length than the control group and this was in respect to higher fibre content in the feed. Also, when *Spirulina* was used to replace fish meal in the diet of Mekong Giant Catfish, it was reported that groups fed with 5% *Spirulina* has the longest intestine and this was due to the presence of higher fibre in the feed (Sudaporn *et al.,* 2010). Similarly, the significantly higher value of RIL observed in fish fed 30% steam heated *Moringa* leaves meal reflects the ability of the fish to adapt to increased fibre content in the steam heated *M. oleifera* leaves. A longer relative intestine length would facilitate digestion by enhancing contact time of the digestive enzymes with the feed components, resulting in increased absorption. However, Al- Hussaini (1949) reported that the low RIL observed for fish meal fed group may be compensated for by increased mucosal fold complexity in the intestine.

In the study, an insignificant higher value of hepatosomatic index (HSI) was observed in plant fed group than the control group. When *Jatropha curcas* kernel meal was used for feeding common carp fingerlings, higher value of HSI was observed in plant protein fed groups (Kumer *et al.,* 2010). It was suggested that it could be as a result of higher lipid deposition in the liver. Although, Sudhir *et al*., 2010 reported that fish fed with *Moringa* leaf meal has low lipid content and this was attributed to the potentiality of *Moringa* leaf to reduce cholesterol. It could therefore be said that the highest HSI observed in groups fed with 30% raw seem to be as a result of low body mass due to low lipid in the flesh. The condition factor of Clarias gariepinus fed varying inclusion levels of Moringa oleifera leaf meal was within the range reported for some other fish species. Olim and Borges (2006) reported that *Cynoscion regalis* has a condition factor (K) which ranged between 0.7 and 1.02; Santic et al.(2006) also reported 0.82 - 1.03 in *Perca fluviatilis* . The K value obtained for *Clarias gariepinus* fed various inclusion level of *Moringa oleifera* leaf meal ranged between 0.92 and 1.0 which suggests that the fish was in good condition.

In conclusion, the study recommends the use of the leaves of *Moringa oleifera,* a locally available plant protein source as a good feed ingredient that can be used to partially replace fish meal up to 30% inclusion levels in the diet of *Clarias gariepinus,* since it has no negative effect on the well-being of the fish and at the same time reduce the cost of its feeding.

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