Ohly Application Note

Benefits of Beta-Glucan Supplementation in Aquaculture: Shrimps

By Dina Krüger

Article Date: 14/10/2019

Ohly GmbH:
Wandsbeker Zollstrasse 59,
D-22041 Hamburg
Germany
Tel: +49 40 68 293 0
Email: info@ohly.com

The well-known immune stimulating effects of yeast β-glucans have also been demonstrated in aquaculture. Dietary supplementation with yeast β-glucans result in a reduction of bacterial infections, mortality and an increase in resistance against a number of diseases. Consequently, dietary beta-glucan provides a valuable health management tool to the aquaculture producer as an alternative to antibiotics.

Keywords: Yeast beta glucan, Shrimp, Aquaculture Antibiotic replacement, Prophylaxis

Introduction

Aquaculture is the global fastest growing animal food-producing sector. Intensive culture has led to serious problems with diseases and pathogen infections and negatively affected the growth of crustaceans (Bonato, 2014). Traditionally, antibiotics were used sub-therapeutically by the aquaculture industry to reduce the impact of bacterial infections. However, there are increasing consumer concerns about drug residues in food products and the rise of antibiotic resistance of pathogenic bacteria. As a result, many countries have banned the inclusion of antibiotics in crustaceans' diets as a routine means of growth promotion. Consequently, there is an increasing demand for alternatives to antibiotics (Ringo *et al*., 2012).

Immunostimulants are dietary additives that enhance the innate (non-specific) defense mechanisms and increase resistance to pathogens. Beta-glucans are being increasingly used in aquaculture and are seemingly very promising in immune enhancement in aquaculture (Ajadi, 2016; Barman et al., 2013). An increasing body of evidence has proven the benefits of beta-glucan, specifically from yeast, in shrimps by enhancing the immune system and disease resistance against both viral and

bacterial infections (Meena et al., 2012; Apines-Amar & Amar, 2015).

Enhancing disease resistance

Shrimp have a relatively primitive immune system compared to fish. They lack an adaptive immune system and are entirely dependent on the non-specific immune system to fight pathogenic infections. The induction of the innate immunity is thus necessary to combat pathogens in shrimps. Beta-glucan activates the innate immune system thereby enhancing the resistance in shrimps against both viral and bacterial infections (Apines-Amar & Amar, 2015).

Vibiriosis

Various pathogens are able to cause serious losses in shrimp culture leading to devastating economic effects on the affected farms. Bacterial diseases, mainly due to 14 different species of *Vibrio*, have been reported in shrimp culture systems (Chandrakala & Priya, 2017). Beta-glucan is able to mitigate the devastating effects of vibriosis.

When shrimps were challenged with *Vibrio alginolyticus,* the survival of shrimps fed beta-glucan-supplemented diets was found to be significantly higher than those fed a control diet (Felix et al, 2008). Moreover, yeast beta-glucan inclusion protected shrimps that were challenged with viable *Vibrio vulnificus* via water-borne infection. Glucan also enhanced the growth of challenged shrimps. The mechanism of better growth probably comes from the disease resistance of shrimp (Sung et al., 1994).

White spot syndrome

The white spot syndrome (WSS) is a major viral disease of shrimp in India, Southeast Asia and the Southern and Central America. It is highly lethal and contagious, killing shrimp quickly. Outbreaks of this disease have wiped out the entire populations of many shrimp farms within a few days. Beta-glucan is able to increase the resistance and survival of shrimps against WSS.

Huang & Song (1999) have shown that the application of yeast beta-glucan enhanced the resistance of shrimp spawners against WSS as well as increased the survival rate of larvae derived from groups of glucan-injected spawners. Moreover, supplementation of WSS vaccine with glucan has decreased the mortality rate of shrimps and increased the protection of shrimp by developing resistance to the virus (Namikoshi et al., 2004).

Infectious myonecrosis virus

Intensification and diversification of the aquaculture practices made an opening to the emergence of new viral diseases. Infectious Myonecrosis Virus (IMNV) is an emerging shrimp virus causing the disease, infectious myonecrosis (IMN). The disease was first reported in Brazil and span further to Indonesia (Prasad et al., 2017). A study conducted in Brazil found that continuous exposure to a diet supplemented with yeast beta-glucan enhanced Pacific white shrimp survival when orally exposed to IMNV (Sabry Neto & Nunes, 2015).

Beta-glucan as immunoprophylaxis

Various viral diseases have caused damage to shrimp culture in South Asia. For example, Taura syndrome has negatively affected production in Central and South America because no effective antiviral drugs are available. Therefore, dietary prophylaxis may be a priority for controlling diseases. Yeast beta-glucans could hence be used as a disease management tool that can greatly benefit the aquaculture industry by increasing the immune responses and decreasing the mortality rates (Ajadi et al., 2016; Meena et al., 2012).

References

Ajadi, A., Sabri, M.Y., Dauda, A.B., Ina-Salwany, M.Y., Hasliza, A.H. (2016) Immunoprophylaxis: a better alternative protective measure against shrimp vibriosis – a review. Pertanika journal of scholarly research reviews, 2:58-69

Apines-Amar, M.J., Amar, E.C. (2015) 3. Use of immunostimulants in shrimp culture: an update. Biotechnological advances in shrimp health management in the Philippines, 45-71

Barman, D., Nen, P., Mandal, S., and Kumar, V. (2013) Immunostimulants for aquaculture health management. J Marine Sci Res Dev 3:3

Bonato, M. (2014) Hydrolyzed yeast as a source of nucleotides and digestible nutrients in shrimp nutrition. International aquafeed Issue Nov/Dec 18-19

Chandrakala, N. & S. Priya (2017) Vibriosis in Shrimp Aquaculture A Review. International Journal of Scientific Research in Science, Engineering and Technology, 3: 27-33

Felix, N., Jeyaseelan, M.J., Kirubakaran, J.W. (2008) Growth improvement and enhanced disease resistance against Vibrio alginolyticus using beta-glucan as a dietary supplement for Penaeus monodon (Fabricius). Indian J. Fish., 55: 247-250

Huang, C.-C., & Song, Y.-L. (1999). Maternal transmission of immunity to white spot syndrome associated virus (WSSV) in shrimp (Penaeus monodon). Developmental & Comparative Immunology, 23:545–552.

Meena, D.K., Das, P., Kumar, S., Mandal, S.C., Prusty, A.K., Singh, S.K., Akhtar, M.S., Behera, B.K., Kumar, K., Pal, A.K. Mukherjee, S.C. (2012). Beta-glucan: an ideal immunostimulant in aquaculture (a review). Fish Physiology and Biochemistry, 39: 431–457

Namikoshi, A., Wu, J. L., Yamashita, T., Nishizawa, T., Nishioka, T., Arimoto, M., & Muroga, K. (2004). Vaccination trials with Penaeus japonicus to induce resistance to white spot syndrome virus. Aquaculture, 229:25–35

Sabry Neto, H., & Nunes, A. J. P. (2015). Performance and immunological resistance of Litopenaeus vannamei fed a β-1,3/1,6-glucan-supplemented diet after per os challenge with the Infectious myonecrosis virus (IMNV). Revista Brasileira de Zootecnia, 44: 165–173

Prasad, K. P., Shyam, K., Banu, H., Jeena, K., & Krishnan, R. (2017). Infectious Myonecrosis Virus (IMNV) – An alarming viral pathogen to Penaeid shrimps. Aquaculture, 477:99–105.

Ringo, E., Olsen, R.E., Vecino, J.L., Wadsworth, S. and Song, S.K. (2012) Use of immunostimulants and nucleotides in aquaculture: a review. J marine Sci Res Development 1:104

Sung, H. H., Kou, G. H., & Song, Y. L. (1994). Vibriosis Resistance Induced by Glucan Treatment in Tiger Shrimp (Penaeus monodon). Fish Pathology, 29:11-17