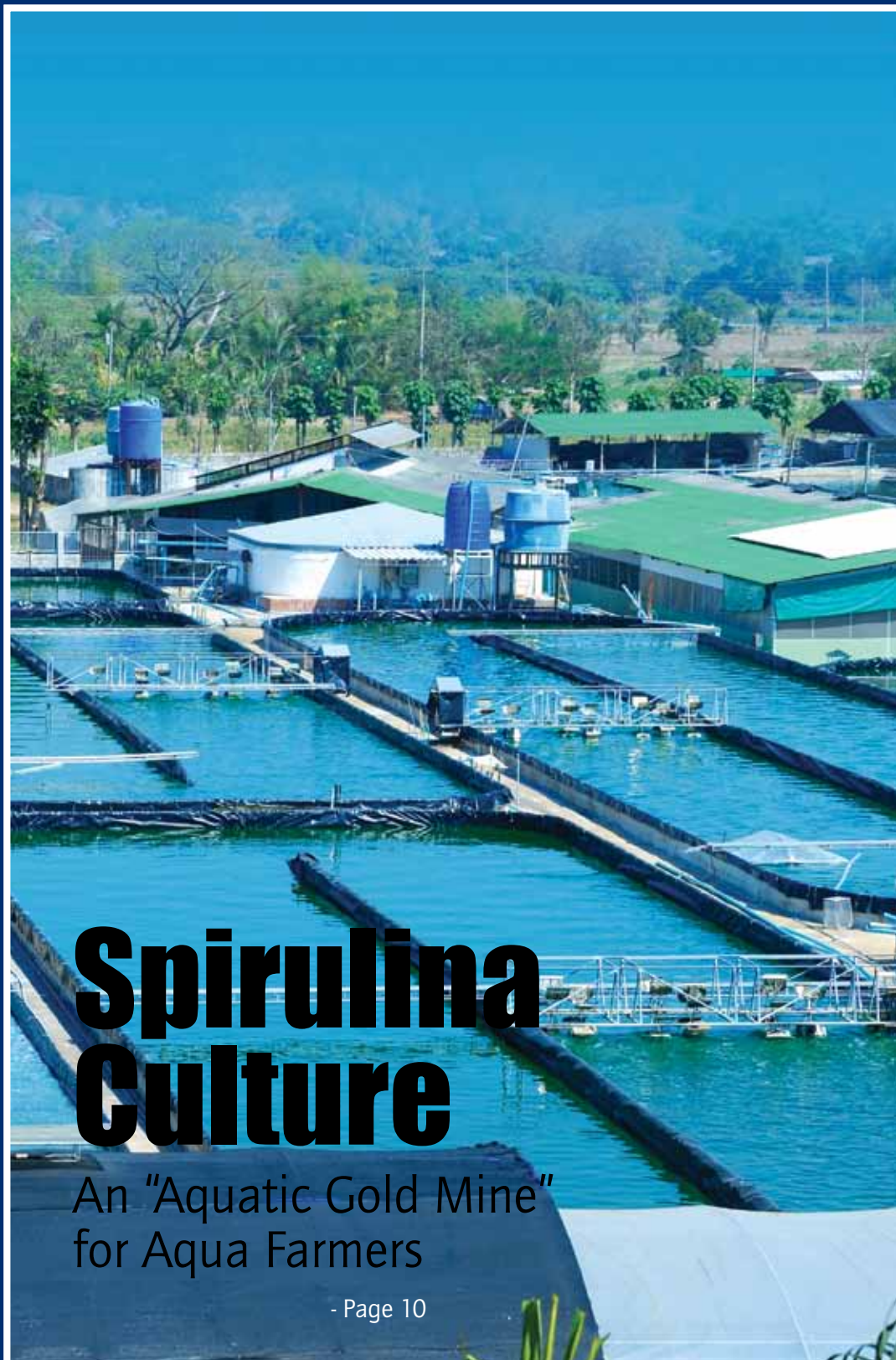


# Aquaculture Spectrum

The Indian Aquaculture Magazine

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# The importance of antioxidants and immuno-modulators to support shrimp health

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*Adisseo*

In January 2021, the India's Society of Aquaculture Professionals (SAP) organized a seminar to review the challenges and solutions of India's shrimp industry after one year of Covid-19 crisis seriously impacting the whole farming business. The speakers focused on how to overcome diseases successfully through farm practices including traditional approaches, such as lower stocking densities and careful attention to water quality and environmental factors, as well as more recent advances such as multi-stage farming systems to keep a tight control on the environment and the pathogens. All these approaches shared the dual necessity to minimize stress factors that increase the risk of disease, and to keep a tight control on pathogens through biosecurity and prophylaxis.

However, the third pillar in health management strategies, boosting the health and **resilience** of shrimp, was marginally covered. There is much that can be done to prevent disease and support the animal in dealing with the stress associated to production, and this includes the use of functional feed additives. In this article, we address antioxidants and immuno-modulators, both crucial in supporting shrimp health and performance.

## Oxidative stress at the base of a weakened immunity

Understanding oxidative stress is key to understanding the role of antioxidants. Shrimp under production conditions is subjected to different types of stress: environmental due to changes in water quality, nutritional due to poor feed quality, disease-related due to the presence and treatment of pathogens, and husbandry-associated due to specific farming

interventions. Stress leads to an overproduction of **reactive oxygen species (ROS)** that damage critical cell components and weaken shrimp immunity if the antioxidant defense system is not capable to balance ROS overproduction with efficient ROS elimination. Even hemocytes release high quantities of ROS when killing invading pathogens and those must be eliminated to maintain hemocyte activity, meaning that building an efficient antioxidant system is crucial for an efficient immune response.

## Antioxidants

There are different **types of antioxidants** working in synergy to deal with the oxidative deterioration by ROS and support an efficient immune response. Micronutrients such as selenium, manganese, and zinc, besides vitamins E, C, and A, provide co-factors and substrate necessary for the optimal functioning of the antioxidant system. Antioxidant enzymes such as selenium-dependent glutathione peroxidase (**Se-Gpx**), superoxide dismutase (**SOD**), and catalase (**CAT**), participate in the first line of the antioxidant defense system and will deactivate ROS. Non-enzymatic antioxidants such as **glutathione** or **vitamins (C, E, and A)** participate in the second level of defense by capturing ROS escaping the first line. Studies have demonstrated that feeding elevated levels of Vitamin C (2000ppm) increases resistance to stress and bacterial infections over normal levels (100ppm) or no vitamin C added<sup>1</sup>. Likewise, supplementing organic selenium in the form of hydroxy-selenomethionine to low and high fish meal diets boosted the antioxidant enzymatic activity<sup>2</sup> and improved survival of shrimp exposed to stress by high nitrite (Figure 1).

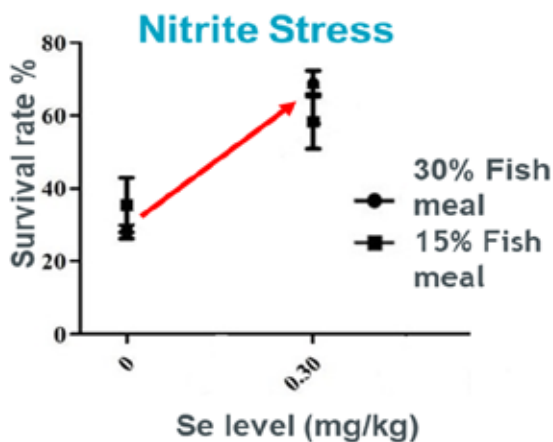


Fig. 1. Effect of organic Selenium (OH-Selenomethionine) on survival of shrimp exposed to a nitrite stress challenge.

## Immuno-modulators

Immuno-modulators are often natural compounds that imitate the components of pathogens that activate the innate immunity and amplify different effectors of the immune response. **Beta-glucans** have proved to boost the shrimp immune response by promoting antioxidant activity and hemocyte production, and in consequence by improving survival under disease challenges<sup>3</sup>.

**Mannan-oligosaccharides (MOS)** support the immune response in the encapsulation of pathogens, and when combined with beta-glucans, have proved to improve survival of *Vibrio*-infected shrimp<sup>4</sup>.

**Nucleotides**, the building blocks of DNA and RNA, play a key role in metabolic patterns of the immune response, and if deficient, liver function and wound

repair may be impaired. When supplemented to the diet of shrimp they have been shown to boost activity of antioxidant enzymes and antimicrobial peptides<sup>5</sup>.

## Synergy is the key in successful immuno-modulation

Under commercial farming conditions, shrimp are exposed to a multitude of pathogens and causes of stress. The resilience to stress and the immune response are dependent on each other, thus combining well-selected antioxidants and active immuno-stimulants can lead to a more efficient capacity to deal with stress and disease. Adisseo has developed and tested Aquastim S, an immuno-modulator composed of carefully selected and calibrated yeast cell wall extracts, nucleotides, antioxidants and other natural compounds. This health solution aims to achieve a synergistic effect towards the optimization of the antioxidant defense system and immune response mechanisms, translating into enhanced resistance to disease and overall feed performance under commercial conditions.

In a lab trial, shrimp were fed for 21 days three test diets: a basal diet without additive (= **Control**), the basal diet supplemented with 4g/kg of a commercial beta-glucan immuno stimulant (= **Glucan**), and the basal diet supplemented with 4g/kg of Adisseo formulated immuno-modulator (= **Aquastim S**). Then, shrimp were challenged with *Vibrio penaeicida* by immersion. After 3 weeks and before infection, shrimp fed Aquastim S had 9% better average body

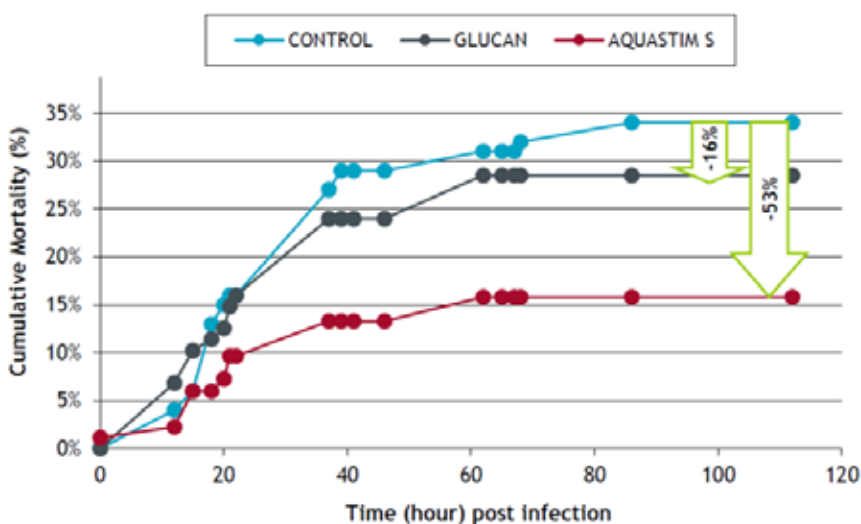


Figure 2. Mortality of shrimp fed 3 test diets (Control, Glucan supplementation, Aquastim S supplementation) and infected with *Vibrio penaeicida*.

weight than the shrimp fed Control or Glucan feeds. Additionally, Aquastim S improved the hemocyte microbicidal effect by 33% and 84% in unchallenged and challenged shrimp, respectively, in relation to those fed Control, and by 5% and 40%, respectively, in relation to the shrimp fed Glucan. More meaningful to farmers was that Aquastim S reduced mortality induced by *Vibrio penaeicida* by 53% in relation to Control, while reduction by Glucans was only 16% (Figure 2).

Aquastim S has also been tested under commercial farming conditions in Brazil, as affected by heavy rains as well as IMNV and NHP infections. Results have shown improved revenue by 19% and biomass harvested by 15%, this being attributed to improvements of 5% in survival and of 10% in shrimp weight.

### Take-home message

Heavy rains, stocking of new PLs, deterioration of

water quality from over feeding, or disease outbreaks in neighboring farms, are unavoidable stress factors that weaken the shrimp immunity and heighten the risk of infection. It is recommended to provide shrimp with extra support based on antioxidants and immuno-modulators to reinforce immunity and further ensure optimal disease resistance and performance. While application can be either at the feed mill or at the farm, dosage and timing of such interventions is critical. Farmers need to follow recommendations from the supplier to achieve maximum efficacy. Application should go in hand with proper farming practices, biosecurity, and prophylaxis. Combination of such antioxidants and immuno-modulators with antimicrobial solutions based on organic acids is proposed as a successful strategy to reduce the severity of infections.

References:<sup>1</sup> Hunter 2000, <sup>2</sup>Guérin 2018, <sup>3</sup>Meena & al. 2012, <sup>4</sup>Solidum & al. 2016, <sup>5</sup>Xiong & al. 2018.



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Feed is much more than just nutrition.

