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New Bacillus probiotic tested for shrimp

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1 January 2011 Diego Moreira de Souza Sabrina Medeiros Suita Fabio Pereira Leivas Leite Luis Alberto Romano Dr. Eduardo Luis Cupertino Ballester

Product increased shrimp performance even in a heterotrophic environment

The authors evaluated a potential probiotic bacteria during the nursery rearing of pink shrimp in a zero-exchange culture system. Photo by Luciano Jensen.

Aquaculture is the fastest-growing food-producing sector in the world, with an average annual growth rate of 8.9 percent since 1970. Marine shrimp culture is the main economic activity developed in this field.

With the increasing intensification and commercialization of aquaculture production, disease problems inevitably emerged that are mainly caused by bacterial pathogens of the genus *Vibrio*, which affect shrimp survival and growth. These opportunistic microorganisms are part of the flora of penaeid shrimp, and may cause illnesses under unfavorable environmental conditions.

The wide use of antimicrobial drugs, pesticides and disinfectants in aquaculture has caused the evolution of resistant strains of bacteria, so defining alternative strategies to support aquaculture productivity is extremely necessary.

Probiotics

Among the alternatives proposed, the use of probiotics has shown promising results and is now widely accepted as a complementary tool for the management of disease and improving nutrition of aquatic animals. Probiotics are also cited as an alternative to antimicrobial drugs, enhancing the growth and disease resistance of cultured shrimp, as well as improving their immunosystem responses and general welfare.

Studies have reported the development of intensive shrimp culture systems without water exchange as a way to improve biosecurity and reduce environmental impacts. However, little information is available regarding the use of probiotics in these systems.

The authors evaluated the use of a commercial probiotic and the newly isolated potential probiotic bacteria Bacillus cereus var. toyoi during the nursery rearing of pink shrimp, *Farfantepenaeus brasiliensis*, in a zero-exchange, aerobic, heterotrophic culture system.

Study setup

The authors conducted the experiment at the Universidade Federal do Rio Grande Marine Aquaculture Station. Three replicate tanks were randomly assigned and stocked at a density equivalent to 150 shrimp per square meter with the following probiotic treatments: a commercial Bacillus species mixture, Bacillus cereus var. toyoi and a control treatment without probiotics.

Commercial probiotics were added daily following manufacturers' recommendations. Bacillus cereus var. toyoi was added to reach an equivalent concentration of the commercial product.

Shrimp were fed twice daily via a specially designed feeding tray. The initial feeding rate was 15 percent of total tank biomass, adjusted daily according to shrimp consumption. At the end of the trial, shrimp remaining in each tank were individually counted to determine survival and weighed to determine mean final weight and specific growth rate.

Throughout the experimental period, water temperature, salinity, pH and dissolved oxygen were measured every day. Water samples were collected every two days to evaluate the water quality parameters. For bacteriological analysis, the concentration of presumptive *Vibrio* species was followed every three days in each tank according to the spread plate technique.

Results

The mean final weight and specific growth rate of the shrimp were significantly higher in the probiotic treatments (Table 1). The water quality parameters monitored during the experiment remained at concentrations suitable for shrimp culture, and no significant differences (P > 0.05) were observed among treatments (Table 2). The bacteriological analysis showed that probiotic treatments maintained the concentration of *Vibrio* species lower than the control group.

de Souza, Mean survival, final weight, Table 1

Treatment	Survival	Final Weight	Specific Growth Rate
Commercial Bacillus species mixture	91.65 ± 11.02^{a}	1.42 ± 0.40^{a}	0.036 ± 0.007^{a}
Bacillus cereus var. toyoi	81.90 ± 13.4^{a}	1.34 ± 0.36^{a}	0.034 ± 0.004^{a}
Control	88.86 ± 6.36^{a}	1.22 ± 0.38^{b}	0.030 ± 0.003^{b}

Different superscript letters indicate significant differences (P = 0.05).

Table 1. Mean survival, final weight and specific growth rate of shrimp reared in different probiotic treatments. Different superscript letters indicate significant differences (P = 0.05).

de Souza, Mean values of water quality parameters, Table 2

Parameter	Control	*Bacillus cereus var. toyoi*	Commercial Probiotic
Temperature (° C)	26.70 ± 0.25	26.50 ± 0.10	26.40 ± 0.25
pH	8.10 ± 0.006	8.08 ± 0.03	8.10 ± 0.02
Salinity (g/L-)	31.47 ± 0.23	32.34 ± 0.40	31.58 ± 0.12
Dissolved oxygen (mg/L)	6.11 ± 0.01	6.14 ± 0.02	6.19 ± 0.07
Total suspended solids (mg/L)	538.09 ± 444.70	635.66 ± 485.29	618.56 ± 453.40
Alkalinity (mg/L)	184.16 ± 12.40	183.33 ± 28.15	172.08 ± 15.73
Total ammonia nitrogen (mg/L)	0.92 ± 1.48	1.25 ± 1.89	0.91 ± 1.55
Nitrite (mg/L)	3.65 ± 3.11	4.11 ± 3.21	4.31 ± 3.54
Phosphate (mg/L)	3.27 ± 1.32	4.78 ± 2.19	3.60 ± 1.80
Clorophyll α (µg/L)	49.78 ± 36.51	48.56 ± 39.78	61.41 ± 60.75

Table 2. Mean values of water quality parameters during the experimental period. No significant differences (P > 0.05) were observed among treatments.

The study demonstrated that Bacillus cereus var. toyoi is a potentially probiotic microorganism for aquaculture use. It increased shrimp performance even in a heterotrophic environment and also presented results similar to those of the commercial product.

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