

Shrimp grow stronger and healthier with krill meal in the feed

By Atul Barman

Seafood is one of the best sources of omega-3 fatty acids, as well as amino acids, vitamins, and minerals. Not only are these nutrients important to humans, but they are also essential for farmed aquaculture species such as shrimp. Shrimp farmers aim to raise healthy and high-quality products for human consumption, and to do so, they need a dietary feed composed of the most effective, nutrient-rich ingredients on the market.

Antarctic krill is the source of one such ingredient for shrimp feeds. Krill are tiny crustaceans found in the Southern Ocean in Antarctica. These small, shrimp-like creatures are located at the bottom trophic level of the food chain, consuming free floating algae which contribute to their nutrient rich nature.

A sustainable source of nutrition for shrimp

The krill fishery is carefully monitored for its sustainability. Krill can only be fished in one area off the Antarctic Peninsula, and krill harvesters are restricted to catching just one percent of the estimated biomass in that area. The goal is to ensure that the krill biomass keeps growing and that krill can continue to be a part of the food chain for other marine wildlife. The wellbeing of Antarctic krill is assessed regularly by the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR), and they have reported that the krill fishery is amongst the best managed in the world.

With a healthy supply and its status as a sustainable marine resource, krill has emerged as an ideal replacement for fishmeal in shrimp feeds. Supply of fishmeal is not enough for rising aquaculture production and alternative protein sources are needed. Krill has been proven through scientific studies to have better nutritional benefits than other alternatives, such as plant-based or animal meals.

A super ingredient for shrimp feed

Krill meal contains up to 58% protein with a well-balanced amino acid profile. It contains essential omega-3 fatty acids, including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), which have proven to be essential for growth, survival and disease mitigation in shrimp. Krill meal also includes trimethylamine N-oxide (TMAO), a molecule generated from choline, betaine and carnitine, as well as nucleotides, all of which help make the feed more attractive for shrimp.

A tastier feed to help shrimp grow

Shrimp producers indicate that krill makes the feed more attractive and taste better to the shrimp. This is a unique attribute of krill meal; all shrimp feeds, especially in starter feeds, need to have enough nutrients for shrimp to both grow and survive. The shrimp nursery is a very important stage, as the shrimp are kept at high densities

in tightly controlled environments. Higher feed intake improves chances of an overall high performing crop.

Shrimp feed manufacturers are also increasingly aware of the benefits of krill meal as a supplement or replacement ingredient for fishmeal in their feeds. Krill gives manufacturers more flexibility with their ingredients, as even low amounts of krill meal combined with other alternatives, have been shown to positively affect the feed's attractability to shrimp. This means that they can maintain cost levels, diversify their ingredients and improve their performance, all at the same time – thanks to krill.

Improve survival rates in nurseries and culture ponds

The nursery and earthen pond stages can be stressful for shrimp, as it is a critical time in their development. There are often low survival rates reported by farmers, which can result in financial losses for them.

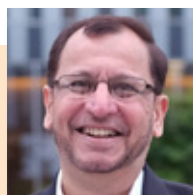
Scientific studies have tested out krill meal as a supplement to the feed at these delicate, early developmental stages. The results show that with krill in the feed mix, survival rates can improve. Krill helps to reduce the initial stress related to transport and the dense environment due to the antioxidants it delivers to the shrimp.

Disease is another factor that impacts the survival rates of shrimp. In particular, white faeces syndrome (WFS) can cause severe damage to the shrimp crop, leading to lower returns for the farmer. Krill meal as a feed ingredient stimulates the hepatopancreas which helps with health and immunity.

One ingredient with a multitude of benefits

Shrimp farmers are seeing krill meal as a much-needed life raft in an already challenged industry. The shrimp industry depends on high-quality, nutrient-rich feed ingredients for farmers to continue to stay profitable.

Krill's attractiveness as a feed ingredient is second-to-none, which is why it is serving as the industry's leading 'sustainable ingredient' that contributes to increased growth, robustness and overall health of farmed shrimp.



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OH, THIS IS
THE BEST!

YES, AND SO
NUTRITIOUS
TOO



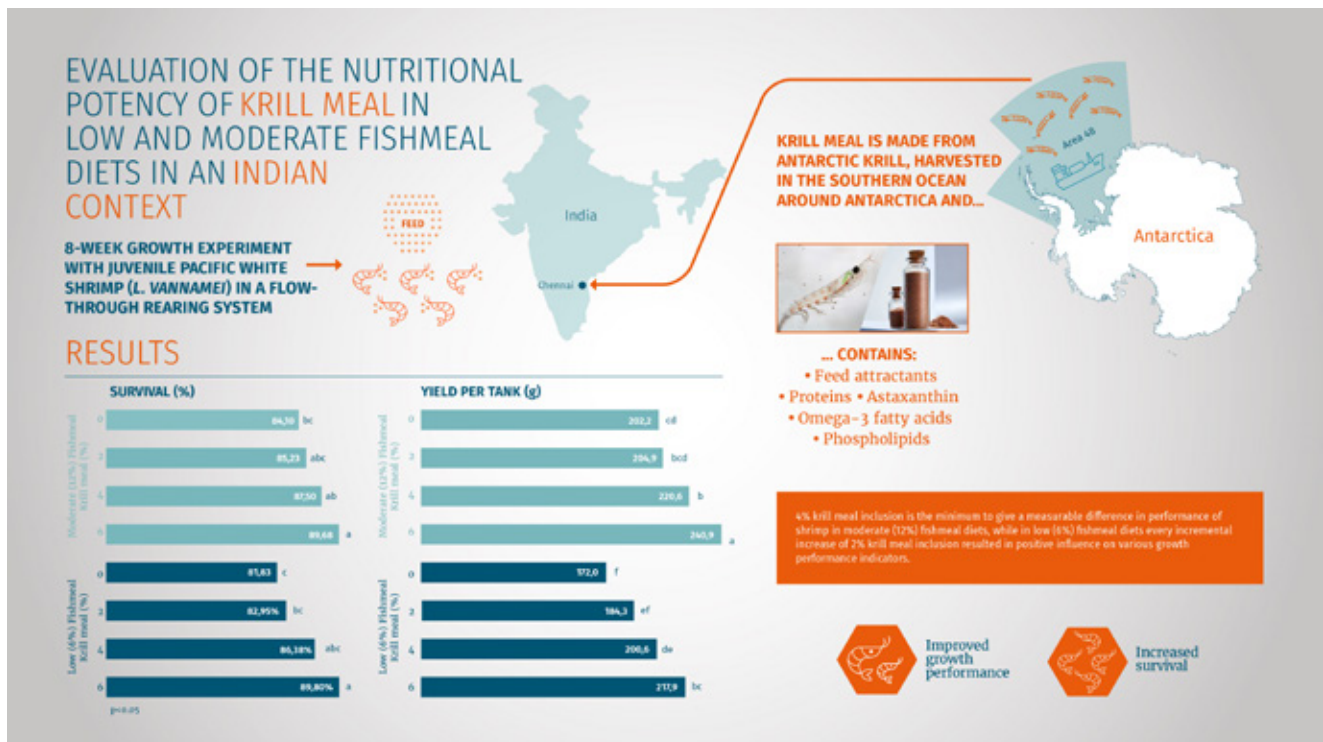
SHRIMP PREFER FEED WITH KRILL

Krill provides a beneficial package of nutrients containing omega-3 phospholipids, proteins and attractants. This makes shrimp feed with krill both a shrimp favorite as well as nutritious.

 **QRILL™ AQUA**
BY  **AKER BIOMARINE**

New study reveals krill meal's high potential for developing sustainable shrimp feed formulations

Dr K. Ambasankar from India's Central Institute of Brackishwater Aquaculture (ICAR) discusses how krill meal is a beneficial functional ingredient for whiteleg shrimp (*Penaeus vannamei*). In an eight-week feeding trial, results reveal that inclusion of 4 to 6% krill meal in the diet can lead to higher body weight and greater survival among the shrimp.



What is the situation in shrimp farming today in India (and globally) that led to this study?

India is one of the world's largest marine shrimp exporters, earning it the title of "shrimp garden of the world". In 2020-21, the country exported nearly 1.15 million tonnes of seafood, with the majority comprising farmed frozen shrimp. An estimate on farmed shrimp production in 2021 was around 680,000 tonnes. A key market opportunity is large sized shrimp and shrimp farmers in India continue to seek ways to improve profitability and productivity, with higher survival rates.

India is a major exporter of shrimp to the US, European and Asian markets. However, its position in the global shrimp industry will depend on its ability to remain competitive, be sustainable and meet higher productivity targets – facilitated through healthier and larger shrimp. Feed plays a major role in helping shrimp producers achieve these goals, which is why it is essential to uncover functional ingredients, such as krill meal, that can help farmers achieve optimal results.

What was the aim of this study?

Fishmeal and fish oil are still considered the most nutritionally balanced and most digestible ingredients

in shrimp feed. However, with restricted supplies and increasing prices, feed formulators continue to experiment with several nutritional alternatives to be able to reduce the use of fishmeal.

The aim of this trial was to find out if krill meal is a beneficial and functional ingredient for increasing body weight and survival for the whiteleg shrimp *Penaeus vannamei*. In addition to shrimp growth performance, the present study focuses on carcass nutrient composition (proximate and fatty acids levels), immune gene expression, histology of hepatopancreas and haemocyte count. This is in relation to three different krill meal inclusion levels (2, 4 and 6%) at two different fishmeal inclusion levels (6 and 12%). This baseline data obtained in an Indian context will help to identify the best areas for utilisation and limitations of krill meal in commercial shrimp feed formulations.

How was the experiment set up?

Feeding trials were conducted at the indoor wet laboratory at the ICAR facility in Chennai, India. There were eight iso nitrogenous and isolipidic diets formulated to contain 36% crude protein and 5.5% crude lipid. Krill meal was included at 0, 2, 4 and 6% in the moderate fishmeal (12%) diets and likewise in the low (6%) fishmeal diets.

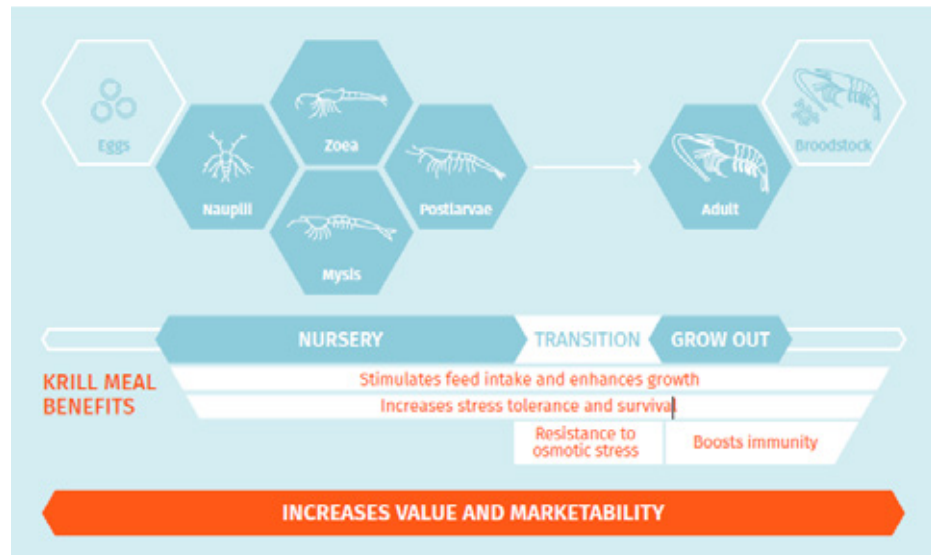
We cultured post larvae to 0.55g juvenile shrimp over eight weeks and fed them at 8% of total biomass. The ration was divided into three meals daily throughout the experiment duration. We also confirmed that the juveniles were free from all the OIE-listed pathogens to rule out any disease risks. We used a total of 32 fiberglass tanks of 350L. There were four replications per treatment.

Final measurements were on weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), apparent protein utilisation (APU) and survival. After the experiment we sampled shrimp in the inter-molt stage for the quantification of immune gene expression. We performed histology of the hepatopancreas and analysed body composition including proximate and fatty acids levels.

What are the key findings from the study?

These were:

- Shrimp fed 6% krill meal in the moderate (12%) fishmeal diet had the highest body weight at the end of the study.
- Survival rates significantly increased in the groups fed 4% and 6% krill meal in the diet.
- When 6% krill meal was included in the diet, shrimp showed a higher content of n-3 polyunsaturated fatty acids.
- Shrimp fed 2% krill meal in a diet containing 12% fishmeal significantly increased the expression of six immune-related genes in the hepatopancreas.
- In particular, a diet with low (6%) fishmeal showed markedly improved performance even with a small amount of krill meal (2%) compared to the respective control.
- The inclusion of krill meal has enhanced the level of n-3 PUFAs, particularly EPA and DHA in the shrimp body, irrespective of the dietary fishmeal level, which is the most beneficial feature for human nutrition.
- In addition, krill meal was found to be a good source of methionine (3.96 g/16gN) in comparison to 2.84g/16gN in Indian fishmeal.



What are key takeaways from the study?

The results of this experiment showed that krill meal, when supplemented in amounts between 4% and 6%, was a beneficial functional ingredient for both moderate (12%) and low (6%) fishmeal diets. This finding is based on the increased growth performance in the groups fed krill meal and overall improved survival rates, leading us to conclude that krill meal can be a viable supplement to fishmeal in shrimp feeds.

The functional aspect of the krill meal was demonstrated by the correlation of important immune genes and combined dietary inclusion of fishmeal and krill meal protein. Krill meal can be a potential functional ingredient in *P. vannamei* feed. It contributes to a sustainable, cost-effective and health-promoting feed with a maximum fishmeal reduction without compromising on growth performance.

Where can readers find more information?

The article published in Aquaculture by K. Ambasankar, J. Syama Dayal, K.P. Kumaraguru Vasagam, T. Sivaramakrishnan, K. P. Sandeep, A. Panigrahi, R. Ananda Raja, Lena Burri, K.K. Vijayan "Growth, fatty acid composition, immune-related gene expression, histology and haematology indices of *Penaeus vannamei* fed graded levels of Antarctic krill meal at two different fishmeal concentrations" can be found here <https://doi.org/10.1016/j.aquaculture.2022.738069>

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