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Ratnakar Mishra
Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal, Madhya Pradesh, India

Dr. Praveen Tamot
Professor, Department of Zoology, Govt. M.L.B. College Bhopal, Madhya Pradesh, India

Vipin Vyas
Department of Bioscience, Barkatullah University, Bhopal, Madhya Pradesh, India

Corresponding Author:
Ratnakar Mishra
Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal, Madhya Pradesh, India

Effect of Biofloc system using several carbon sources on survival rate and weight gain of (*Cyprinus carpio* L.) Fry

Ratnakar Mishra, Dr. Praveen Tamot and Vipin Vyas

Abstract
A 90 days feeding trial was carried out to evaluate the effects of different carbon sources (sugar beet molasses: SBM + BFT, sugar: S + BFT, corn starch: CS + BFT) on growth performance, for common carp fry. Results showed a significant difference in water quality parameters among different culture systems; CS + BFT had the lowest amount of total ammonia nitrogen (TAN) at the end of culture period. Results showed the fish weight was the highest in CS + BFT. Overall, this study suggests that microbial flocs formed in corn starch based biofloc can improve common carp growth performance and survival rate of common carp under zero water exchange and hence ensures sustainability.

Keywords: Biofloc, Survival rate and weight gain, etc.

Introduction
Globally, common carp (*Cyprinus carpio* L.) is the fourth most important cultured fish with a share of 7.7% of total aquaculture fish production (FAO, 2020) [16]. Moreover, common carp culture practice is changing from semi-intensive form to more intensive systems (Bakhshi *et al.*, 2018) [8]. High stocking density can lead to stress related issues in fish, which are the disease-causing harmful pathogen, low growth and feed utilization performance (Xie *et al.*, 2018) [34]. Intensification of aquaculture has been warranted because of increasing per capita demand, which eventually led to increase in pollution load especially in tropical carp culture sector (Mpeza *et al.*, 2013; Tavakol *et al.*, 2017) [37, 29]. increasing per capita demand, which eventually led to increase in pollution load especially in tropical carp culture sector (Mpeza *et al.*, 2013; Tavakol *et al.*, 2017) [37, 29]. Globally common carp (*Cyprinus carpio* L.) is the fourth most important cultured fish with ashare of 7.7% of total aquaculture fish production (FAO, 2020) [16]. Moreover, common carp culture practice is changing from semi-intensive form to more intensive systems (Bakhshi *et al.*, 2018) [8]. High stocking density can lead to stress related issues in fish which are the major concerns in the current context due to high incidence of disease-causing harmful pathogen, low growth and feed utilization performance (Xie *et al.*, 2018) [34]. In recent times, biofloc technology (BFT) is getting more attention in aquaculture due to its greater effectiveness in terms of sustainable production (Ahmed *et al.*, 2017) [1] through improvement of water quality, feed efficiency and immunity of fish. Moreover, the technology has a huge potential to conserve land and water and to promote heterotrohic feed resources (Ekasari and Maryam, 2015) [14]. Also, the main principle of BFT is based on more efficient use of nutrient input in limited or zero water exchange (Avnimelech, 1999) [3]. BFT is mainly focused on prevention of feed-borne toxic nitrogen metabolites (NH3, NO2 –, etc.) accumulation through stimulation of heterotrophic microbes by manipulation of carbon/nitrogen ratio (C:N) (Avnimelech, 2009) [12]. High proliferation ability of heterotrophic bacteria results in formation offlocs, so called biofloc which contains heterogenous populations of heterotrophic microbes, fungi, plankton, protozoa, nematodes, organic polymers and dead cells (De Schryver *et al.*, 2008; Avnimelech, 2009; Ekasari *et al.*, 2015) [28, 12, 14]. Regular consumption of floc by cultured fish can increase feed efficiency (Xu *et al.*, 2012) [36], resource productivity (Wei *et al.*, 2016) [32], and bio-security in aquaculture (Pérez Fuentes *et al.*, 2016) [25]. Also, the biofloc can ameliorate water quality and improve growth performance of common carp under zero water exchange system (Bakhshi *et al.*, 2018) [8]. Schneider *et al.* (2005) [27] reported that 7–13% of improvement nitrogen retention can be possible through optimization of C:N ratio in biofloc system.

Biofloc can also favor phosphorus mineralization and the mineralization process becomes limited in maintaining the balance between available nitrogen: phosphorus beyond 0.065 mg l1 (Dinda *et al*., 2019) [13]. The successful culture of fish in biofloc supplemented system has been reported in common carp channel catfish (Green *et al*., 2014) [18], Nile tilapia (Ekasari *et al*., 2015) [14] with promising findings. Mahanand *et al*. (2013) [37] reported that biofloc technology could able to enhance the good water quality, natural food availability and growth performance of common carp in high-intensity systems. The omnivorous common carp is compatible to ingest and digest bioflocs and able to tolerate high concentrations of suspended material in the water, and low concentrations of oxygen and stress when cultured in intensive BFT system (Najdegerami *et al*., 2016) [24]. Various medicinal herbs are used in aquaculture to reduce or replace chemicals and drugsdue to development of antibiotic resistance of bacteria (Cabello, 2006) [11]. Application of different parts of neem (*Azadirachta indica*) in aquaculture has become a means to control pathogen and disease (Martinez, 2002) [21] to benefit from its bioactive compounds (azadirachtin and nimbin) (Biswas *et al*., 2002) [10]. The presence of natural bioactive compounds, namely azadirachtin in neem highly influence the phosphatase activity (Gopal *et al*., 2007) [17] and to some extent inhibit the nitrification process in aquaculture (Das *et al*., 2018) [13]. Dinda *et al*. (2019) [13] reported that neem based biofloc system can inhibit nitrification process in culture of common carp. However, farmers in India have been recently using neem leaves extract as herbal therapeutants in biofloc supplemented aquaculture of both finfish and shrimps (Dinda *et al*., 2019) [13]. Therefore, the present study amied that the application of different carbon sources in biofloc system, significantly affect the weight and survival rate of common crop fry.

2. Materials and Methods

The experiment was conducted at the Department of Applied Aquaculture and Zoology in Barkatullah University Bhopal Prior to initiation of the experiment, was done on common carp fry (initial weigh 2.03±0.02g) procured from a fish farm MM Fisheries and were acclimatized to experiment conditions in a rectangle tank. The tank was provided with continuous aeration and a water flow system, and the water temperature was maintained at around 22 ± 1 °C. In the second stage, the experimental design was completely randomized, with four treatments each administered to three replicates in 12 rectangle tanks (Vol. 70 L). In control group, the fish were fed with commercial diets at 3.5% of their body weight, with a flow-through system, whereas in the BFT treatment groups, the fish were fed with BFT and a commercial diet (75% DFI), and there was no exchange of water. The control and BFT treatments were used as follows: control or 100% DFI, sugar beet molasses as carbon source in BFT + 75% DFI (SBM + BFT), sugar as carbon source in BFT + 75% DFI (S + BFT), and corn starch as carbon source in BFT + 75% DFI (CS + BFT). For the formation of microbial flocs stock, 200 L of the first-stage effluent was transferred to four conoid tank. Different carbon sources were added based on the calculation of Avnimelech (1999) [3]. The tanks were continuously aerated using an air-stone connected to an air pump. The light regime was maintained at 12:12 (light/dark, artificial luminosity of ~600 lx).Common carp fry were stocked at the aforementioned density and fed using the treatment schedule described.

Results

The mean initial body weight of (common carp) fry of Corn flour + BFT diet fish experiment on the 1st day of stocking was 2.03±0.02 g. On 30th day, the mean weight of was observed as 10.76±0.20 g. At the end of the experiment (90th day), the mean final weight was recorded as 35.16±0.45g. The fish fry showed gain in weight as compered to control as showin in fig- 1.Similar results were found in a fry reared in (Sugar+wheat flour+ BFT biofloc meal incorporated diet) The mean weight of (common carp) fry on 30th day was recorded as 10.97±0.24 g. At the end of the experiment, the mean final body weight were recorded as 30.28±0.48g.as shown in fig-2.The (common carp) fry were stocked in (Molasses+ BFT incorporated diet) experimental troughs. On 15th and 30th day of experiment, the mean weight was observed as 5.54±0.12 g and 10.09±0.09 g respectively. On 90th day, the final mean body weight were noted as 27.11±0.26g. as shown in fig-3.The mean body weight gain recorded in Control diet was 24.56±0.9g whereas in Corn flour, Sugar+wheat flour, and Molasses biofloc meal incorporated diet was recorded as, 35.16±0.45g. 30.28±0.48g, and 27.11±0.26g and respectively. Corn flour, diet yielded better body weight gain among all the experimental diets. As shown in fig.4.

Survival rate

Survival of the fry under experimental conditions using bio-floc technology has been studied. Survival rate was calculated on 15th day and 90st day after stocking the post fry. Survival was better and more in the experimental tanks compared to the controls. On 15th day survival rate of fry in experimental tanks fed with Corn flour + BFT was (94±1) and the value was low in the control tank (89.33 ± 1.53). In the remaining experimental tanks it was recorded as 92%. It was found that the survival rate has exhibited a significant difference among the experimental and control tanks on 15th day. On 90st day, survival rate was between of 87.67-89.34% in experimental tanks, while it was lower in control tanks (84.5%). Survival of the fry under experimental conditions using bio-floc technology has been given in fig-5.

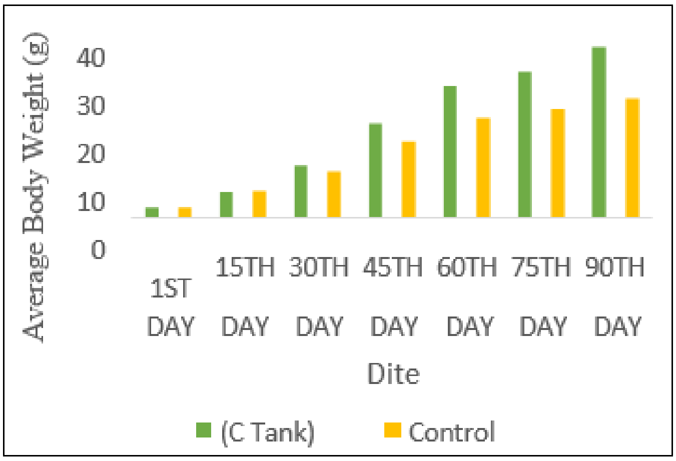

Fig 1: The fish fry showed gain in weight as compered to control as show in

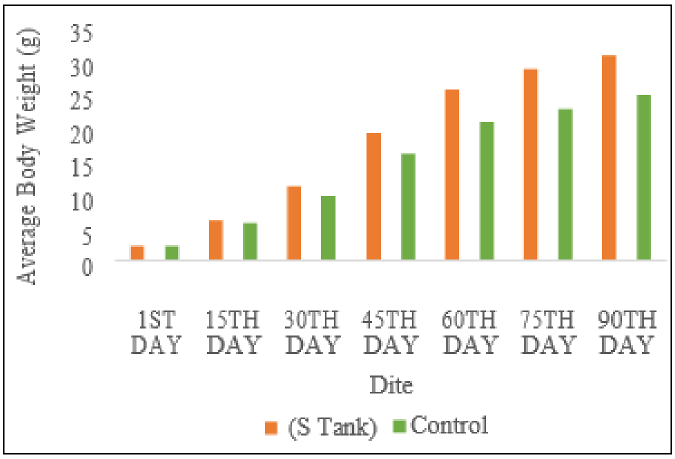

Fig 2: The mean final body weight were recorded

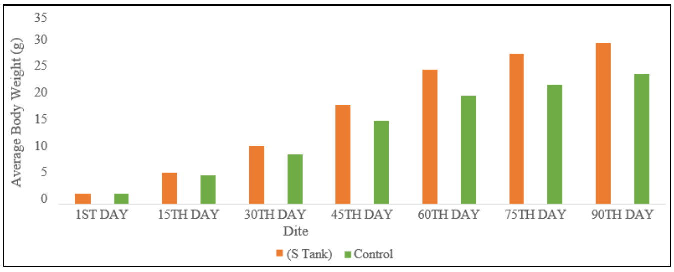

Fig 3: The mean body weight gain recorded in Control diet

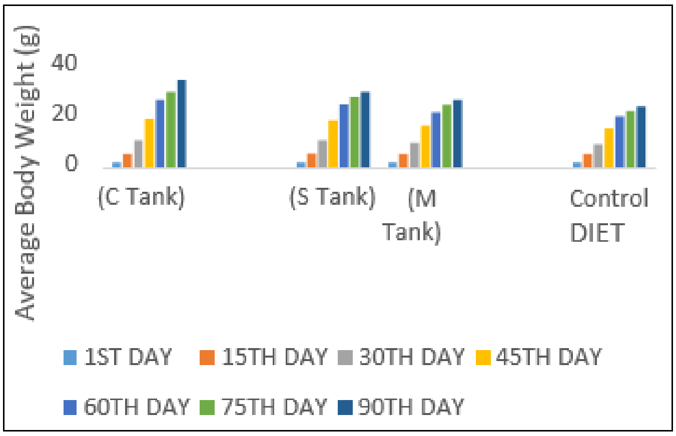

Fig 4: Corn flour, diet yielded better body weight gain among all the experimental diets

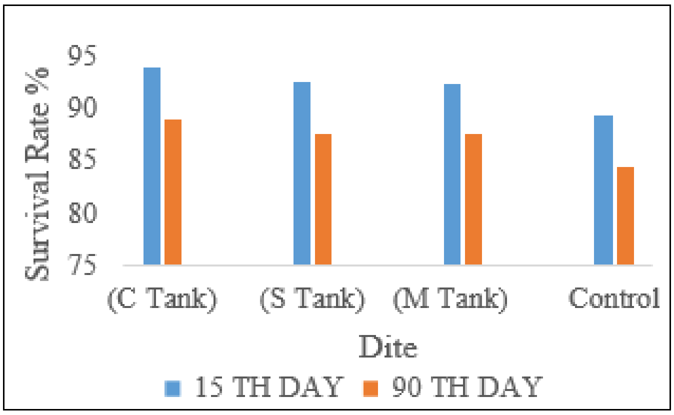

Fig 5: Survival of the fry under experimental conditions using bio-floc technology has been given

Discussion

It is illustrated that the application of different carbon sources in biofloc system, significantly affect the weight and survival rate of common crop fry. In the current research increase was noticed in the final weight Of BFT treated tanks in comparison to those cultured in control. Based on literature review, the role of the BFT system in promoting common carp growth is largely unknown and this effect may include several aspects. water quality, growth performance, in common carp fingerling culture. In our study, a direct relationship was observed between Wait gain, survival rate and carbon sources in biofloc system. The positive relationship between microbial community and water quality parameters supports the idea that managing the microbial community may be an important consideration for proper overall system management. Avnimelech (2012) [6] reported that simple carbohydrates (sugars) are able to remove ammonia nitrogen faster compared to complex carbohydrates (rice brans)which supports the growth of fry as compered to control tank similar results were found in our study. our results, are further in agreement with those reported by Ekasari *et al*. (2015) [14] and Avnimelech (2012) [6]. In previous studies, the positive effects of the application of BFT on growth performance and FCR have been reported in Oreochromis spp. (Avnimelech, 1999, 2007; Azim and Little, 2008) [3, 5, 2], *Macrobrachium rosenbergii* (Asaduzzaman *et al*., 2010) [2], *Litopenaeus vannamei* (Xu *et al*., 2012a, 2012b), Labeo rohita (Mahanand *et al*., 2013) [37], *Clarias gariepinus* (Bakar *et al*., 2015) [7], and Carassius auratus (Wang *et al*., 2009) [31]. In the present study high survival rate was recorded in the C tank (fed with Corn flour as carbohydrate source) on 15th day (94%) and 90st day (89.34%) and it was significantly lower in control tanks (89.33 and 84.5% respectively). Total feed used (68.54g) and total yielded mass (60.80g) was found relatively high in the C tank. Several earlier reports have dealt with survival, growth performance, feed conversion ratio of the post- larvae in conjunction with bio-floc system (Azimand Little, 2010; and Kim *et al*., 2014) [2, 19].

Conclusion

The current study contributed to a better understanding of the effects of different carbon sources in BFT system on common carp fry culture. The results indicate that water quality parameters in BFT system with different carbon sources change with microbial community dynamic; hence, microbial community management is an important factor in BFT efficiency. Also, the results demonstrate that corn starch biofloc based had beneficial effects on weight and survival rate of common carp. These findings may encourage fisherman's to consider corn starch as a viable carbon source in intensive culture of common carp in BFT system.

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