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Application of Biofloc Technology in Rearing of Two IMC Fish Species *Cirrhinus mrigala* and *Labeo rohita* and Estimation of Length – Weight Relationship under the Same Feeding Regime

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Biofloc technology (BFT) is an innovative technology which is based upon zero or minimal water exchange where heterotrophic bacteria which consume organic carbon are grown on unconsumed feed, fish excreta and inorganic nitrogenous products resulting in the removal of these unwanted components from the water. The present study demonstrates the effective application of Biofloc technology to culture Indian Major Carps (mainly *C. mrigala* and *L. rohita*) in semi-indoor conditions

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with less water requirements. After conducting the study for a period of 6 months, relationship between length-weight was derived in both the fishes. The value of 'b' showed an increase with 2.8701 (in *C. mrigala*) and 2.7567 (in *L. rohita*) after the study period. The value of K_n lied within the range of 0.9545-1.0511 (in *C. mrigala*) and 0.925-1.01 (in *L. rohita*). Coefficient of determination (R^2) and correlation coefficient (r) were prominent with R^2=0.9071 (r=0.952) and R^2=0.9517 (r=0.975) in *C. mrigala* and *L. rohita* respectively. The findings of the current study demonstrates that IMC can be reared effectively using this technique rather than going for large scale culture where cost of feed and space limitation is a major problem.

Keywords: Biofloc; indian major carps; length-weight; relative condition factor.

1. INTRODUCTION

The field of aquaculture is increasing at a rapid rate. This growing industry is affected by a number of environmental and social issues [1]. Some of the major problems faced by the aquaculture industry are the treatment and release of farm effluent, high dependency on fishmeal for the preparation of feed and outbreak of diseases. Inorganic nitrogen species (NH^{4+} and NO^{2-}) are the major excretory material in aquatic animals which will get accumulated in the aquaculture system [2] is the main issue of concern. Ammonia is toxic to fishes. Elevated concentrations of ammonia affect growth, oxygen consumption and can cause mortality of fish. So this ammonia needs to be removed at definite time interval by exchange of water. But the flushing out and then adding new water is a tiresome process. Biofloc technology (BFT) is an innovative technology which is based upon zero or minimal water exchange. The major driving force is the intensive growth of heterotrophic bacteria which consume organic carbon [3]. This microbial biomass is grown on unconsumed feed, fish excreta and inorganic nitrogenous products resulting in the removal of these unwanted components from the water.

In biometric studies, it is imperative to determine the growth characteristics related to the weight and length of the fish [4]. The length-weight relationships (LWRs) in fish helps in providing information about the growth pattern, fish condition, general health, habitat conditions, life history as well as morphological characteristics of the fish [5]. LWRs differ among fish species depending on the body shape and the physiological factors such as maturity and spawning [5]. Depending on the fullness of stomach, general condition of appetite and gonadal stages, the value of 'b' changes during different time periods [6]. An additional important biometric tool is the relative condition factor (K_n) that was derived from the LWRs [7]. A value of K_n measures the deviation of weight of an organism from the average weight in a given sample. This value helps in assessing suitability of a specific water environment for growth of fish [8]. A fish species is considered to be fit when K_n values are equal or greater than 1. This study was conducted to analyse the growth of two species of fish in captive condition using BFT and fed under the same feeding regime.

2. MATERIALS AND METHODS

2.1 Fish Stocking and Rearing

Two species of Indian Major Carps viz. *Cirrhinus mrigala* and *Labeo rohita* were reared using Biofloc Technology (BFT) in large cemented tanks of diameter 4m, height 1.5 m and having a water holding capacity of 10,000 liter. 50 fishes of each species with a maximum size of 40-45 cm and weight of 400-600 g were stocked and reared for a period of 6 months from May, 2021 to October, 2021. Fishes were fed commercial feed (Protein 28 %, Fat 5 %, Fiber 10% and Moisture 12 %) at 2 % of the total stocked biomass daily. Probiotic culture (Pro-Acua W, Godrej agrovet) was spread over the water at a month's interval time. This technology has an advantage of zero-water exchange, so no exchange of water was done during the whole period. This whole experiment was carried out in and around local areas of Dhakuakhana College, Dhakuakhana, Assam.

2.2 Management of Water Quality

During this whole period the water parameters viz. D.O, Ammonia, pH, Nitrate, T.D.S, Total alkalinity, Hardness, Conductivity and Temperature were checked regularly using YSI Pro DSS Multiparameter water quality meter (HI

98194 pH/EC/DO Multiparameter). pH was checked twice daily, once in the early morning and once in the evening. Ammonia was checked every alternate day till 5 weeks, thereafter at a week interval. Nitrite and nitrate levels were checked once a week. 100gm of Bio-lime ($CaCO_3$) was added per 1000 L of water every 25-30 days. Temperature of the water was between the range of 22-35° C during the study period.

2.3 Management of Biofloc Tanks

C:N ratio of 10:1 [3] were maintained in the tank using different carbon sources: glucose, molasses and rice bran for healthy biofloc culture. 20% carbon sources (rice water) were added daily for 7-10 days till microbial population developed and took control of the water quality system. Carbon sources were completely mixed with water with the help of a stirrer before spreading into the tank.

2.4 Analysis of Growth

i. Length-weight relationship: The scatter diagrams of length and weight were plotted in MS Excel sheet (Microsoft Excel 2010). The length-weight relationships were found out by carrying linear regression analysis. The length-weight relationship of the experimental fish worked out as per cube law given by Le Cren [7]:

$$W = aL^b,$$

Where,
W is weight of the fish in gm, L is observed total length in cm, 'a' is the regression intercept and 'b' is the regression slope. When applying this formula, b may deviate from the ''ideal value" of 3 because of certain environmental circumstances or the condition of the fish themselves. A value of 3 represents an isometric growth of fish [9]. A value less than 3 indicates negative allometric growth with fish becoming slimmer with increase in length. A value greater than 3 indicates a positive allometric growth with fish become heavier reflecting optimum conditions for growth.

ii. Relative condition factor (K_n): K_n was established to assess the condition of different fish species under study. K_n is given by the equation

$$K_n = W_o/W_c,$$

Where;
W_o is the observed weight of the fish (g), and W_c is the calculated weight of the same fish (g) (Le Cren, 1951). A value of $K_n \geq 1$ indicates good growth condition of the fish while the organism is in poor growth condition compared to an average individual with the same length when $K_n < 1$.

2.5 Statistical Analysis

Length-weight relationships (LWR) data was presented in MS Excel sheet software (Micrsoft Excel 2010) and the relative condition factor was calculated using the same software.

3. RESULTS

A total of N=46 specimen of *C. mrigala* and N=21 specimen of *L. rohita* (out of 50 fish of each species) were taken randomly into examination during this study. The length of the fish species at the start of the study ranged within the range of 21.2-36.5 cm (in *C. mrigala*) and 36.35-43.8 cm (in *L. rohita*) which increased to 26.0-40.20 cm (in *C. mrigala*) and 39.0-48.85 cm (in *L. rohita*) after rearing using Biofloc technology for a period of 6 months. The weight of the fish species were prominent too with value being within the range of 94.5-292 g (in *C. mrigala*) and 490-599.18 g (in *L. rohita*) at the start of the study, subsequently increasing to 174.96- 401.1 g (in *C. mrigala*) and 554.95-792.85 g (in *L. rohita*) after a period of 6 months. Relationship between length-weight before and after conducting the study was derived in both the fishes (Fig. 1). The value of 'a' and 'b' were recorded from these logarithmic graphs. The value of 'b' in *C. mrigala* recorded from the graph increased from 2.1456 (before study) to 2.8701 (after study). Likewise in *L. rohita,* the value of 'b' increased from 2.2388 (before study) to 2.7567 (after study). Minimal difference was noted in finding of relative condition factor (K_n). The value of K_n lied within the range of 0.8025-1.00 and 0.9545-1.0511, before and after the study respectively in *C. mrigala.* In case of *L. rohita* value of K_n lied within the range of 0.925-1.01 and 0.9485-1.067, before and after the study respectively. Coefficient of determination (R^2) and correlation coefficient (r) were prominent with R^2=0.8071 (r=0.898) before the study and R^2=0.9071 (r=0.952) after the study in *C. mrigala.* In *L. rohita* both the values significantly increased from R^2=0.7797 (r=0.883) to R^2=0.9517 (r=0.975).

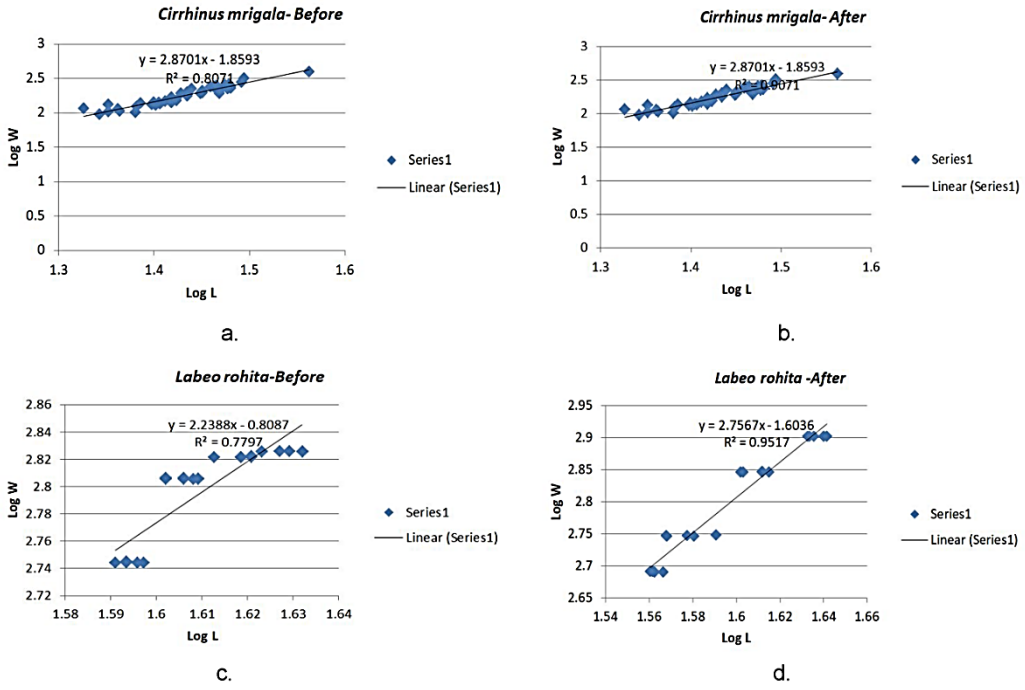

Fig. 1. Graphical presentation showing Coefficient of determination (R^2)

4. DISCUSSION

The length-weight relationship of Indian major carps has been previously discussed by various researchers from different localities of India. Desai and Shrivastava [10] observed an exponent value of 2.9143 for *Cirrhinus mrigala* collected from Rihand reservoir. Johal and Kingra [11] reported exponent value ranging from 2.752 to 3.545 in three Indian major carps. Pandey and Sharma [12] reported exponent values for *Cirrhinus mrigala* and *Labeo rohit*a as 1.7932 and 2.2502 respectively. In Rajasthan, Jain [13] reported a high variation in 'cube law' for *Labeo rohita and Cirrhinus mrigala* from Siliserh reservoir, and observed that availability of living space and food could strongly influence the values of exponent. Panicker [14] reported an exponent value of 3.113 in *Labeo rohita* collected from Chulliar reservoir. He further stated that the shifting of exponent value to higher than 3 indicated a favourable environment for fish in the reservoir for their good growth and well-being. All of these findings correlate with the current findings where the value of 'b' was found to be 2.8701 and 2.7567 in case of *C. mrigala* and *L. rohita* respectively after rearing in Biofloc for a period of 6 months thus suggesting BFT to be an equally important technique which can be used for rearing of IMC fish species. A value less than 3 could be due to small duration of the study and lesser number of samples taken for the study. In one of the studies conducted by Rathore et al. [15], the exponent value 'b' was found to be deviated from 'cube law' i.e. the value was 0.262. Such deviations from 'cube law' were also observed by earlier researchers. This may be due to lesser availability of food and nutrients from where the fishes were collected. Balai et al. [16] reported in their study the correlation coefficient (r) to be 0.967 and 0.946 for *L. rohita* and *C. mrigala*, respectively. In the current study the results were similar with r=0.952 and r=0.975 for *C. mrigala* and *L. rohita* respectively. Balai *et al.,* 2016 reported the value of K_n to be 1.010±0.013 and 1.008±0.012 for *L. rohita* and *C. mrigala* respectively. The current study finds the value of K_n to be within the range of 0.9545-1.0511 and 0.9485-1.067 for *C. mrigala* and *L. rohita* respectively which correlate with the finding of other authors. Similar value of K_n was also reported by Johal and Tandon [17] in *C. mrigala* collected from Sukhna Lake (Chandigarh). Similar findings on Kn were also reported by Ujjania *et al.* [18] for *L. rohita* in different water bodies of southern Rajasthan (Ujjania [19].

5. CONCLUSION

The present study demonstrates the effective application of Biofloc technology to culture IMC

(mainly *C. mrigala* and *L. rohita*) in semi-indoor conditions with less water requirements. The findings of the current study demonstrates that IMC can be reared effectively using this technique rather than going for large scale culture where cost of feed and space limitation is a major problem. A high value of b=2.8701 and b=2.7567 in case of *C. mrigala* and *L. rohita* suggest better conditions of growth than that reported by some earlier researchers working on these fish species in various parts of the country. As such, this zero water exchange technique proves to be effective and can be used for rearing of IMC.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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