IMPROVEMENT OF MARICULTURE POND W ATER QUALITY AND SHRIMP HEALTH USING BIOREMEDIATION

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Introduction

Good water quality is an integral part of aquaculture as any deterioration in water quality causes stress and makes the cultured organism more susceptible to pathogens. Intensification in aquaculture and poor feed management leads to improper mineralisation of excess nutrients, which affect the water quality. Microorganisms play a major role in mineralisation of organic matter in any aquatic environment (Moriarty, 1996). Hence, water quality in aquaculture to a great extent is controlled by microbial degradation of organic matter. Bioremediation is a novel biotechnological approach, which involves reduction of hazardous organic waste to environmentally safe levels through the use of microorganisms or macroorganisms (Srinivasa Rao et al. 1997; Ehrlich et al. 1988). Studies on water quality, bacterial populations and their interaction with cultured organism gives an insight of problems concerning organic load in culture systems. The present study focussed on the microbial biomass estimation, water quality management in intensive shrimp culture ponds and the efficacy of commercial bacterial products on water quality in aquaria and field conditions.

Materials and Methods

Studies on estimating the bacterial populations in water and sediments involved in nutrient degradation, and assessment of the efficacy of commercial bacterial product on water quality were carried out in commercial shrimp ponds and in laboratory tanks. Physico-chemical and biological analyses of water and sediment were carried out in appropriate intervals. Estimation of total heterotrophic and autotrophic bacterial counts was done according to standard procedures (Rodina, 1972). Physical and chemical parameters were analysed using standard procedures (Parson et al. 1984). Water temperature, pH, salinity, dissolved oxygen and sulphide concentrations were analysed *in situ* whilst the ammonia-nitrogen, nitrite and nitrate-nitrogen, soluble reactive phosphorus and silica were analysed in UPM laboratory. Four commercial bacterial products were screened for bacterial composition in the laboratory. Experiments on the inhibitory effects of selected beneficial bacteria on pathogenic bacterial species were also accomplished.

Results and Discussion

Results obtained from the analysis of shrimp ponds showed that the water quality of ponds deteriorated with the culture period as indicated by progressively increasing levels of ammonia-nitrogen, nitrite and nitrate-nitrogen. Bacterial load in sediment was consistently higher than that of water throughout the culture period indicating higher nutrient availability at the pond bottom. The total bacterial count ranged from $10^5$to 10^8 cfu/g in sediment and $10^3$to 10^5 cfu/ml in water. The total aerobic bacterial counts in commercial bacterial products ranged from 10^6 to 10^8 cfu/ ml. *Bacillus was* the dominant genus followed by *Vibrio* and *Serratia* species in all the samples. The total ammonia nitrogen, hydrogen sulphide and total aerobic bacteria were higher in old the ponds compared to new ones. New ponds showed higher survival rate (85-90%) and production (9 t/ha) compared to old ponds (survival was 50-55% and production was 6 t/ha). In the field study, a significant difference ($p<0.05$) was noticed in ammonia-nitrogen and reactive silica levels between treated (probiotic) and control ponds. *In vitro* studies indicated that the nutrients in the water and sediments such as ammonia, phosphorus and nitrate were significantly reduced after exposure to probiotic and aeration. However, no significant difference between the probiotic and aeration treatments were observed, indicating that aeration alone was sufficient to improve the water quality. The ineffectiveness of the probiotic product may be due to low application dosage and unsuitable varieties of bacteria, which were of temperate origin. The assortment of suitable probiotic organisms for tropical shrimp ponds is being formed.

Conclusions

The study indicated that the progressive accumulation of organic matter deteriorates the pond environment during culture period. Old culture ponds have lower production compared to the new ones due to accumulation of organic matter and poor water quality. Laboratory studies showed encouraging results of the locally isolated bacterial species, especially the inhibitory effects of *Bacillus* spp. on the pathogenic *Vibrio* spp.

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