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The Influence of Moringa Oleifera Leaf Powder on Organosomatic Index, Condition Factor and Glucose Profile of *Clarias Gariepinus*

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Abstract The effect of *Moringa oleifera* leaf powder on the organosomatic index (gill, kidney, liver, heart and spleen), condition factor and glucose profile was carefully examined in this study. It was observed that the responses of *Clarias gariepinus* juveniles (mean length, 29.8±1.40cm SD; mean weight, 203.3± 5.11g SD g) exposed to 0.05, 0.10, 0.15 and 0.20g/l of *Moringa Oleifera* leaf powder for 15 days was concentration dependent. Fish gill recorded the highest index at 0.20g/l (24.55%) and least at 0.05g/l (17.42%) when compared with control (19.57%). Gill, kidney and spleen indices at 0.05, 0.10, 0.15 and 0.20g/l and condition factor were not significantly impacted ($P>0.05$) while liver and heart were significantly impacted ($P<0.05$) with increase in *M. oleifera* leaf concentration when compared with control. Glucose level was significantly ($P<0.05$) impacted at all the treatment levels when compared with control. The study indicated that the phytochemicals in *Moringa oleifera* leaf could improve the health status or well being and influence positively on the utilization of energy derived from glucose for other necessary use in fish body.

Keywords Organosomatic index, Condition factor, Phytochemical, Cardioprotective, Clariidae

Introduction

Moringa oleifera Lam., also known as the 'drumstick tree,' is recognized as a vibrant and affordable source of phytochemicals, having potential applications in medicines, functional food preparations, water purification, and biodiesel production [49, 50, 52]. The multiple biological activities including antiproliferation, hepatoprotective, anti-inflammatory, antinociceptive, antiatherosclerotic, oxidative DNA damage protective, antiperoxidative, cardioprotective, as well as folk medicinal uses of *M. oleifera* (MO) are attributed to the presence of functional bioactive compounds, such as phenolic acids, flavonoids, alkaloids, phytosterols, natural sugars, vitamins, minerals, and organic acids [22, 55]. The low molecular weight of *M. oleifera* cationic proteins (MOCP) extracted from the seeds is very useful and is used in water purification, because of its potent antimicrobial and coagulant properties.

Clarias gariepinus belongs to the family clariidae which are air breathing non-scaly fresh water fish, valuable food of commercial importance [35]. It has a wider distribution than any species in the clariids family [48]. They have gained popularity in fish farming in Nigeria because they have high survival rate under culture conditions, readily accept artificial feeds and high flesh quality [5, 38]. This fish species constitute a major catch of fisher folks particularly during the rainy season in most river in the southern part of the country [37]. The African catfish (*Clarias gariepinus*) remains the most cultured species in Nigeria and is appreciated by consumers for the quality of its meat. The African catfish is an excellent species for aquaculture, as it is omnivorous, grows fast, and tolerates relatively poor water quality [38]. Fish is a vital source of high-quality protein, providing approximately 16% of the

animal protein consumed by the world's population [18]. It is a particularly important protein source in regions where livestock is relatively scarce. Fish supplies less than 10% of animal protein consumed in North America and Europe, but 17% in Africa, 26% in Asia and 22% in China [19]. FAO estimates that about one billion people world-wide rely on fish as their primary source of animal protein [19].

The condition factor is an organism – level response, to factors such as nutritional status, pathogen effects and toxic chemical exposure, causing greater – than normal and less – than – normal weights [6, 7]. The condition factors are used as indicator of the well being of individual organism, because it integrates many levels of the organizational processes. For example, a decrease in condition factor is considered a reflection of depletion in energy reserves because these indices are positively related to muscle and livers energy content [30, 25]. Organosomatic indices can be described as the ratios of organs to body weight [44], measured organ in relation to body mass can be directly linked to toxic effects of chemical on target organ [21]. It can also be used as indices of changes in nutritional and energy status [36]. Commonly used organosomatic indices in various stress related studies include hepatosomatic index (HIS), viscerosomatic index (VSI), spleenosomatic index (RSI) and Cardiosomatic index (CSI). Akinrotimi et al [5] observed that hepatosomatic index is one of the most investigated biomarker due to important role of liver in detoxification of pollutants, while Dogan & Can [16], observed that organosomatic index is an appropriate bioindicator for endocrine disruption in fish consequent of chemical exposure. The current investigation was undertaken to understand the influence of *Moringa oleifera* leaf powder on organosomatic index, condition factor and glucose profile of this species.

Materials and Methods

Project Location: This work was carried out at the Department of Fisheries Demonstration farm. University of Port Harcourt, Rivers State, Nigeria.

Experimental Design, Rearing Units and Stocking of Fish: The design of the experiment is a Completely Randomized Design (CRD) with four treatment levels at three replicates each. A total of 12 transparent plastic vats of dimension (1.2m x 0.6m x 0.4m) each, were used for the experiments. The 12 vats were labeled based on treatment levels and replicates. Each basin was stocked with thirty six (36) juvenils.

Feeding of Experimental Fish: The juveniles were handfed to visual satiety twice daily at 8.00hr and 17.00hrs. The daily ration of 5% body weight was divided into two and half fed to fish each time. The weight of feed fed was adjusted every two weeks. The fish were cultured for 15 day

Processing of *Moringa oleifera* Leaf

Moringa leaves (*Moringa oleifera*) was collected from Isiokpo community in Ikwerre Local Government Area, Rivers State, Nigeria. The leaves were thoroughly washed with water to remove dirt, drained properly and later shade dried for seven (7) days. Thereafter, the leaves were ground into fine powder.

Experimental Procedure: Thirty six (36) African catfish juveniles (*C.gariepinus*) of average weight 203 g were obtained from Aqualife consult fish farm in Nbodo Aluu, Ikwerre Local Government Area. Rivers State. Nigeria. Specimens were acclimated in 12 rectangular plastic aquaria containing twenty litres of water each for 7 days. The top of the aquaria were covered with perforated lid to prevent fish from escape and the water was changed daily (24hrs). The aquaria were washed with a piece of foam and fish fed twice per day with 42% crude protein diet at 3% body weight.

Preparation of Test Solution and Experimental Procedure: The four levels of solution were prepared by interchanging 0.05, 0.10, 0.15 and 0.20g of powdered *M.oleifera* leave to one litre of water after every 3 days. This was done for 15 days after which samples were collected.

Sample Collection: At the end of the experimental period of 15 days, the total length (TL) of the fish was measured from the tip of the anterior part of the mouth to the caudal fin using a metre rule calibrated in milli metre. Fish weight was measured after drying with a piece of clean hand towel. Weighing was done with a table top weighing balance, to the nearest gram. Blood samples were also collected from the fish (behind the anal fin) with 21g size needle and syringe and preserved in EDTA for haematological studies. Blood for enzymes analysis were stored in heparinised bottles. Fish were killed with a blow on the head after blood collection and dissected in order to collect samples of gill, kidney, liver, heart and spleen tissues with the aid of penknife.

Blood Glucose Analysis: The blood glucose in the exposed fish was analyzed following the method described by [23].

Organosomatic Indices: Organosomatic indices were calculated using the formula:

$$\text{Organo. Indices} = \frac{\text{Weight of Organ}}{\text{Weight of fish}} \times 100$$

Fulton's condition factor:

Values of Fulton's condition factor were calculated using the formula:

$$\text{Fulton condition factor (K)} = \frac{Weight\ of\ Fish}{l^3} \times 100$$

Result

Table 1 presents the organosomatic indices of C. gariepinus following M.oleifera exposure. The chemical content of M.oleifera respectively caused the decrease: in gill index by 2.15, 1.57 and 1.05% at 0.05, 0.10 and 0.15g/l except at 0.20g/l where the gill index was raised by 4.98% ; in kidney index by 0.47, 2.35 and 2.12% at 0.05, 0.10 and 0.15g/l except at 0.20g/l where the kidney index was raised by 0.24%; in liver index by 11.15, 13.57, 14.76, and 19.25 at 0.05, 0.10, 0.15 and 0.20g/l; in the heart index by 8.09, 8.43, 8.43 and 10.30% at 0.05, 0.10, 0.15 and 0.20g/l; in spleen index by 0.86, 5.13, 6.84 and 2.57% at 0.05, 0.10, 0.15 and 0.20g/l, when compared with control. The changes between the initial (K1) and the final (K2) were not statistically significant ($P > 0.05$) – Table 2. The exposure of *C. gariepinus* to varying concentration of phytochemical in *M.oleifera* resulted in significant ($P < 0.05$) decrease in glucose level when compared to control (Table 3).

Table 1: Organosomatic indices of *C. gariepinus* juveniles exposed to M. Oleifera leave (mean±S.D)

g/l	Gills index	%	Kidney	%	Liver	%	Heart	%	Spleen	%
0.00	10.10 ± 0.30^a	19.57	0.89 ± 0.11^a	20.94	3.00 ± 0.00^b	31.55	0.37 ± 0.03^b	27.21	0.27 ± 0.03^a	23.08
0.05	8.99 ± 0.27^a	17.42	0.87 ± 0.06^a	20.47	1.94 ± 0.22^a	20.40	0.26 ± 0.03^a	19.12	0.26 ± 0.03^a	22.22
0.10	9.29 ± 0.92^a	18.00	0.79 ± 0.11^a	18.59	1.71 ± 0.49^a	17.98	0.25 ± 0.02^a	18.38	0.21 ± 0.03^a	17.95
0.15	9.56 ± 1.06^a	18.52	0.80 ± 0.04^a	18.82	1.69 ± 0.26^a	17.77	0.25 ± 0.02^a	18.38	0.19 ± 0.02^a	16.24
0.20	12.67 ± 0.60^b	24.55	0.90 ± 0.09^a	21.18	1.17 ± 0.45^a	12.30	0.23 ± 0.03^a	16.91	0.24 ± 0.03^a	20.51

Renasomatic index- kidney; Hepasomatic index- liver; Cardiosomatic index – heart; Spleenosomatic index – spleen

Table 2: Condition factor for juvenile *C.gariepinus*exposed to *M. oleifera* leave

g/l	Initial condition (K1)	% control	Final condition (K2)	% control
0.00	0.86±0.03	20.50	0.81±0.04	20.25
0.05	0.76±0.04	19.00	0.82±0.03	20.50
0.10	0.79±0.02	19.75	0.74±0.02	18.50
0.15	0.75±0.02	18.75	0.79±0.04	19.75
0.20	0.74±0.01	18.5	0.84±0.03	21.00

Glucose levels dropped significantly with increase in *M. oleifera* concentration in all the treatments

Table 3: Glucose levels of *C. gariepinus* juveniles exposed to *M. oleifera* leaves

(g/l)	Glucose levels	% control
0.00	7.00 ± 0.12^c	33.54
0.05	4.30 ± 0.42^b	20.60
0.10	2.90 ± 0.31^a	13.90
0.15	4.20 ± 1.01^b	20.13
0.20	2.47 ± 0.20^a	11.84

Discussion

Lin *et al* [28], observed that changes varies widely among fish species, depending on the concentrations of phytochemicals, age of fish, and exposure period. It is well known that fish have the ability to concentrate xenobiotics, and different substances in their muscles, gills and different organs such as liver and kidney. Recently, Organosomatic indices and fish condition factor have been used to determine the influence of phytochemicals during the clinic diagnosis of fish physiology [12, 17, 33, 40, 47, 54]. The use of various organosomatic indices is based on the assumption that there is proportional relationship between fish size and the particular ratio in assessing fish well-being by xenobiotics [44]. In the organosomatic indices, there was slight decrease in weight of the gill except at

0.20g/l, kidney, liver, heart and spleen as concentration increased to 0.20g/l. A similar report was made by [26], when he observed a decrease in the weight of the liver, adrenals and kidneys of rats exposed to propoxur and heavy metals. [46] also reported reduced gonadosomatic and hepatosomatic indices when the fish *Oreochromis niloticus* was exposed to xenobiotics. Decrease in the weight of liver suggests a balance in the production of endoplasmic reticulum for protein systhesis in liver tissue under xenobiotic exposure [1-4, 10]. Liver reduction could also be as a result of decreased lipid storage [23]. The initial and final condition factor of *C. gariepinus* exposed to *M. oleifera* leaf powder in this work, were within the same range, this result is in line with the report of [7] in Johnius belangerii exposed to fluoride but contradict that of [8] who exposed Solea senegalensis to cypermethrin pesticide and observed a decrease in condition factor which depicted a reduction in growth rate which may be due to a reduction in oxygen carrying protein levels and red blood cells, while increase occurred in the number of white blood cells. Anderson [9] also observed a decrease in condition factor when Indian shad was exposed to bleached kraft mill effluent. However, an increase condition factor was observed by [34] in white sucker (*Astostomes commessomi*) and suggested a change in metabolic capability and altered energy allocation. The slight increase in final condition factor may be due to some necessary changes in the olfactory systems which might have improved feeding, resulting in alterations of metabolic activities and energy allocation of the fish systems [56].

The glucose produced when fish is under stress supplies energy to tissues such as the brain, gills and muscles in order to cope with the increased energy demand [20, 31, 32, 45]. The liver is the main source of glucose production and it is achieved by glycogenolysis or gluconeogenesis [13, 14, 42]. Cortisol has been linked to increased glucose [27, 29, 41]. Tilapia showed marked hyperglycemic response to stressed environmental conditions as a result of incomplete metabolism of the blood sugar due to impaired osmoregulation [11, 15, 24, 39, 43, 51]. Gabriel et al [23] also reported that blood glucose level generally increased as a result of the subjection of *C.gariepinus* to various handling procedures [53]. The present study demonstrates that *C. gariepinus* exposed to varied levels of *M.oleifera* powder displayed a significant reduction in the level of blood glucose (i.e. hypoglycemia).

Conclusion

The indices measured in the present study is useful for monitoring the long-term effects of *M.oleifera* on fish. It can be concluded that *M. oleifera* is highly beneficial to *C. gariepinus*. As the exposure to varied levels of *M. oleifera* resulted in organosomatic and glucose levels changes. These changes may add to the survivability of *C. gariepinus* in the culture medium. This should be taken into consideration when this phytochemical is used in fish production.

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