

Effect of various biofloc systems on growth efficacy in *Litopenaeus vannamei* (Boone, 1931)**Sakshi Pandey, Anosh Achin, Tirkey, R. Lakshmanan**

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Abstract

The experiment was carried out in triplicate in 500 L tanks with three biofloc treatments and one control. Biofloc tanks were filled with 360 L of water and fed sugarcane molasses, wheat flour, Rice flour, and clean water as a control without biofloc for 28 days. The postlarvae of *Litopenaeus vannamei* (Boone, 1921) were stocked at a rate of 130 PL m⁻² and cultured for a period of 50 days while being fed pelleted feed at a rate of 1.5% of biomass. The average body weight of the post larvae was 0.15 ± 0.02 g. In the biofloc treatments, the addition of carbohydrate greatly boosted the population of total heterotrophic bacteria (THB) while dramatically reducing the total ammonia-N (TAN), nitrite-N, and nitrate-N in the water. The wheat flour treatment had a significantly higher final average body weight (8.17 ± 0.26 g) than the treatment and control groups of shrimp. The treatment had no effect on the shrimp survival rate, which varied from 72.6% to 86.3%. Conclusion: The use of wheat flour effectively increased the formation of biofloc and contributed to better water quality, resulting in higher shrimp production.

1. Introduction

The world population is expected to grow by 2 billion people to 9.7 billion by 2050 (UNDESA, 2015). The food production industry faces a significant difficulty in trying to keep up with rising food demand on an ever-shrinking amount of farmland. Consequently, intensive growth strategies like those used in aquaculture are likely to play a pivotal role in maximising the use of diverse aquatic resources to produce a wide range of food species. (P_uez-Osuna, 2001; Piedrahita, 2003). The cultivation of Pacific white shrimp (*Penaeus*

vannamei) is one of the most important aquaculture enterprises in several nations, generating 53 percent of the world's shrimp production in 2016 (FAO 2018). In order for farmers to achieve a high level of production, the demand to intensify is increasing, and the alteration of current agricultural practises has become unavoidable. Incorporation of biofloc technology (BFT) in shrimp culture is the most alluring current agricultural practise among farmers. Due to zero or minimum water exchange, this technique could create a biosecure system. (Ahmad *et al.* 2017; Panigrahi *et al.* 2017, 2018). Extensive research indicates that Biofloc contributes to the maintenance of high water quality in the system and to the nourishment of the farmed animals (Avnimelech, 1999). The essential premise of biofloc is to transform waste nutrients, particularly nitrogen, into microbial biomass. This is then utilised by domestic animals and converted into feed ingredients. (Avnimelech, 2012; Crab *et al.*, 2010). Thus, there is a need to reduce waste through protein reduction, and cultured animals have access to floc as a supplementary food source. Some research indicated that employing low-protein meals in biofloc-based culture systems could also result in satisfactory survival and growth of cultured shrimp (Ballester *et al.*, 2010; Wasielesky *et al.*, 2006).

2. Materials and methods

2. 1. Experimental setup

The study utilized identical Fibber tanks that had a capacity of 500 L and a diameter of 0.92 m. Each tank was fill up with 360 L of water. The experiment followed a completely randomized design and consisted of three treatments with a control, each set up in triplicate. The three treatments were as follows: Biofloc tank fertilized with sugarcane molasses, wheat flour, and Rice flour. All treatments, as well as the control, received feed with 35% crude protein twice daily. Aeration was provided in all experimental tanks, with each aeration contain a regulator to regulate the air pressure to 7 mg L⁻¹.

The seawater was collected during high tide and stored in a 5000 L tank. The collected seawater dilute with fresh water to reach a salinity of 25 g L⁻¹. The experimental tanks were filled with 360 L of this diluted seawater. Biofloc was produced in 500 L capacity tanks using carbohydrates from sugarcane molasses, wheat flour, and Rice flour which contain 70-75% nitrogen-free extracts. Boiling sugarcane juice with yeast for three days produced sugarcane molasses. For each gram of TAN released, 20 grams of carbohydrate was added. It was estimated that 50% of the dietary protein input was converted to ammonia, and therefore, 0.55 kg of carbon was applied for each kg of 35% dietary protein feed administered. The experimental period had a 12-hour light and 12-hour dark photoperiod.

2. 2. Tank management and shrimp seed stocking

For this study, *L. Vannamei* seeds were used. Before being placed in the test tanks, the postlarvae were acclimated in 500 L tanks for two weeks.. In tanks with bioflocs that had a total suspended solids (TSS) measurement of more than 100 mg L⁻¹ and between 5 and 50 mL floc volume, juvenile shrimp (0.16 ± 0.03 g) were stocked.. The shrimp were stocked at a rate of 120 PL m⁻² in biofloc treatments and control tanks that were 28 days old. To keep the dissolved oxygen content at saturation levels, an air pump was used. Feeding rates were modified every two weeks after weighing shrimp samples and were based on observations of feeding behaviour during the first week of the experiment. Pelleted feeds (1.8-3.0 mm) were utilised throughout the experiment. Daily feed rations were divided into two equal portions and distributed in equal amounts at 08:00 and 16:00 in all treatment and control tanks. During 50 days, the shrimp were cultured, and if the pH of the water fell below 7.0, NaHCO₃ was added to bring it up to 7.5. To make up for evaporation loss, freshwater was injected, and floc removal was done once a week.

2.3. Shrimp growth parameters

To determine the shrimp's body weight, sampling was done every two weeks. 20% of the test animals were randomly chosen and weighed for all treatments after being deprived overnight for the shrimp. Electronic balances were used to measure the weight. Shrimp were collected by draining the tanks after the experiment was completed, and various measurements, including survival rate, average body weight, specific growth rate, protein efficiency ratio, and total weight gain, were calculated.

2.4. Statistical analysis

Statistical analysis was carried out using Windows Excel. Oneway analysis of variance (ANOVA) was used to investigate the variations in growth parameters observed in cultured shrimp and the nutritional quality of biofloc across the different treatments and control. The statistical tests were conducted at a significance level of 5%

3. Results

The growth parameters exhibited a significant difference ($P < 0.05$) in terms of average body weight, growth rate, protein efficiency ratio and specific growth rate between the treatments and control. However, no significant difference was observed in the survival rate. Shrimps subjected to wheat flour treatment showed significantly higher average body weight, growth rate, protein efficiency ratio and specific growth rate than those treated with other biofloc treatments and control. Moreover, the total weight gain was also significantly ($P < 0.05$) greater in Wheat flour treatment than in other treatments and control in following Table 1.

Table 1. Shrimp growth metrics under various biofloc treatments and the control (means \pm SD) significant ($P < 0.05$).

Parameters	Treatment			
	Control	Sugarcane molasses	Wheat flour	Rice flour
Average body weight (g)	6.16 \pm 0.07	7.32 \pm 0.29	8.17 \pm 0.26	7.78 \pm 0.35
Growth rate (g day ⁻¹)	0.07 \pm 0.03	0.08 \pm 0.00	0.10 \pm 0.002	0.08 \pm 0.001
Specific growth rate	5.25 \pm 0.02	4.89 \pm 0.03	5.71 \pm 0.05	4.56 \pm 0.02
Protein efficiency ratio	2.31 \pm 0.06	2.69 \pm 0.02	3.11 \pm 0.07	2.87 \pm 0.05
Survival (%)	76.58 \pm 2.9	72.6 \pm 5.8	86.3 \pm 0.79	82.6 \pm 3.7
Total weight gain (g)	669.00 \pm 11.32	678.18 \pm 18.15	955.81 \pm 2.16	723.21 \pm 3.32

4. Discussion

The growth rate and final weight of individual shrimp were higher in the wheat flour treatment compared to the other treatments. Although survival did not show significant differences, there were significant differences in average body weight, growth rate, protein efficiency ratio between the biofloc and control treatments. This suggests that adding an appropriate quantity of carbohydrates can promote the growth and survival of *L. vannamei*. Research has shown that adding carbohydrates can lead to the production and buildup of bioflocs (Avnimelech 2007; Emerenciano, et al., 2011; Gao, Shan, et al., 2012), Bioflocs can act as a crucial food source for zooplankton within the biofloc system, potentially leading to increased shrimp growth. Additionally, research has shown that bioflocs can serve as a valuable protein source for shrimp, potentially reducing the need for protein in their feed (Tacon, et al., 2002; Burford & Lorenzen 2004). Avnimelech, et al., (2008) Studies have also indicated that adding carbohydrates can enhance protein utilization and provide essential lipids and vitamins for shrimp growth.

5. Conclusion

The study aimed to examine how biofloc affects the growth of *L. vannamei*. The results showed that biofloc technology was able to decrease total ammonia-nitrogen levels while also maintaining optimal water quality for shrimp culture. The addition of wheat flour in the biofloc generation process was found to be effective in enhancing biofloc production and improving water quality, which ultimately led to higher shrimp yields. Wheat flour

serves as an easily digestible carbon source that enables microorganisms to proliferate faster and assimilate more efficiently compared to other treatments. The biofloc produced from wheat flour had higher nutritional value, resulting in better growth performance of *L. vannamei* in comparison to other treatments. In general, biofloc technology can promote the growth of *L. vannamei* by providing supplementary nourishment from assimilated plankton, bacteria, and organic compounds. The study underscores the potential of biofloc as a viable method for sustainable aquaculture by improving water quality, reducing feed consumption, and increasing shrimp production for greater profits in shrimp farming.

6. References

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