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Effect of dietary supplementation of biofloc on growth performance and digestive enzyme activities in *Penaeus monodon*

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ABSTRACT

A 60-day indoor growth trial was conducted to study the effect of dietary supplementation of biofloc on growth performance and digestive enzyme activities in *Penaeus monodon* juveniles. Biofloc developed in indoor fiber-glass reinforced plastic (FRP) tanks (1000 L) was used as dietary supplement for *P. monodon* (2.90 ± 0.10 g) reared in 1000 L FRP tanks. Graded level of dried biofloc was included in shrimp basal diets; 0 (B0, control), 4 (B4), 8 (B8) and 12% (B12). The dried biofloc contained 24.30 ± 0.28% protein. Fatty acid profile of biofloc revealed palmitic acid (46.54%), cis-Vaccenic acid (15.37%), linoleic acid (10.67%) and oleic acid (9.19%) as major fatty acids. There were 16.9 and 13.9% significantly higher ($p < 0.01$) final body weights in B8 and B4 respectively compared with control, B0. Similarly, significantly better ($p < 0.05$) feed conversion ratio (FCR), 1.84 ± 0.09 and protein efficiency ratio (PER), 3.48 ± 0.17 was noticed in B4 compared to control (FCR 2.29 ± 0.11 and PER 2.80 ± 0.13). At the end of the feeding trial, B4 recorded 57.6, 45.5, 61 and 78.6% significant increases ($p < 0.01$) in hepatopancreas digestive enzyme activities for amylase, cellulase, lipase and protease respectively compared with control. However, treatment with 12% level of biofloc inclusion (B12) did not differ significantly ($p > 0.05$) for most of the growth performance parameters and digestive enzyme activities compared with control. The present study elucidates the suitability of biofloc as a dietary supplement at 4% level in shrimp feed for enhancing growth and digestive enzyme activities in tiger shrimp juvenile.

1. Introduction

Penaeid shrimps are highly valued seafood commodity in domestic and international markets. Economics of shrimp farming is largely dependent on the feed which constitutes 40–60% operational expenses (Tan et al., 2005). Dietary supplements are widely used in shrimp culture to enhance the growth, immune response and digestive enzyme activities. Commonly used dietary supplements in penaeid shrimp are microalgal products (Boonyaratpalin et al., 2001; Ju et al., 2009; Supamattaya et al., 2005), macroalgae (Yeh et al., 2006), probiotics (Wang, 2007; Yang et al., 2010; Ziaei-Nejad et al., 2006), prebiotics (Zhang et al., 2012) and periphyton (Anand et al., 2013b).

Recently, manipulation of carbon nitrogen ratio (C:N ratio) for development of biofloc has shown promise in aquaculture (Anand et al., 2013a; Avnimelech, 1999). The C:N ratio is manipulated by supplementation of external carbon source or elevated carbon level in the feed (Ballester et al., 2010; Crab et al., 2012; McIntosh, 2000). At high C:N ratio, heterotrophic bacteria immobilize the ammonium ion for production of microbial protein and maintain inorganic nitrogen level within the limit (Avnimelech, 1999). Biofloc enhances the growth performance of *Penaeus monodon* (Anand et al., 2013a; Arnold et al., 2009; Hari et al., 2006), *Litopenaeus vannamei* (Wasielesky et al., 2006; Xu and Pan, 2012), *Farfantepenaeuspaulensis* (Ballester et al., 2010) and *Marsupenaeus japonicus* (Zhao et al., 2012). Apart from being a source of quality proteins, bioflocs are rich source of growth promoters and bioactive compounds (Ju et al., 2008a) which enhance digestive enzymes (Xu and Pan, 2012) and health status of the cultured shrimps (Singh et al., 2005).

In general, most research makes use of *in situ* developed microbial floc for growth performance of shrimp (Hari et al., 2006; Xu and Pan, 2012). However, these *in situ* based techniques need additional oxygen demands for microbial respiration, in addition to the oxygen demand of shrimp (Burford et al., 2003; Tacon et al., 2002). This added oxygen demand requires additional aerators, which increases the aeration expenses in shrimp farms compared to conventional shrimp culture

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