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Treatment of wastewater from shrimp farms using a combination of fish, photosynthetic bacteria, and vegetation

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ABSTRACT

An innovative system combining fish, photosynthetic bacteria, and vegetable cultivation was used to treat the wastewater discharged from the shrimp farms. The experiment was divided into three phases, starting with photosynthetic bacteria *Rhodopseudomonas palustris* which are added to shrimp aquaculture wastewater at concentrations of 0.5×10^6, 1.0×10^6, 2.0×10^6, 4.0×10^6, and 8.0×10^6 colony-forming units (CFU)/mL (treatment 1, 2 3, 4, and 5, respectively) for 4 days to determine the optimal bacteria level. In the second phase, silver carp (*Hypophthalmichthys molitrix*) were introduced at the biomass levels of 0.25, 0.50, 0.75, 1.00, and 1.25 kg/m^3 (treatment 6, 7, 8, 9, 10, respectively) for 7 days. In phase 3, *Ipomoea aquatica*, *Oenanthe javanica*, *Lactuca sativa*, and *Brassica pekinensis* were introduced and cultivated (treatment 11, 12, 13, 14, respectively) for 7 days. The wastewater values of TP, TN, COD_{Cr}, NH_4, NO_3, and NO_2 were analyzed after each phase of treatment. The results showed that the wastewater quality changed drastically after the completion of all wastewater treatments. The removal rates of TP, TN, COD_{Cr}, NH_4, NO_3, and NO_2 increased with increasing photosynthetic bacterial concentrations in Phase I. The removal rates of TP, TN, COD_{Cr}, and NO_3 increased with increasing fish biomass, while the removal rates of NH_4 and NO_2 decreased in Phase II. The removal rates of TP, TN, NO_3, and NO_2 were the highest for treatment 11, while the removal rate of COD_{Cr} reached the highest value in treatment 12, and NH_4 in treatment 14. *I. aquatica* showed the best removal of nutrients from among the four vegetables in Phase III. It is suggested that a combination photosynthetic bacteria (4.0×10^6 CFU/mL)–fish (0.75 kg/m^3 silver carp)–vegetable (1.00 kg/m^2 *Ipomoea aquatica*) system could be a practical system for nutrient recycling in shrimp aquaculture wastewater on a larger scale.

Keywords: Fish; Photosynthetic bacteria; Vegetable system; Removal rate; Shrimp farm wastewater

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