

ORGAN WEIGHT CHANGES AND MORPHOMETRIC CHARACTERISTICS OF *Clarias gariepinus* JUVENILES FED DIFFERENT GRADED LEVELS OF COMBINATION OF PLANT-BASED SUPPLEMENTED DIETS

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ABSTRACT

This study evaluated the efficacy of different graded levels of medicinal plants mixture (MPLM) {fenugreek (*Trigonella foenum-graecum*), scent leaf (*Ocimum gratissimum*), stone breaker (*Phyllanthus niruri*), and garlic (*Allium sativum*)} dietary supplementation on *Clarias gariepinus*. Two hundred forty *C. gariepinus* juveniles (mean weight 6.70 ± 0.02 g) were randomly assigned to seven treatment diets in a completely randomised design for 8 weeks. Seven experimental diets composed of Control (without medicinal plants mixture) MPLM₂ (0.5%), MPLM₃ (1.0%) MPLM₄ (1.5%), MPLM₅ (2.0%), MPLM₆ (2.5%), MPLM₇ (3.0%) of 40% crude protein in 14 experimental tanks. The experimental fish were replicated twice with 20 fish per replicate, fed twice daily at 3% body weight. The organ index (heart, liver, kidney, spleen, and intestine) and morphometric characteristics (standard length, total length, dorsal length, head length and height) were measured. The organ index obtained at the end of the experiment showed that there was an increase in the value obtained among the dietary groups when compared to the values obtained before the experiment, and there were significant differences ($P < 0.05$) among the dietary groups. The result of the Morphometric characteristics revealed that there was a general increase in the values of total length, standard length, dorsal width, height and head length of *C. gariepinus* juveniles. Also, it was observed that the weight increases as the week of the feeding trial increases, and the treated groups perform better than the control group. Conclusively, organ index and morphometric characteristics of *C. gariepinus* could be improved without harmful effects by the incorporation of medicinal plant mixture in the diet of *C. gariepinus* at 0.5% - 3.0% levels of inclusion

Keywords: *Clarias gariepinus*, Internal organs, Morphometric characteristics, Medicinal plant mixture

DESCRIPTION OF PROBLEM

Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as a good source of protein and other vital nutrients for the maintenance of a healthy body [1]. The major fish species cultured in Nigeria include tilapia, catfish and carp. However, African catfish (*C. gariepinus*) is the most widely cultured in Nigeria because of its fast growth rate, availability, disease resistance, and sensory quality [2]. The high cost of feed ingredients and availability have led to the need to identify alternative fish feed ingredients. Therefore, in order to achieve more economically, sustainable, environmentally friendly and viable production, research interest has been directed towards the uses of medicinal or natural plants. Medicinal

plants have been known to be a great benefit to animals and humans [3]. The leaves, roots and seeds of medicinal plants contain phytochemicals and antioxidant properties which have a tendency to improve growth, fertility and immune response [4,5]. Scientists have worked on different medicinal plants such as onion bulb and walnut leaves [6], garlic [7], African star apple [8], and drumstick [9]. However, little or no research has been conducted on the combination of medicinal plants on indigenous fish such as *C. gariepinus*, which command a high price and demand in Nigeria. This study aims to determine the effect of a combination of medicinal plants on organ index and morphometric characteristics of *C. gariepinus* juveniles.

MATERIALS AND METHODS

Plant Source, Identification and Processing

The medicinal plant mixture - Fenugreek and garlic was obtained from Mooju Ventures, Lagere, Ile-Ife, Osun State, Nigeria. Scent leaf and stone breaker were obtained from Ondo city and Igbodan-Lisa, Okitipupa, respectively. These plant-based medicinal plants were identified at the Department of Biological Sciences (Botany Programme) of Olusegun Agagu University of Science and Technology, Okitipupa. The scent leaf and stone breaker were air-dried for four weeks. All the plants were ground into fine powder using a fabricated hammer mill and stored (40 °C) until required for use.

Feed Formulation and Experimental Diet

Medicinal plants mixture {fenugreek, scent leaf, stone breaker, and garlic} was thoroughly mixed in a ratio of 1: 0.5: 0.5: 0.5 on a dry w/w basis, respectively, decided based on previous findings. The ground medicinal plants mixture was added at different inclusion levels of 0, 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0% to formulate 40% crude protein diets, 14.67% ash, 10.45% crude fibre, 7.46% ether extract, 6.31% moisture, and 21.10% nitrogen-free extract using Pearson's square method to determine individual ingredient contribution at g/100g diet. Each ingredient, such as fish meal, soybean, blood meal, maize, wheat bran, vitamin-mineral premix, starch, vegetable oil, and Di-calcium phosphate, was weighed using a sensitive weighing balance. The dry ingredients were mixed thoroughly using the manual method. The mixture of plant ingredients was added as feed additives in the study as a partial replacement for the vitamin-mineral premix. Each diet was treated separately. Water was added, and the result was a dough that was extruded/pelleted through a 2 mm pelleting machine to form a noodles-like strand which was manually broken into suitable sizes for the *C. gariepinus*. The pelleted diets were oven-dried at 60 °C and stored in airtight nylon bags at room temperature to prevent mycotoxin formation until required.

Experimental Fish and Procedure

Two hundred and eighty *C. gariepinus* juveniles (6.27±0.03g) were purchased from Olokoabata Farms and transported in an oxygenated bag to the Teaching and Research Farm of the Department of Fisheries and Aquaculture, Olusegun Agagu University of Science and Technology, Okitipupa. The fish were acclimatised for three weeks before the commencement of the study and were fed a commercial diet (2 mm Blue Crown). The fish were randomly assigned to five dietary treatments in a completely randomised design. Each treatment was replicated twice with 20 fish per replicate. The water level was maintained at a volume of 35 litres throughout the experimental period. Water in each tank was replaced every three (3) days throughout the experiment to prevent fouling that may result from the faecal and uneaten feed. The experiment lasted for 8 weeks, during which the fish were fed at 3% body weight daily at 8.00 am and 4.00 pm.

Organ Index

Three *C. gariepinus* juveniles were taken before and at the end of the experiment from each experimental treatment. Organ of the fish (liver, kidney, heart, spleen, and intestine) were collected and weighed to calculate the organ index as described by [10]. They were calculated as follows: Organ index (%) = 100 x (organ weight [g] / whole fish weight [g])

Morphometric characteristics of *Clarias gariepinus* juveniles

Total Length (TL), Standard Length (SL), Head Length (HL), Dorsal Width (DW) and Height (H) were measured as described by [4]

Statistical Analysis

Data resulting from the experiment were subjected to one-way analysis of variance (ANOVA) using SPSS (Statistical Package for Social Sciences, 2006 version 20.0). Duncan multiple range tests were used to compare differences among individual means at P = 0.05.

RESULTS

Morphometric performance of *C. gariepinus* fed with the experimental diet for 56 days

The results of the study show an increase in the values of standard length, total length, dorsal length, head length and height of *C. gariepinus* juveniles across the experimental treatments, and the nutrient content of the diet was adequate for the fish (Table 1).

Organ Index of *C. gariepinus* fed a combination of medicinal plants mixture for 56 days.

The result of the organ index in this study shows that there was variation in the value of the organs across the dietary groups. There were no significant differences ($P > 0.05$) in heart, liver and spleen among the dietary groups, while significant differences ($P < 0.05$) were observed in the kidney and intestine among the dietary groups.

Table 1: Morphometric performance of juvenile *Clarias gariepinus* fed a combination of plant mixtures for 56 days

	Control	MPLM2	MPLM3	MPLM4	MPLM5	MPLM6	MPLM7
Standard length							
Week 2	12.60±1.00 ^{ab}	12.95±0.05 ^{ab}	12.35±0.35 ^{ab}	13.30±0.30 ^b	12.80±0.00 ^{ab}	12.20±0.50 ^{ab}	11.45±0.75 ^a
Week 4	14.80±0.18 ^a	14.15±0.75 ^a	14.20±0.00 ^a	16.00±0.60 ^a	14.85±0.35 ^a	15.10±0.20 ^a	15.15±0.15 ^a
Week 6	19.30±0.20 ^b	17.55±0.05 ^{ab}	16.90±0.50 ^a	16.55±0.15 ^a	17.55±0.55 ^{ab}	17.35±0.75 ^{ab}	15.95±1.25 ^a
Week 8	21.05±1.45 ^b	19.05±0.55 ^{ab}	18.25±1.25 ^{ab}	18.00±1.25 ^{ab}	19.20±0.70 ^{ab}	19.10±0.40 ^{ab}	16.60±0.90 ^a
Dorsal length							
Week 2	8.50±0.50 ^a	8.70±0.05 ^a	8.75±0.25 ^a	9.40±0.20 ^a	9.20±0.40 ^a	8.50±0.50 ^a	8.60±0.80 ^a
Week 4	10.55±0.35 ^a	10.55±0.15 ^a	10.15±0.15 ^a	11.80±0.20 ^a	11.25±0.45 ^a	12.70±1.70 ^a	11.25±1.25 ^a
Week 6	13.85±0.35 ^a	12.80±0.20 ^a	12.50±0.50 ^a	14.80±2.80 ^a	12.70±0.70 ^a	12.80±0.60 ^a	11.50±0.50 ^a
Week 8	15.40±0.40 ^b	13.85±0.65 ^{ab}	12.50±0.50 ^a	13.40±1.40 ^{ab}	13.50±0.50 ^{ab}	13.90±0.60 ^{ab}	11.85±0.65 ^a
Head length							
Week 2	3.75±0.05 ^a	3.80±0.10 ^a	3.60±0.10 ^a	3.95±0.10 ^a	4.05±0.15 ^a	3.85±0.05 ^a	3.70±0.30 ^a
Week 4	4.00±0.20 ^a	4.10±0.10 ^{ab}	4.10±0.10 ^{ab}	4.20±0.40 ^{ab}	4.45±0.05 ^{ab}	4.40±0.10 ^{ab}	4.75±0.25 ^b
Week 6	4.90±0.10 ^{ab}	5.00±0.00 ^b	4.15±0.35 ^{ab}	4.10±0.30 ^{ab}	4.20±0.40 ^{ab}	4.60±0.20 ^{ab}	3.95±0.25 ^a
Week 8	5.75±0.20 ^b	5.10±0.10 ^{ab}	4.90±0.10 ^{ab}	5.10±0.50 ^{ab}	5.15±0.15 ^{ab}	5.10±0.10 ^{ab}	4.20±0.00 ^a
Height							
Week 2	2.40±0.00 ^a	2.55±0.15 ^a	2.50±0.10 ^a	2.65±0.05 ^a	2.65±0.25 ^a	2.45±0.15 ^a	2.55±0.25 ^a
Week 4	2.65±0.05 ^a	2.75±0.05 ^a	2.75±0.05 ^a	2.60±0.00 ^a	3.00±0.20 ^a	3.15±0.50 ^a	3.35±0.85 ^a
Week 6	3.35±0.15 ^b	3.45±0.25 ^b	3.00±0.00 ^{ab}	3.00±0.00 ^{ab}	3.10±0.10 ^b	3.00±0.00 ^{ab}	2.60±0.20 ^a
Week 8	3.40±0.00 ^a	3.45±0.25 ^a	3.40±0.20 ^a	3.30±0.30 ^a	3.35±0.15 ^a	3.50±0.00 ^a	2.80±0.40 ^a
Total length							
Week 2	14.15±0.35 ^a	14.50±0.20 ^a	14.55±0.75 ^a	15.65±0.35 ^a	15.15±0.85 ^a	14.05±0.35 ^a	14.65±1.65 ^a
Week 4	17.20±0.28 ^a	16.75±1.06 ^a	15.95±0.63 ^a	17.75±0.35 ^a	16.85±0.49 ^a	16.05±1.06 ^a	15.50±2.12 ^a
Week 6	21.35±0.65 ^b	19.90±0.10 ^{ab}	18.80±0.80 ^{ab}	18.70±0.30 ^{ab}	19.50±0.90 ^{ab}	19.35±0.15 ^{ab}	17.35±1.35 ^a
Week 8	23.25±1.25 ^b	21.30±0.30 ^{ab}	20.00±1.00 ^{ab}	20.65±1.85 ^{ab}	21.50±1.00 ^{ab}	21.35±0.15 ^{ab}	18.10±0.90 ^a

The mean values in each column with similar superscript are not significantly different ($P > 0.05$)

Table 2: Organ Index of *C. gariepinus* fed a combination of medicinal plants mixture for 56 days

	HEART	KIDNEY	LIVER	SPLEEN	INTESTINE
Before	0.06±0.02	0.27±0.03	0.61±0.01	0.10±0.00	1.84±0.04
Control	0.15±0.03 ^a	0.42±0.04 ^a	0.82±0.04 ^a	0.45±0.05 ^a	3.55±0.58 ^a
MPLM2	0.14±0.01 ^a	0.76±0.11 ^{ab}	1.46±0.31 ^a	0.37±0.06 ^a	4.31±0.04 ^{ab}
MPLM3	0.22±0.01 ^a	0.49±0.13 ^a	1.16±0.39 ^a	0.48±0.06 ^a	4.90±0.85 ^{ab}
MPLM4	0.15±0.01 ^a	0.74±0.05 ^{ab}	1.46±0.43 ^a	0.40±0.10 ^a	4.02±0.32 ^{ab}
MPLM5	0.20±0.02 ^a	0.83±0.27 ^{ab}	1.02±0.13 ^a	0.33±0.11 ^a	3.84±0.02 ^a

MPLM6	0.13±0.02 ^a	0.83±0.07 ^{ab}	1.28±0.21 ^a	0.30±0.02 ^a	4.76±0.02 ^{ab}
MPLM7	0.20±0.03 ^a	1.04±0.05 ^b	1.43±0.20 ^a	0.83±0.14 ^b	5.44±0.42 ^b

The mean values in each column with similar superscript are not significantly different ($P > 0.05$)

Discussion

The result of this study revealed a general increase in the value of the heart, kidney, liver, spleen and intestine across the dietary groups when compared to the value obtained before the experiment. The values of heart and spleen were relatively similar, and there was no significant difference ($P > 0.05$) among the dietary groups. The value of the kidney, liver, and intestine obtained was better in the treated groups compared to the control. These results may be due to the presence of bioactive compounds in the medicinal plant mixture-supplemented diets that enhance the production of these organs. This study agrees with [10, 8] who reported better values of kidney, liver and intestine in *C. gariepinus* fed nutmeg and Africa star apple supplemented diet respectively. This study is also similar to the report of [11] who observed a significant increase in the final intestine and viscera organs at the end of the experiment in the treated groups compared to the control. The result obtained in this study showed that there was an increase in standard length, head length, total length, dorsal length, and height in the treated groups when compared to the control. Generally, this morphometric characteristic increased as the month of feeding trials increased. This is an indication that the fish make use of the experimental diet to enhance growth probably as a result of phytochemical constituents such as flavonoids, alkaloids and tannins present in the combination of medicinal plants help to stimulate growth. This result was in agreement with [11] who reported an increase in the values of head length, standard length, total length, dorsal width, and height in the treated groups when compared to the control of the fish fed with 1% *Myrmeco diatuberosa*.

Conclusion and Application

The results of this study indicated that inclusion (0.5% - 3.0%) of combination of medicinal plants mixture (*Trigonella foenum-graecum*, *Ocimum gratissimum*, *Phyllanthus niruri*, *Allium*

sativum) in the diets of *C. gariepinus* juveniles as feed additives would enhance the physiological functions of the fish which may increase productivity in aquaculture.

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