Supporting the sustainability of shrimp production with organic trace minerals

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Shrimp is a very popular source of protein globally, with few limitations from a religious perspective; it is easy to prepare and offers high nutritional value. As general wealth has increased across the global population, protein consumption per capita has increased as well. However, not only do we eat more protein, but there has also been a shift towards more valuable sources, such as shrimp. As a result, shrimp consumption has grown rapidly over the last few decades, both in the classic importing markets, such as Japan, Europe and the United States, as well as in major regions of shrimp production in Latin America and Southeast Asia. As the growth potential of capture fisheries is limited by fishing quota, available resources and historical supply chains, aquaculture has rapidly been increasing and has even overtaken capture fisheries in the volume of products (including shrimp) available for human consumption.

Sustainability challenges

With increasing aquaculture, the predictability of quality and availability have greatly improved, but the higher inputs and outputs resulting from intensifying production have led to new challenges. As an example, and this is also true for livestock production, intensifying production increases the risk of pathogenic diseases, which has resulted in the high use of antibiotics, major outbreaks and decimation of stocks in important production areas from time to time (*e.g.* Thailand) (FAO, 2018).

In recent years, there has been a lot of attention towards more sustainable production through the use of the following strategies: replacing fishmeal and fish oil in feed (with vegetable-based and even insect-sourced substitutes), reducing environmental effects (with water recycling systems), disease prevention (via biosecurity) and improved feed efficiency (by optimizing feed and management).

Major improvements have been made in all these areas, but there is still more to be done (FAO, 2018). For example, the lack of an adaptive immune system in shrimp provides an additional challenge for their biosecurity when compared to livestock, as this means that they cannot be vaccinated. The reduction of fishmeal and fish oil in shrimp feeds leads to other challenges, not only in replacing high-quality protein, but also other nutrients, like minerals, as they are no longer provided in a highly available form. Trace minerals are known to be important for a number of functions, improving not only growth but also development, fertility, final product quality and immunity. Organic forms of trace minerals, for example, B-TRAXIM® minerals (PANCOSMA, Switzerland), have been shown to offer higher bioavailability and additional benefits in livestock species compared to traditionally used inorganic forms (Hansen *et al.*, 2008, Jang *et al.*, 2010, De Marco *et al.*, 2017, Zhang *et al.*, 2017). Organic trace minerals (OTM) may therefore

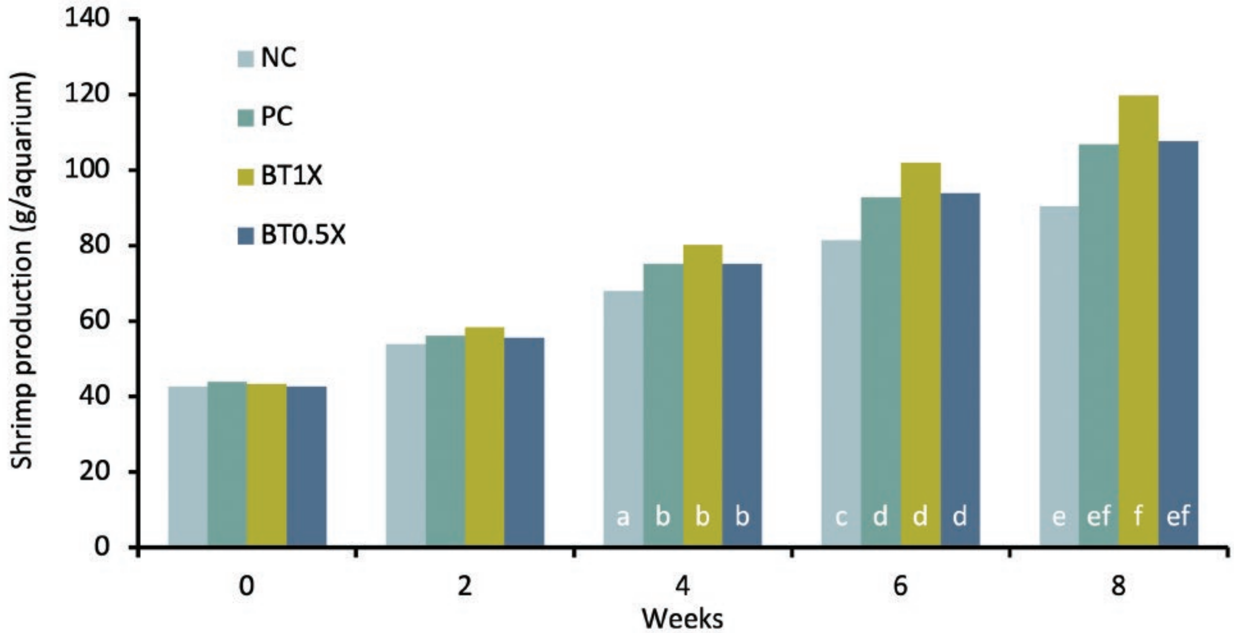

Figure 1. Total shrimp weight produced over time, in gram per aquarium.

contribute to improved efficacy in feed formulations and to a reduction in the environmental impact of shrimp production.

Benefits of organic trace minerals

In line with more sustainable production methods, OTM can help reduce the impact of waste from shrimp production on the environment by reducing mineral excretion. And although aquafeeds already contain much less fishmeal and fish oil than before, these remain important ingredients, especially for high value and more carnivorous species (*e.g.* shrimp and salmon) (FAO, 2018). The high levels of unsaturated fats from fish sources are a challenge to the stability of aquafeeds. Metal ions, and especially zinc, iron and copper, are known to be major catalyzers of oxidation (McDowell, 2008). If metals are stabilized with an organic bond, this may not only increase their bioavailability but reduce oxidation of important nutrients as well.

After earlier confirmation of the practical advantages and the potential positive impact of using OTM on shrimp performance, commercial use of glycine-based OTM has begun both in Latin America and Southeast Asia. To confirm positive practical experiences from the market, a new trial in a controlled environment was set up in Thailand by Professor Orapint Jintasataporn (Department of Aquaculture, Faculty of Fisheries, Kasetsart University, Thailand). In this trial, the effect of OTM on the growth performance and immune parameters of white shrimp (*Litopenaeus vannamei*) was studied. The shrimp were fed either a non-supplemented diet (negative control, NC) or one of the following treatments: a full dose of inorganic minerals (positive control, PC), a full dose of B-TRAXIM® minerals (BT1X), or a half dose of B-TRAXIM® minerals (BT0.5X). Shrimp fed BT1X showed the fastest growth, best feed conversion and numerically the highest survival rate. The total shrimp production per tank is of interest for shrimp producers, as it combines the result of growth performance and survival rate in 1 parameter (Fig. 1). The glycine-based OTM (BT1X) consistently showed the highest production.

Another interesting strategy confirmed by this trial is to reduce inorganic mineral supplementation by 50% and instead use OTM (BT0.5X). This has been shown to maintain growth performance and feed efficiency, while reducing mineral excretion. This is fully in line with results from other species, e.g. in broilers (De Marco *et al*., 2017).

In the same trial, some important immunity parameters were checked. This is of particular interest as disease-related mortality in shrimp production is a common issue. Stimulating general immunity and optimizing the immune response is important, as vaccinating is not possible because shrimp rely only on their innate immune system. Lysozyme is an enzyme with antibacterial properties that acts as part of the innate immune system by cutting the carbohydrate chains forming the main structure of bacterial cell walls (Iacono *et al.*, 1980). The BT1X shrimp showed a significant increase of lysozyme activity in the hemolymph (which plays the same role as blood in mammals). Also, superoxide-dismutase (SOD) activity, as part of the antioxidant system, showed a trend towards higher levels in the hemolymph of BT1X shrimp. Both these factors show that the BT1X shrimp had an improved ability to protect themselves against bacterial and oxidative challenges.

More sustainable shrimp

Summarizing the available trial data as well as practical experience, the glycine-based OTM from PANCOSMA are able to support shrimp producers in some of their main challenges towards better sustainability.

Mineral excretion into the environment can be reduced without losing performance, an efficient immune response is supported, which may reduce the impact of diseases, and improved growth and feed efficiency have been shown, allowing for a better return on investment. OTM will not solve all the challenges faced in aquaculture, but it can be used as a solution to support shrimp producers on their path towards a more sustainable way to provide high-quality food globally.

References available on request

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