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Efficacy of probiotics in grow-out systems

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By Ami Horowitz, Ph.D. and Sarah Horowitz, Ph.D.

Evaluations on *L. vannamei* conducted at Texas A&M University

Shaded outdoor tanks were used in research to evaluate the effectiveness of probiotic additives. Photo by Tzachi Samocha.

An aquaculture microbial probiotic is a bacterial supplement (single or mixed culture of selected bacteria) added to a production system to modify or manipulate the microbial communities in the water and sediment, to reduce or eliminate selected pathogenic microorganisms, and to improve growth and survival of the cultured species. Manufacturers claim probiotics also improve water quality and lower organic sludge levels.

Probiotics have been reported effective as an inoculation to newly disinfected water in larval culture systems, where they reduce the need for antibiotics. The efficacy of probiotic additions to natural waters in grow-out systems is more controversial.

Testing protocol

With assistance from Tzachi Samocha and co-workers at Texas A&M University, we evaluated the routine use of a commercial bacterial supplement that claimed to improve water and sludge quality, and production of two shrimp species (*Penaeus setiferus* and *Litopenaeus vannamei*). Tests lasted three months, and were conducted in outdoor tanks under "zero water discharge" using a high aeration rate, stocking densities of 40 to 50 shrimp per square months, and both high- (45 percent) and low- (20 percent) protein diets.

We tested a commercial mixture of several species of the genus *Bacillus* (*B. subtilis, B. megaterium, B. polymyxa,* and *B. licheniformis*). All were non-pathogenic, viable, and naturally occurring bacteria that had not been genetically altered or engineered. Prebrewed microbial preparations were added to test tanks five times a week, per manufacturer specifications.

We monitored water quality, including dissolved oxygen, temperature, salinity, pH, Secchi disc, total ammonia-N, nitrite-N, nitrate-N, total phosphorus, reactive phosphorus, fiveday carbonaceous biochemical oxygen demand (cBOD5), chemical oxygen demand (COD), total suspended solids (TSS) and volatile suspended solids (VSS). At harvest, sediment slurry from each tank was sampled and analyzed for its relative dry weight, sediment volume, COD, cBOD5 and VSS content, and microbial respiration. Shrimp survival, mean final weight, final yield, and FCR were also determined.

Results

The studies revealed no significant differences between tanks treated with the commercial bacterial supplement and those that were not, for shrimp survival, final yield, mean final weight, and FCR with both diets for either shrimp species. The bacterial treatment did not produce any significant improvement on ammonia or nitrite removal, nitrate accumulation in the tanks, or any other water quality parameters monitored.

There were no significant differences in sludge parameters between the treated and untreated shrimp tanks. Therefore, addition of the bacterial supplement did not produce any measurable improvements in water or sediment quality, or shrimp yield over the untreated tanks.

Tests with other species

Claude Boyd and co-workers at the International Center for Aquaculture and Aquatic Environments at Auburn University in Alabama, USA, tested the same probiotic product in channel catfish ponds. They reported no significant differences in water quality parameters between treated and untreated ponds.

There was a higher survival rate in the probiotic-treated ponds, which ultimately led to greater fish production. However, fish had larger average weight in the untreated ponds.

Suhendra and co-workers reported that addition of this probiotic supplement to intensive tiger prawn (*Penaeus monodon*) cultures improved the cleanliness of water and sediment. But it is not possible to isolate the direct effect of the bacterial supplement from the possible contribution of all other factors that were modified, because different management strategies were followed in shrimp farms that participated in this study.

Conclusion

The benefits of using bacterial supplements to improve grow-out systems are still controversial. These supplements should be applied in ways that favor their establishment and activity, including direct introduction (e.g., by incorporating them in the feed), added surface area for microbial adhesion, manipulating the microbial population genetically by selection and enrichment, and by identifying and supplying factors that might otherwise limit beneficial microbial proliferation.

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Authors

AMI HOROWITZ, PH.D.

UPAH Tech, Inc.
Shaker Heights, Ohio USA

upahtech@yahoo.com (mailto:upahtech@yahoo.com)

SARAH HOROWITZ, PH.D.

UPAH Tech, Inc.
Shaker Heights, Ohio USA

upahtech@yahoo.com (mailto:upahtech@yahoo.com)