

## **Administration of *Bacillus subtilis* strains in the rearing water enhances the water quality, growth performance, immune response, and resistance against *Vibrio harveyi* infection in juvenile white shrimp, *Litopenaeus vannamei***

### **Abstract**

In this study, vegetative cell suspensions of two *Bacillus subtilis* strains, L10 and G1 in equal proportions, was administered at two different doses 10<sup>5</sup> (BM5) and 10<sup>8</sup> (BM8) CFU ml<sup>-1</sup> in the rearing water of shrimp (*Litopenaeus vannamei*) for eight weeks. Both probiotic groups showed a significant reduction of ammonia, nitrite and nitrate ions under in vitro and in vivo conditions. In comparison to untreated control group, final weight, weight gain, specific growth rate (SGR), food conversion ratio (FCR) and digestive enzymatic activity were significantly greater in the BM5 and BM8 groups. Significant differences for survival were recorded in the BM8 group as compared to the control. Eight weeks after the start of experiment, shrimp were challenged with *Vibrio harveyi*. Statistical analysis revealed significant differences in shrimp survival between probiotic and control groups. Cumulative mortality of the control group was 80%, whereas cumulative mortality of the shrimp that had been given probiotics was 36.7% with MB8 and 50% with MB5. Subsequently, real-time RT-PCR was employed to determine the mRNA levels of prophenoloxidase (proPO), peroxinectin (PE), lipopolysaccharide- and  $\beta$ -1,3-glucan- binding protein (LGBP) and serine protein (SP). The expression of all immune-related genes studied was only significantly up-regulated in the BM5 group compared to the BM8 and control groups. These results suggest that administration of *B. subtilis* strains in the rearing water confers beneficial effects for shrimp aquaculture, considering water quality, growth performance, digestive enzymatic activity, immune response and disease resistance.

**Keyword:** Aquaculture; *Litopenaeus vannamei*; *Bacillus subtilis*; Vibriosis; Immune response