HEALTH IMPLICATION, SURVIVAL AND ORGAN WEIGHT CHANGES OF *Clarias gariepinus* JUVENILES FED DIFFERENT INCLUSION LEVELS OF GELATIN

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ABSTRACT

This study investigated the effect of Gelatin (GT) on health implications, survival and organ weight changes of *C. gariepinus* juveniles for eight (8) weeks. Seven (7) experimental diets of 40% crude protein were formulated and gelatin was included at different graded levels (0%, 1%, 1.5%, 3%, 4.5%, 6%, and 7.5%) and was denoted as Control - GT_7 respectively. *Clarias gariepinus* (210) juveniles were randomly distributed in duplicate of 7 experimental tanks at a stocking density of 15 fish per treatment and were fed at 3% body weight. Weight gain, survival rate, and condition factor were determined. The organ weight changes (liver, intestine, muscle, spleen, kidney, gill and heart) were measured. Data were analyzed using descriptive statistics and ANOVA at P=0.05. The result shows that fish-fed experimental diets supplemented with gelatin significantly perform better than the control group in weight gain, and condition factors. The conditions factor of the treated groups was better than the control and there was a significant difference ($P<0.05$) among the dietary groups. The organ weight gain of the treated groups was higher than the control group. This shows that fish fed with diets supplemented with gelatin perform better and improve weight gain, condition factors, and organ weight changes of *C. gariepinus* juveniles

Keywords: *Clarias gariepinus;* Gelatin; Growth; Condition factor; Weight changes

INTRODUCTION

Feed is one of the major inputs in aquaculture production and fish feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the World (Gabriel *et al*., 2007). The high cost of fish feed was observed as one of the problems hampering aquaculture development in Nigeria (Gabriel *et al*., 2007). Expensive feeds will marginalize or even nullify the profitability of fish farming thereby incapacitating the expansion of farms to increase production and consequently low yield in terms of quality and quantity, resulting in the scarcity of the commodity (fish), and eventually the high cost of the few available ones to the disadvantage of the populace (Adikwu,1992). This has motivated the research for local, edible, palatable, easily digestible and suitable diet as an alternative energy feed for *C. gariepinus* that aims to reduce the cost of production without compromising fish quality.

Gelatin is a translucent, colourless and flavorless, food ingredient commonly derived from collagen taken from animal body parts (Ward and Courts, 1977). Generally, gelatin is in the form of tablets, granules or powders and sometimes it can be dissolved in water before use (Ward and Courts, 1977). Gelatin is widely explored by researchers as a matrix for three-dimensional cell culture and as a component of tissue-engineering scaffolds (Rizwan *et al*., 2017). Collagen is obtained in the body, but the skin, bones, tendons, and ligaments are the most abundant (Kodjo *et al.*, 2010). Gelatin is fat- and cholesterol-free with high-protein and low energy and also poses beneficial protective colloids (Kodjo *et al.,* 2010). Gelatin application in foodstuff can be used as a gelling agent, thickener, emulsifier, foam maker, edible film, and stabilizer. In the pharmaceutical department, gelatin is widely used for the manufacture of soft and hard capsules. There is little or no information on gelatin as feed ingredients in fish farming. Hence, this study assesses the health implication, survival and organ weight changes of *Clarias gariepinus* juveniles fed different inclusion levels of gelatin

MATERIALS AND METHODS

Gelatin Collection and Identification

Gelatin was obtained from a pharmaceutical store in Okitipupa, Ondo State, Nigeria. The gelatin was authenticated at the Department of Food Science and Technology, Olusegun Agagu University of Science and Technology, Okitipupa.

Experimental Fish and System

Two hundred and forty (240) juveniles of *C. gariepinus* of average weight 22.04 ± 0.02g were obtained from a renowned fish farm in Akure, Ondo State. They were transported to the Fisheries and

Aquaculture Laboratory, Olusegun Agagu University of Science and Technology, Okitipupa in a modified plastic jerry can containing sufficient water from the farm. The juveniles were acclimatized for a week in the 45 litres experimental tanks (6) at the Fisheries and Aquaculture Laboratory, Olusegun Agagu University of Science and Technology, Okitipupa. During this period, they were fed commercial diets (blue crown, 4 mm) of 40% crude protein twice daily at 3% body weight. The experiment was carried out in fourteen plastic experimental tanks (45 litres capacity) for 8 weeks in the Fisheries and Aquaculture Laboratory of Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State. The water level was maintained at a volume of 40 litres throughout the experimental period. Water in each tank was replaced every three (3) days throughout the experiment to maintain relatively uniform physiochemical parameters and also to prevent fouling of the result from feed residues. The source of water was the Olusegun Agagu University of Science and Technology, Okitipupa (OAUSTECH) borehole.

Experimental Procedure and Feeding Trials

Seven (7) experimental treatments with two replicate, 15 fishes per replicate with a mean initial weight of 22.04±0.02g and uniform–sized fish was selected from 240 juveniles in a completely randomized design (CRD). Weighed and distributed into experimental tanks. The experiment last for 8 weeks during which the fish was fed at 3% body weight daily. The diet per day was divided into two; 1.5% given in the morning by 8:00 – 9:00 am and 1.5% in the evening by 5:00 pm. Measurement of the weight changes was performed every two weeks for a thorough feeding rate and to determine the new body weight of the fish.

Formulation and Preparation of Experimental Diet

Seven experimental diets were formulated at 40% crude protein, 13% ash, 10% crude fibre, 7% ether extract, 6% moisture, and 24% nitrogen-free extract diets using Pearson's square method to determine individual ingredient contribution at g/100g diet. Each ingredient such as fish meal, soybean, groundnut cake, blood meal, maize, wheat bran, rice bran, indomie waste, vitamin-mineral premix, salt, methionine, lysine, vegetable oil, and Di - calcium phosphate was weighed using sensitive weighing balance. Gelatin was incorporated at different inclusion levels of 0%, 1%, 1.5%, 3%, 4.5%, 6%, and 7.5% respectively. The dry ingredients were mixed thoroughly using the manual method. Gelatin was added as a feed additive in the study as a partial replacement for a blood meal. Each diet was treated separately and pelleted through a 2 mm pelleting machine to form a noodle-like strand which was manually broken into suitable sizes for the *Clarias gariepinus*. The pelleted diets were sundried and stored in airtight nylon at room temperature to prevent mycotoxin formation until required.

Growth Performance Evaluation

Fish were evaluated as described by Olusola and Olorunfemi, (2017) as follows:

Weight gain = final body weight - initial body weight

Survival rate (%) = initial number of fish stocked – mortality/ initial number of fish stocked x 100;

Condition factor (K) = $100W/L^3$ Where: W =Weight of fish (g), L = Standard length (cm)

Organ Weight Changes

Three (3) *C. gariepinus* juveniles were taken at the beginning of the experiment and the end of the experiment for organ weight changes. Three (3) fish from each treatment were dissected and the organs (liver, intestine, muscle, spleen, kidney, gill and heart) were taken out and measured using a measuring scale (SF 400; 10000x1g,), the average was calculated and recorded.

Statistical Analysis

Data obtained were subjected to one-way analysis of variance (ANOVA) while the means were compared for significant differences using the Duncan multiple range test.

RESULTS

Growth performance evaluation of *C. gariepinus* juveniles fed gelatin for 56 days

The results of the study revealed that weight gain was highest in GT 7 (68.93g) and lowest in the control (46.33g) and there was a significant difference ($P< 0.05$) among the dietary groups. The value obtained in survival rate was highest in the control (100%) and lowest in the GT 2 and GT 4 (90%), there was no significant difference ($P>0.05$) among the dietary groups. Better values of condition factor were obtained in the GT 7 (0.07) and the least in the control (0.27) and there was a significant difference ($P< 0.05$) among the dietary groups (Table 1)

Table 1: Growth performance evaluation of *C. gariepinus* juveniles fed gelatin for 56 days

	Control	GT 2 (1%)	GT 3 (1.5%)	GT 4 (3.0%)	GT 5 (4.5%)	GT 6 (6.0%)	GT 7 (7.5%)
IBW	22.04±0.00^{a}	22.04±0.00^{a}	22.04±0.00^{a}	22.04±0.00^{a}	22.04±0.00^{a}	22.04±0.00^{a}	22.04±0.00^{a}
FWG	68.37±0.24^{a}	68.68±8.25^{a}	69.69±0.84^{a}	69.09±0.16^{a}	78.72±2.72^{a}	80.52±2.06^{ab}	90.97±2.40^{b}
WG	46.33±0.24^{a}	46.64±8.25^{a}	47.65±0.84^{a}	47.04±0.21^{a}	56.68.±2.72^{a}	58.48±2.06^{ab}	68.93±2.40^{b}
SR	100.00±0.00^{a}	90.00±3.33^{a}	93.34±6.67^{a}	90.00±3.33^{a}	93.34±6.67^{a}	96.67±3.34^{a}	93.34±6.67^{a}
ICF	0.63±0.00^{a}	0.63±0.00^{a}	0.63±0.00^{a}	0.63±0.00^{a}	0.63±0.00^{a}	0.63±0.00^{a}	0.63±0.00^{a}
FCF	0.90±0.01^{d}	0.86±0.02^{c}	0.79±0.00^{b}	0.73±0.02^{a}	0.71±0.02^{a}	0.73±0.01^{a}	0.70±0.01^{a}
DCF	0.27±0.00^{c}	0.23±0.00^{c}	0.16±0.00^{b}	0.10±0.00^{ab}	0.08±0.00^{a}	0.10±0.00^{ab}	0.07±0.00^{a}

IBW= Initial body weight, FBW= final body weight, WG= weight gain, SR= survival rate, PPI= production performance index, ICF= initial condition factor, FCF= final condition factor, DCF= difference between final condition factor and initial condition factor. The above values are means of duplicate data, mean values in each row with similar superscripts are not significantly different (P > 0.05)

Organ weight changes of *C. gariepinus* juvenile fed gelatin at different inclusion levels

The values of organ weight changes in the gill, liver, muscle, intestine, kidney, spleen and heart were presented below (table 2). There was a significant difference (P <0.05) among the dietary groups.

Table 2: Result of the organ weight changes of *C. gariepinus* fed gelatin for 56 days

Parameters	Gill	Liver	Muscle	Intestine	Kidney	Spleen	Heart
Before	1.44±0.03^{a}	0.40±0.02^{a}	2.12±0.02^{a}	1.10±0.20^{a}	0.05±0.03^{a}	0.04±0.02^{a}	0.02±0.02^{a}
Control	2.73±0.22^{c}	1.28±0.03^{e}	3.81±0.07^{b}	2.00±0.02^{b}	0.55±0.03^{c}	0.27±0.02^{c}	0.06±0.01^{b}
GT 2 (1%)	2.07±0.10^{b}	0.96±0.05^{d}	3.56±0.46^{b}	2.00±0.02^{b}	0.54±0.01^{c}	0.11±0.01^{b}	0.12±0.01^{c}
GT 3 (1.5%)	2.54±0.10^{bc}	1.30±0.02^{e}	3.75±0.10^{b}	2.53±0.05^{c}	0.60±0.01^{c}	0.13±0.01^{b}	0.08±0.01^{b}
GT 4 (3.0%)	2.49±0.10^{bc}	0.78±0.10^{c}	3.90±0.25^{b}	2.22±0.05^{b}	0.45±0.03^{b}	0.09±0.01^{ab}	0.19±0.01^{ef}
GT 5 (4.5%)	3.49±0.29^{d}	1.18±0.01^{e}	4.70±0.03^{c}	2.70±0.05^{c}	0.41±0.01^{b}	0.12±0.03^{b}	0.16±0.01^{cd}
GT 6 (6.0%)	3.55±0.25^{d}	1.00±0.05^{d}	5.13±0.10^{cd}	3.77±0.05^{d}	0.55±0.05^{C}	0.27±0.02^{C}	0.14±0.01^{cd}
GT 7 (7.5%)	3.90±0.08^{d}	0.60±0.05^{b}	5.70±0.25^{d}	3.84±0.02^{d}	0.53±0.02^{c}	0.12±0.01^{b}	0.21±0.01^{f}

The above values are means of duplicate data, mean values in each column with similar superscripts are not significantly different (P > 0.05)

DISCUSSION

It was observed from the result that treatment fed with gelatin supplemented diet had better values in weight gain compared to the control diet and there was a significant difference (P<0.05) among the dietary groups. The treatment fed with the highest inclusion levels of gelatin (7.5%) had the best weight gain (68.93g), this was in agreement with Adeparusi and Agbede, (2005) who report a better performance in the weight gain in *C. gariepinus* fed with Leucaena and gliricidia leaf protein concentrate compared to the control diet. The high survival rate recorded in this study indicated that feeding *C. gariepinus* with a gelatin-based diet does not lead to mortality and that the incorporation of gelatin into the diet is palatable for *C. gariepinus*. The best survival rate was recorded in GT 6 (6% inclusion) among the treated groups, although there were no significant differences (P> 0.05) among the dietary groups. The fish was able to digest and absorb the nutrients in the diet to enhance growth. This observation was similar to the work of Bello *et al*., (2012) who reported better weight gain in *C. gariepinus* fed onion bulb and walnut leaves extracts supplemented diets compared to the control. The results of the study show that all the fish were in better condition at the end of the experiment than they were at the beginning. However, the treated groups had better condition factors than the control (Table 2). Ibrahem *et al.*, (2010) reported that the body weight gain, condition factor and survival rate were significantly higher (P< 0.05) in fishes fed a basal diet supplemented with insulin and vitamin C than the control which is in accord with the present study

It was observed from the study that there was an increase in the growth rate of the fish thereby leading to an increase in the weight of the organ of the fish except for the weight of the liver and spleen. The organ of the fish was increased as the inclusion levels of gelatin increased, this could be a result of the essential amino acid and other nutrient composition in the gelatin which may serve as a growth promoter and there were significant differences (P <0.05) among the dietary groups. However, the slight decrease in the weight of the liver with the value of the treated groups lower than the weight of the control might be a result of the hepatoprotective effect of the gelatin on the liver organ of the fish and this is in agreement with the report of Ayebidun *et al*., (2022) who observed a decrease in weight of the liver of C. gariepinus fed different graded levels of fleshy fruit pulp of African star apple

(*Chrysophyllum albidum*).

CONCLUSION

A good quality, healthy and sustainable juvenile fish with a higher survival rate is a key determinant of continuity in the production of fish in Africa. This study shows that the dietary inclusion of gelatin can improve the performance, survival and health of *C. gariepinus* and it is recommended that 7.5% of gelatin in the diet of *C. gariepinus* would enhance sustainable aquaculture.

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