

10th Euro-Global Summit on

Aquaculture & Fisheries

October 08-09, 2018 | London, United Kingdom

Removal of ammonia and nitrite nitrogen in *Litopenaeus vannamei* culture: Application of bottom substrate improvement and bacterial immobilization

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The rapid intensification and expansion of shrimp (*Litopenaeus vannamei*) culture has raised environmental concerns because these activities discharge a large amount of nutrient rich wastewater. Thus, culturing shrimp intensively with less or no water change is highly appreciated, which would reduce the effluent, making aquaculture more responsible and sustainable. To achieve the purpose, removal of ammonia (TAN) and nitrite nitrogen (NO₂-N) is the first step of all. In this study, improvement of bottom substrate and bacterial immobilization were used to improve the shrimp culture environment, particularly in removal of TAN and NO₂-N. The effect of four bottom substrates, oyster shell powder (OP), sugarcane bagasse (SB), a mixture of OP and SB (OS) and fresh soil (FS), on the water quality and bacterial population of intensive shrimp culture tanks without water change were studied. In addition, SA beads composed of *V. alginolyticus* VZ5, sodium alginate and sugarcane bagasse were used for TAN and NO₂-N removal in shrimp culture. At the end of a 110 days culturing trial, the TAN of water on SB and the NO₂-N on OS was significantly lower than that on the other substrates (P<0.05), which coincided with the high density of ammonium and nitrite-oxidizing bacteria in the water on SB and OS, respectively. In the study of bacterial immobilization, the results indicated that SA beads have a maximum capacity of 1.0×10⁸ colony-forming units (cfu)/bead. The maximum NO₂-N degradation rate achieved for the SA beads was 8.44 mg/L/day, and the average NO₂-N degradation was 0.06 mg/bead. In summary, SB and OS used as bottom substrates were much effective for removal of TAN and NO₂-N in *L. vannamei* culture. The new approach of bacterial immobilization was proved to be effective for TAN and NO₂-N removal in shrimp culture.

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