A field study validates the efficacy of organic acid blends in promoting growth of Pacific whiteleg shrimp

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Shrimp farming encounters various challenges, with disease posing the most significant issue. Furthermore, concerns about environmental impact, market prices, and animal quality also require attention. To meet the rising demand for aquafeeds, there is a need for cost-effective and innovative ingredients. The use of functional feed additives with health-promoting properties such as organic acids has garnered attention. These additives help control pathogen loads and reduce the severity of disease, resulting in better survival, growth rates, and feed conversion efficiencies. Ultimately, health-promoting additives help farmers achieve higher profitability.

Organic acids first deliver pathogen inhibition capabilities. They can disrupt the structure and function of bacterial cell membranes, impairing pathogen colonization in the digestive tract of shrimp. This translates into a more balanced gut microbiome, as shown by reductions of harmful bacteria like *Vibrio* spp. and increases in beneficial species such as *Cetobacterium* and *Bacillus* spp. (Silva *et al*., 2023). A more balanced gut microbiome is key to increasing disease resistance. In addition, organic acids contain high levels of energy and are readily absorbed and used for ATP production by digestive cells, resulting in enhanced villi development (Lim *et al*., 2015). They can also stimulate the secretion of gastric acid and digestive enzymes, aiding in protein digestion and mineral absorption in shrimp (Silva *et al*., 2016). Supplementation of organic acids to shrimp feeds has proved to not only improve survival but also growth and feed efficiency via improved nutrient digestibility (Su *et al*., 2014; Silva *et al*., 2013).

Bacti-Nil®Aqua is a blend of organic acids specifically designed for aquatic species. Previous research has shown that cost-effective supplementation of Bacti-Nil®Aqua in shrimp feeds reduced Vibrio presence in hepatopancreas, resulting in less tissue damage and a significant improvement in survival (Morales-Covarrubias *et al*., 2022). Such control of pathogen loads also reflects in growth performance, with Bacti-Nil®Aqua showing growth-promoting effects under high-density rearing stress (Nuez-Ortín *et al*., 2020).

A blend of organic acids in shrimp

A recent peer-review publication led by the National Institute of Oceanography and Fisheries (NIOF, Cairo, Egypt) evaluated the growth-promoting effect of Bacti-Nil®Aqua supplementation to white shrimp (*Penaeus vannamei*) subject to the natural biotic and abiotic fluctuations of pond rearing (Eissa *et al*., 2022). Healthy juvenile shrimp with an average weight of 3g were stocked in twelve hapa nets (1 x 1 x 1m) within an earthen pond, with a density of 40 shrimp/m^2 per hapa in triplicates. The control group was fed a basal diet containing 30% fishmeal (38% crude protein, and 10% crude fat), while the treatment groups received the same basal diet but supplemented with 0.2% and 0.3% Bacti-Nil®Aqua. Feed was given three times daily, and the feeding rates were adjusted biweekly depending on the total biomass of each hapa.

After 60 days of feeding, results indicated that Bacti-Nil®Aqua supplementation significantly improved the survival and growth of shrimp. The

Table 1. Chemical body composition of shrimp and feed utilization. PER: Protein efficiency ratio; PPV: Protein productive value

Parameter	Control	0.2% BNA	0.3% BNA
Moisture (%)	79.17 ± 0.22	79.04 ± 0.41	79.00 ± 0.28
Dry matter	20.83 ± 0.2	20.96 ± 0.21	21.00 ± 0.21
Protein	15.85^{a} ± 0.18	16.17^{b} ± 9.22	16.23^{b} ± 0.25
Lipid	1.98^{a} ± 0.28	1.53^{b} ± 0.17	1.94^{a} ± 0.08
Ash	3.05 ± 0.08	3.09 ± 0.069	2.95 ± 0.40
PER (%)	2.09 ± 0.01	2.41 + 0.01	2.7 ± 0.01
PPV (%)	60.35 ± 0.21	77.09 ± 0.21	88.51 ± 0.22

dose-response effect was primarily found in survival, with improvements of 65.2% and 72.5% in the 0.2% and 0.3% inclusions, respectively. Average daily gains (ADG) were increased by 32% and 50% with the 0.2% and 0.3% inclusions, respectively (Fig. 1), while specific growth rates (SGR) were improved by 14% and 21%. The dose response was also effective in reducing the feed conversion ratios (FCR), with improvements of 14% and 23%.

Interestingly, shrimp fed with Bacti-Nil®Aqua showed a significantly higher whole-body protein content. The protein efficiency ratio (PEV) and protein productive value (PPV) were also improved, indicating that the shrimp were able to utilize dietary protein

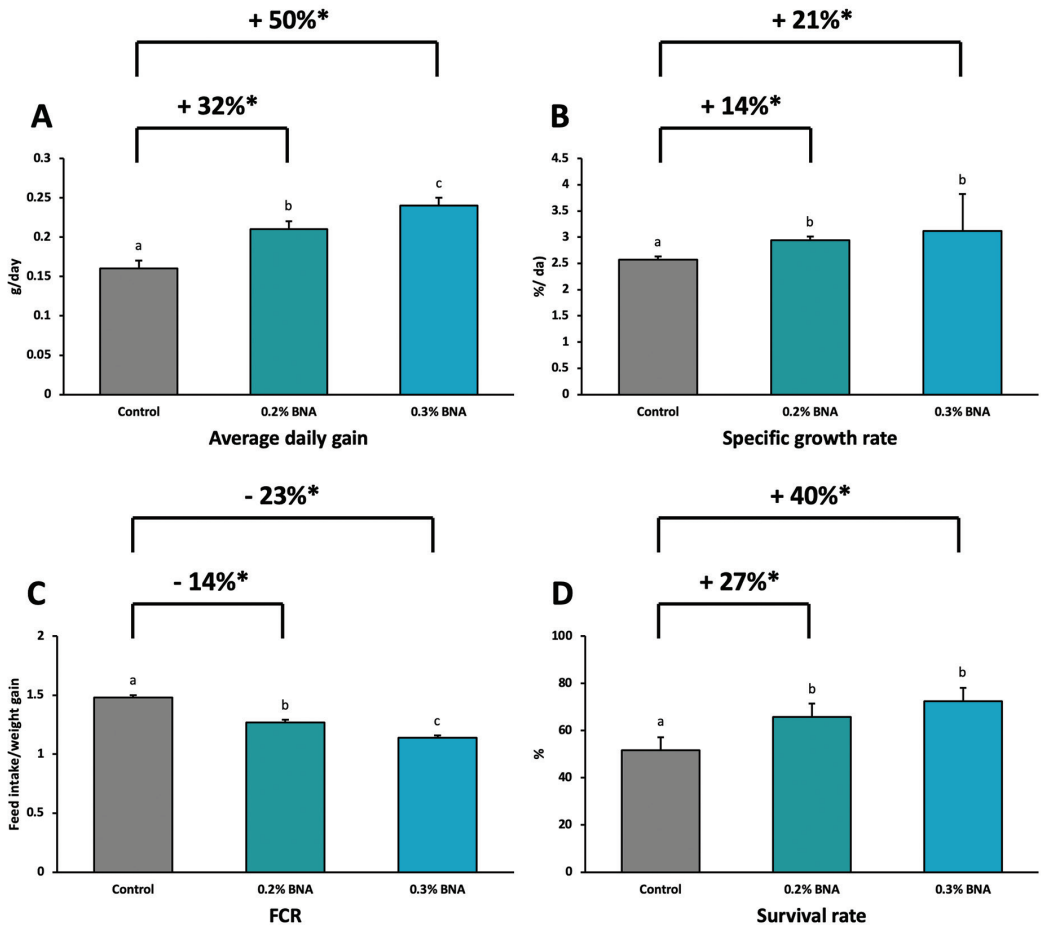

Figure 1. The effect of Bacti-Nil®Aqua supplementation on the growth performance of shrimp after 60 days of feeding on ADG (A), SGR (B), FCR (C), and SR (D). The one-way ANOVA results were analyzed using Tukey's multiple comparison test. Different letters indicate significant differences ($P < 0.05$)

more effectively with the addition of Bacti-Nil®Aqua (Table 1). This is likely the consequence of a more functional hepatopancreas with improved absorptive and digestive capacity.

Conclusion

Supplementing shrimp diets with Bacti-Nil®Aqua effectively reduces pathogen loads. This leads to a more stable gut microbiota, ultimately promoting optimal growth and feed efficiency of shrimp. This research further corroborates the efficacy of Bacti-Nil®Aqua as a strategy to achieve farm profitability.

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