

Turning trash into treasure: Innovative pathways for marine byproduct valorization

The following article is a part of FIFP webinars conducted on 26th July, 2025 on the topic “Turning trash into treasure: Innovative pathways for marine byproduct valorization”.

Note from the Chief Editor:

Turning trash into treasure: Innovative pathways for marine byproduct valorization was the topic of FIFP webinar conducted on 26th July, 2025. Marine byproduct valorization is the process of transforming waste or byproducts into valuable resources. It represents a paradigm shift in how waste is perceived. Marine byproduct valorization is about recognizing the inherent value in byproducts previously considered waste and transforming them into valuable resources. Environmental regulations, economic incentives and sustainability goals comprise the main drivers for byproduct valorization. Through his presentation, Mr. Munir brought out the importance of marine byproducts; transforming marine waste into wealth; innovation and commercialization of marine byproduct utilization; and benefits and challenges of byproduct valorization. Some of the research organisations, academic institutions and private players in India are driving research, innovation, and commercialization of marine byproduct utilization. Mr. Munir highlighted how the innovative technologies and sustainable practices transformed marine byproducts from seafood processing into valuable products for food, feed, health, and industry.

Introduction

Marine byproducts are the unused or leftover components of seafood such as shells, bones, heads, skin, and internal organs generated during processing for human consumption. With the global seafood industry expanding, the volume of these byproducts has risen sharply, creating both an environmental challenge and an opportunity for sustainable valorization. Instead of treating them as waste, these resources can be transformed into valuable products, contributing to a circular economy in the marine sector.

According to the FAO (2024), global aquatic production in 2022 reached 223.2 million tonnes, of which 78.1 million tonnes, or 35 percent, were considered waste or losses. Furthermore, about 15 percent of total aquatic food produced is lost, while only 5 percent of byproducts are effectively utilized. Since nearly 40 percent of aquatic foods undergo processing, the potential for improved utilization of byproducts remains substantial and underexploited.

Importance of marine byproducts

Marine byproducts are rich in high-value compounds including proteins and peptides, fish oils, gelatine, collagen, chitin and chitosan, enzymes, minerals, pigments, and bioactives. These valuable components can be used across a wide

range of industries such as aquaculture, livestock feed, pharmaceuticals, nutraceuticals, cosmetics, agriculture, and human health. Their recovery not only reduces environmental burdens but also generates economic opportunities.

Transforming marine waste into wealth

Innovation plays a vital role in transforming marine waste into wealth. Shrimp processing, particularly with Vannamei shrimp, highlights this potential since shrimp heads account for 35 to 45 percent of body weight, yet only 1.6 percent of their potential value is currently realized. Through upcycling, shrimp heads can be converted into protein hydrolysates, chitin, and other bioactive compounds, significantly increasing their contribution to the economy while reducing waste.

Byproduct valorization and its benefits

Protein hydrolysates are a key example of byproduct valorization. Produced through enzymatic hydrolysis of shrimp heads and shells, they are rich in amino acids and small peptides that are easily digestible. They are widely used in aquaculture to enhance growth, digestion, and immunity, as well as in poultry and livestock feed, pet food, organic fertilizers, and even cosmetics and nutraceuticals.

The benefits include their high protein content, digestibility, improved feed efficiency, and waste reduction, making them a sustainable alternative to conventional protein sources. The global market for marine protein hydrolysates is valued at USD 500–600 million in 2024, with a projected growth rate of 6 to 8 percent annually, while India's market is expanding even faster at 21 to 24 percent.

Challenges

Despite the strong potential, there are several challenges. High initial investment costs, expensive enzymes, odour control, and process optimization issues create technical and financial barriers. Market limitations such as limited awareness, niche demand, and competition from cheaper proteins also restrict growth. Additionally, regulatory hurdles, seasonal variability in raw material supply, hygiene concerns, and consumer hesitancy toward “food from waste” products further complicate large-scale adoption.

Innovation and commercialization of marine byproduct utilization

India demonstrates growing engagement in this field, with key contributions from government institutions such as ICAR-CIFT, CMFRI, NIOT, and CSIR-CFTRI, academic centers like the College of Fisheries in Mangalore, and private players including Marsco Nutraceuticals, AVN Aqua Feeds, Sea6 Energy, and Fishverse. These organizations are driving research, innovation, and commercialization of marine byproduct utilization.

Conclusion

Marine byproducts represent a largely untapped resource with the potential to deliver environmental, economic, and social benefits. By advancing innovative technologies such as enzymatic hydrolysis and fostering collaboration between research institutions, industries, and policymakers, seafood waste can be

transformed into high-value products. The way forward lies in recognizing that what is currently considered waste can, in fact, be a cornerstone of a sustainable blue economy.

Author: Mr. Muneer Ahamed

Head of Research and Development at NPM Aquatic Fish Links Pvt Ltd, Thrissur

Mr. Muneer Ahamed, an alumna of the School of Industrial Fisheries, Cochin University of Science and Technology (CUSAT) is currently working as the Head of Research and Development at NPM Aquatic Fish Links Pvt Ltd, Thrissur. He leads initiatives aimed at converting marine processing waste into high-value, sustainable products. Mr. Muneer Ahamed is a dynamic and innovation-focused professional with expertise in seafood byproduct utilization, particularly in the development of shrimp protein hydrolysate and chitin. He has been professionally trained by the scientists of ICAR-CIFT, Kochi, where he actively collaborates in the Byproducts section of the Fish Processing Department, contributing to research testing and new product development initiatives.

His academic and practical training spans Aquaculture (MPEDA RGCA), Seafood processing (NIPHATT), Molecular biology and Microbiology (ICAR-NBFGR), Seamanship (CIFNET), and Digital marketing (IIDE, Mumbai), thus having a comprehensive understanding of the seafood value chain from harvest to consumer. His professional journey includes significant roles in quality assurance at Mangala Marine Exports and Febin Marine Foods. He is a certified FSSAI FoSTaC Level 2 professional and was the winner of the ASAP Reboot Hackathon 2021 (Energy theme).