Use of Beneficial Bacteria to Increase Shrimp Production

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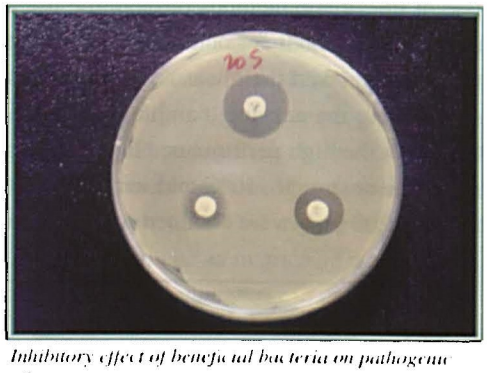
Award Winner

Shrimp is an important commodity in Malaysia that generated more than RM473 million from a production of approximately 16,000 tonnes in 2000. There are more than 7,000 ha of shrimp farms with about 7,400 ponds along the coastal areas, both in the East and West Malaysia with an average production rate of 2.2 tonnes/ha. Currently, shrimp industry is plagued with problems related to bad water quality and diseases. The increase in production has not been proportionate to increased pond acreage mainly because of the unsustainable pond management practices. Absence of defined regulations on the use and discharge of water in aquaculture industry has resulted in self-eutrophication. Water for the farms is usually drawn during the high tide when the water quality is good and the raw effluent is discharged at the same site as the water intake during low tides. After a number of years, the coastal area experiences organic pollution due to untreated aquaculture effluents coupled with discharge from other agro-based industries such as pig farming, rubber and oil-palm industries in the upstream. Generally, the production in new ponds is higher than in aging ponds due to environmental degradation.



Inhibitory effect of beneficial bacteria on pathogenic vibrio

Shrimp fed with beneficial bacteria shows better growth

Declining shrimp production needs to be addressed at the root level. Shrimp industry needs a sustainable supply of good quality water and thus the act of discharging untreated effluents into estuaries and coastal waters should be ceased. However, water treatment incurs high cost, and if enforced, the fledgling industry like shrimp culture will become unattractive to investors. New technologies using cheap raw materials need to be investigated. One such technology is the use of beneficial microbes in high density to increase the degradation of organic matter in shrimp ponds. Coupled with adequate aeration, microorganisms could bioremediate the pond environment by accelerating the mineralization process under aerobic condition. In this way, toxic metabolites, such as ammonia and hydrogen sulphide commonly found in shrimp ponds, would be reduced.

Bacterial consortium for higher shrimp production in commercial ponds

The use of imported commercial microbial products in improving water quality and controlling microbial infections in shrimps has shown promising results. However, these products showed insignificant increase in shrimp production, probably due to unsuitable environmental conditions for the proliferation of exotic microorganisms. For bio-safety reasons as well as to avoid sudden changes in the microbial flora of the ecosystem, our research focused on the use of indigenous microorganism to improve water quality in shrimp culture ponds and to enhance shrimp health. In addition, the use of imported bacterial products adds to the import bill of the country.

Indigenous *Bacillus* spp. isolated from local marine waters were used as potential candidates for the bioremediation product and their selection was based on their ability to secrete extracellular enzymes, express competitive exclusion, high survival rate, non-pathogenic to shrimp larvae, and ability to grow fast. The effect of combination of two *Bacillus* spp. showed that rate of ammonia reduction was higher compared to individual species under simulated shrimp pond conditions. In addition shrimp fed with bacterial additives showed better growth and survival compared to the control fed with commercial shrimp feed. Furthermore, shrimp fed on bacterial supplemented diet had higher survival rate when challenged with the white spot syndrome virus (WSSV) whereas shrimp fed on artificial diet showed higher mortality.

Bacillus spp. also demonstrated the ability to suppress the growth of pathogenic bacteria isolated from *Artemia* cyst and shrimp ponds. Thus, utilization of these bacteria for biocontrol of pathogenic vibrios might be a good alternative to antibiotics that has ecotoxicological implications and ill effects on human health. These bacterial have been proven to be non-pathogenic to shrimp and might be useful in formulating an effective bioremediation product for shrimp culture. In addition, the same bioremediation products can be used in other aquaculture activities such as fish/shrimp hatchery, aquarium, and other aquaculture systems.

Research is now being conducted to mass-produce the bacteria consortium for commercial purposes.

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