Journal of Advanced Zoology
ISSN: 0253-7214
Volume 44 Issue S1 Year 2024 Page 194-199

Comparative Evaluation Of Different Carbon Sources In The Biofloc System While Growing Out Common Carp (Cyprinus Carpio L.) Fry.

Ratnakar Mishra[1*], Praveen Tamot[2] and Vipin Vyas[3]

[1*,3] *Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal.*
[2,] *Department of Zoology, Government Maharani Laxmi bai Girl (Autonomous) Post Graduate College Bhopal*

****Corresponding author**- Ratnakar Mishra*
Department of Zoology and Applied Aquaculture, Barkatullah University Bhopal.
ratnakarscholar23@gmail.com

Abstract

A 10 weeks feeding trial was carried out to evaluate the effects of different carbon sources (sugar beet molasses: SBM + BFT, sugar: S + WF (Wheat Flour) BFT, corn starch: CS + BFT) on water quality, 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. 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 tanks water quality under zero water exchange and hence ensures sustainability.

Keywords: Carbon source, Biofloc Common carp Fry, Microbial community, TAN.

Introduction

Around the world, several hundred million people rely on fisheries and aquaculture as major sources of food, nutrition, income, and livelihoods (FAO, 2016). Possibly the most common carp (Cyprinus carpio L.) top-known teleost in the world and the third-most significant cultivated fish, in part because of its lengthy history of domestication and first statements (Komen, 1990). Farmers using ponds throughout the inland aquaculture industry, this species is significant and mostly raised within earthen ponds (Bauer et al., 2006). In fact, some nations have produced intensive and super intense common carp cultures in concrete ponds as a result of growing populations and local market demands. Concerns about the development of sustainable aquaculture have grown as a result of the high-intensity systems' rapid accumulation of organic waste, feed residues, and hazardous inorganic nitrogen (Samocha et al., 2004; Avnimelech, 2006; Azim and Little, 2008; Zhao et al., 2012). A relatively innovative and alternative aquaculture system is therefore desperately needed. Recently, the use of Biofloc technology (BFT) to stop the buildup of hazardous nitrogen metabolites has been explored. Even in zero-water exchange settings, this system functions by adjusting the carbon/nitrogen ratio (C/N) and transforming these metabolites into heterotrophic microbes and organic particles (Avnimelech, 2007; Azim and Little, 2008; De Schryver et al., 2008; Crab et al., 2009). In biofloc systems, harmful nitrogen metabolites (such NH3 and NO2-) are thought to be transformed into microbial flocs, which aquatic animals can eat in addition to their regular diet (De Schryver et al., 2008; Avnimelech, 2009).According to Bauer et al. (2012), BFT is a cost-effective substitute that can be utilised to lessen the commercial diets of fish in fishponds and also minimise any possible environmental issues. The majority of BFT research done to date has primarily examined prawn culture. For instance, BFT enhances the water quality in intensive prawn production, according to a literature analysis that surveyed all reported examples (Megahed, 2010; Zhao et al., 2012). Additionally, it can boost growth performance by promoting the activity of digestive enzymes and adding more microbial flocs (BecerraDorame et al., 2011; Xu et al., 2012a, 2012b). These actions help strengthen the immune system (Kim et al., 2014). Overall, not many studies using fish in the BFT system have been done. Numerous studies have reported the beneficial effects of BFT on the growth performance, water quality, immune response, and digestive enzyme activity in tilapia (Avnimelech, 2007; Azim and Little, 2008; Crab et al., 2009; Widanarni and Puspita, 2012), Labeo rohita (Verma et al., 2016), and African catfish (Clarias gariepinus) (Ekasari et al., 2015). Thus far, research on BFT's effects on common carp has only been conducted by Najdegerami et al. (2016), who found that adding sugar beetroot molasses to BFT enhances the growth performance, the activities of digestive enzymes, and the histology of the liver. Nevertheless, it is unclear how different carbon sources affect the biofloc and gut microbial flora, which are crucial for carp aquaculture, as well as body composition, water quality, and growth performance.

2. Materials and methods

2.1. Tank facilities and experimental design

The experiment was conducted at the Department of Applied Aquaculture and Zoology in Barkatullah University Bhopal. Prior to initiation of the experiment, approximately 300 common carp fry (initial weigh 2.03±0.02g) procured from a fish farm (MM Fisheries) and were acclimatized to experiment conditions in a circular 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 circular 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, and total ammonium nitrogen (TAN) was measured. Different carbon sources were added based on the calculation of Avnimelech (1999) who assumed that 20 g of carbon source is required to convert 1 g of TAN. 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) Tank aeration was stopped when TAN concentration decreased to almost zero and total suspended solids reached 300 mg L^{-1}, after which the experimental tanks were inoculated with 200 mg L^{-1} of microbial flocs in each treatment. Common carp fries were stocked at the aforementioned density and fed using the treatment schedule described. During the experimental period, carbon sources were added at the rate of 20 times the TAN concentration to maintain a C/N ratio of 20 for optimum production of BFT.

2.2. Water quality parameters

During a 10-week experimental period, water temperature, pH (ELMETRON CP-411), and dissolved oxygen (AZ Instrument 8403, Portable DO Meter) were determined twice daily in the tanks. First, the total ammonia nitrogen (TAN), nitrite (NO_2^-), and nitrate (NO_3^-) were measured. Then, 100 mL of water in each tank was filtered under vacuum pressure through a microfiber glass filter paper (Whatman).

2.3. Sampling and analysis

The survival of the fry over the 10 weeks was calculated according to daily observation in each tank. The initial (W0) and final weights (W) of all the fry from each tank were determined at the beginning and end of the experiment. Weight gain was calculated using the following formula: weight gain = final weight - initial weight.

Results

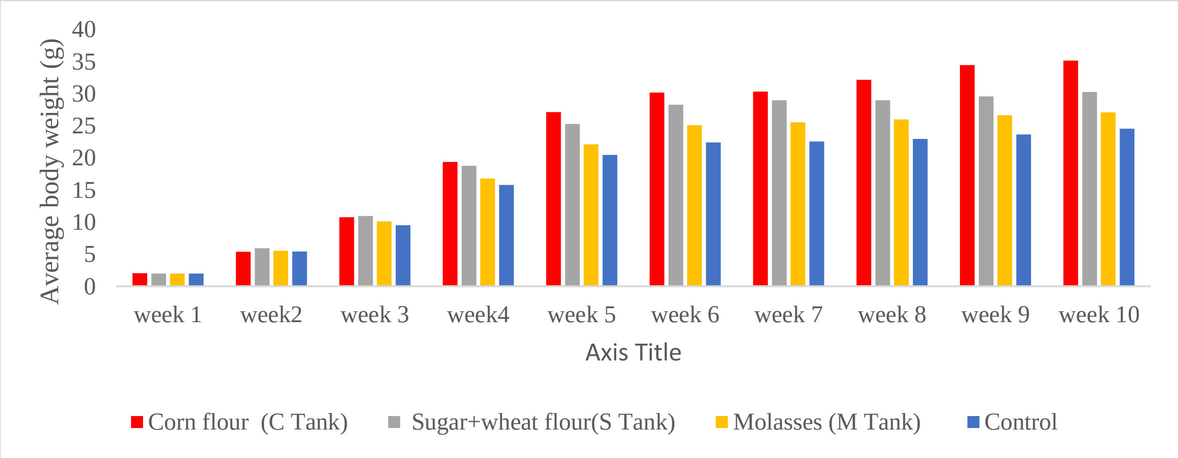
Average water DO concentrations (6 mg l^{-1}, range 5–6 mg l^{-1}), temperature (28°C, range 27–28 °C), were within the range for common carp culture condition. The results of dissolved inorganic nitrogen (TAN) concentrations over the experimental period are presented in Fig. 1. A high degree of fluctuation in TAN (Fig. 1a) levels was observed in BFT treatment. Besides, the fluctuation pattern was similar in both par ameters. TAN concentrations increased until week 5, and then dramatically decreased in BFT treatments. During the experiments, pH changes in SBM + BFT were approximately constant; however, was very high in the control treatment.

Table-: ANOVA test result of TAN values between experimental and control tanks of during the nursery phase of common carp (cyprinus -carpio) reared with Bio-floc technology.

Tank	F value	p value	Status of significance
(S+Wheat flour) tank	4.086631	0.04995	Significant
SBM tank	4.090573	0.049845	Significant
Cs tank	4.15289	0.048215	Significant

Fig. 1. Fig. 1. Showing fig; (a) DO (b) pH, (c) TAN Values which are means of three replications in each week for treatments. The standard deviations were within ± 5% (not shown in the figures). In the figures, SBM + BFT: biofloc based on sugar beet molasses, S + BFT: biofloc based on sugar+ wheat flour, CS + BFT: biofloc based on corn starch.

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.



Discussion

In the present research, it is illustrated that the application of different carbon sources in biofloc system, significantly affect the water quality, growth performance, in common carp fingerling culture. One of the major water quality problems in intensive aquaculture systems is the accumulation of toxic nitrogen metabolites (NH4 + and NO2 −) in the water (Avnimelech, 1999). The harmful effects of ammonia (> 0.1 mg L−1) and nitrite (> 5 mg L−1) in farmed fish and shrimp have been reported in different studies (Qiao et al., 2006; Wang et al., 2015b). Therefore, ammonia and nitrite nitrogen are more sensitive to intensive aquaculture systems (Tovar et al., 2000). In this study, the microbial flocs grown on various carbon sources showed a high performance in maintaining the water quality parameters in a normal range for common carp growth. Two points are obvious from these results. First, accumulation of TAN, in early weeks until week 5 and then a dramatic declining was noticed in all BFT treatments. The accumulation of mentioned parameters may have caused by nitrification process, reported in several BFT studies (Azim and Little, 2008; Widanarni and Puspita, 2012; Xu et al., 2012a; Zhao et al., 2012). Also, reducing these parameters from the week 5 to the end of the experiment occurred due to immobilization by heterotrophic bacteria, which inhibited the nitrification process. It is known that microbial communities play a crucial role in nutrient cycling in BFT system and a potential role in the provision of supplemental nutrition (Ray et al., 2012). In our study, a direct relationship was observed between microbial dynamics and water quality during the experiment period. Moreover, along with microbial community dynamic, water quality parameters were significantly improved. This 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 (Ray et al., 2012).Regarding the second point, Avnimelech (2012) reported that simple carbohydrates (sugars) are able to remove ammonia nitrogen faster compared to complex carbohydrates (rice brans). our results, are in agreement with those reported by Ekasari et al. (2015) and Avnimelech (2012). 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), Macrobrachium rosenbergii (Asaduzzaman et al., 2009), Litopenaeus vannamei (Xu et al., 2012a, 2012b), Labeo rohita (Mahanand et al., 2013), Clarias gariepinus (Bakar et al., 2015), and Carassius auratus (Wang et al., 2015b). In the current research increase was noticed in the final weight were seen 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.

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 of common carp. These findings may encourage farmers to consider corn starch as a viable carbon source in intensive culture of common carp in BFT system.

REFRENCES:

1. Asaduzzaman, M. Wahab, M.A. Verdegem, M.C.J. Adhikary, R.K..Rahman, S.M.S Azim, M.E. Verreth ,J.A.J.(2010) Effects of carbohydrate source for maintaining a high C:N ratio and fish driven re-suspension on pond ecology and production in periphyton-based freshwater prawn culture systemsAquaculture, 301, 37-4.
2. Avnimelech, Y. (1999). Carbon/nitrogen ratio as a control element in aquaculture systems. Aquaculture, 176(3-4), 227-235.
3. Avnimelech, Y. (2006). Bio-filters: The need for an new comprehensive approach, Aquacultural Engineering, 34(3), 172-178.
4. Avnimelech, Y. (2007). Feeding with microbial flocs by tilapia in minimal discharge bio-flocs technology ponds, Aquaculture,226,1-4.
5. Avnimelech, Y. (2012). Biofloc technology: a practical guide book. World Aquaculture Society.
6. Azim, M., & Little, D. (2008). The Biofloc technology (BFT) in indoor tanks: water quality, biofloc composition, and growth and welfare of Nile tilapia, Oreochromis niloticus. Aquac 283: 29–35.
7. Bakar, N. S. A., Nasir, N. M., Lananan, F., Hamid, S. H. A., Lam, S. S., & Jusoh, A. (2015). Optimization of C/N ratios for nutrient removal in aquaculture system culturing African catfish,(Clarias gariepinus) utilizing Bioflocs Technology. International Biodeterioration & Biodegradation, 102, 100-106.
8. Becerra-Dorame, M. J., Martínez-Córdova, L. R., Martínez-Porchas, M., & Lopez-Elías, J. A. (2011). Evaluation of autotrophic and heterotrophic microcosm-based systems on the production response of Litopenaeus vannamei intensively nursed without Artemia and with zero water exchange.
9. Becerra-Dorame, M. J., Martínez-Córdova, L. R., Martínez-Porchas, M., & Lopez-Elías, J. A. (2011). Evaluation of autotrophic and heterotrophic microcosm-based systems on the production response of Litopenaeus vannamei intensively nursed without Artemia and with zero water exchange.
10. Crab, O. Kochva, M. Verstraete, W. Avnimelech, Y. (2009) Bio-flocs technology application in over-wintering of tilapia,Aquacultural Engineering, 40(3),105-112.
11. Ekasari J., Crab R. & Verstraete W. (2015) Primary nutritional content of bio-flocs cultured with different organic carbon sources and salinity. Hayati Journal of Biosciences 17, 125–130.
12. Ekasari, J. Zairin, M. Putri, D.U. Sari, N.P. Surawidjaja, E.H. Bossier, P. (20158). Biofloc-Based Reproductive Performance of Nile Tilapia Oreochromis Niloticus L. Broodstock. Aquac,46, 509–512.
13. FAO (Food and Agriculture Organization), 2016. Cultured Aquatic Species Information Programme Penaeus Monodon (Fabricius, 1798).
14. Kim, Y. S., Sasaki, T., Awa, M., Inomata, M., Honryo, T., Agawa, Y., & Sawada, Y. (2016). Effect of dietary taurine enhancement on growth and development in red sea bream Pagrus major larvae. Aquaculture Research, 47(4), 1168-1179.
15. Komen, J. (1990). Clones of common carp, Cyprinus carpio: new perspectives in fish research. Wageningen University and Research.
16. Megahed, M. E. (2010). The effect of microbial biofloc on water quality, survival and growth of the green tiger shrimp (Penaeus semisulcatus) fed with different crude protein levels. Journal of the Arabian Aquaculture Society, 5(2), 119-142.
17. Najdegerami, E.H., Bakhshi, F. & Lakani, F.B. Effects of biofloc on growth performance, digestive enzyme activities and liver histology of common carp (Cyprinus carpio L.) fingerlings in zero-water exchange system. Fish Physiol Biochem 42, 457–465 (2016).
18. Samocha,T.L., Lawrence, Craig, A., Collins, Frank, L. Castille, William, A. Bray, C.J. Davies, P.G. Lee, G.F. Wood., (2004) Production of the Pacific White Shrimp, Litopenaeus vannamei, in High-Density Greenhouse-Enclosed Raceways Using Low Salinity Groundwater. Journal of Applied Aquaculture 15:3-4, 1-19.
19. Schryver, P. D., Crab, R. Defoirdt, T. Boon, N. Verstraete, W. (2008) The basics of bio-flocs technology: The added value for aquaculture, Aquaculture,227,125-137.
20. Verma, R., Balakrishnan, L., Sharma, K. (2016). A network map of Interleukin-10 signaling pathway. J. Cell Commun. Signal. 10, 61–67.

21. Wang, N. Xu, X. Kestemont P. (2009) Effect of temperature and feeding frequency on growth performances, feed efficiency and body composition of pikeperch juveniles Sander lucioperca quaculture, 289, 70-73.
22. Widanarni, W., Wahjuningrum, D., & Puspita, F. (2012). Aplikasi bakteri probiotik melalui pakan buatan untuk meningkatkan kinerja pertumbuhan udang windu (Penaeus monodon). Jurnal Sains Terapan: Wahana Informasi dan Alih Teknologi Pertanian, 2(1), 19-29.
23. Xu, W. J., Pan, L. Q., Sun, X. H., & Huang, J. (2013). Effects of bioflocs on water quality, and survival, growth and digestive enzyme activities of Litopenaeus vannamei (Boone) in zero-water exchange culture tanks. Aquaculture Research, 44(7), 1093-1102.
24. Zhao, P. Huang, J. Xiu-Hua .W. Xiao-Ling ,S. Cong-Hai, Y. Xu-Guang ,Z. Guo-Cheng.,(2012). The application of bioflocs technology in high-intensive, zero exchange farming systems of Marsupenaeus japonicus, Aquaculture, 354(355), 97-106.