

DEVELOPMENT OF INNOVATIVE FISH FEED INGREDIENTS FROM MARINE SOURCES FOR FORMULATION OF AQUA-FEEDS

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Introduction

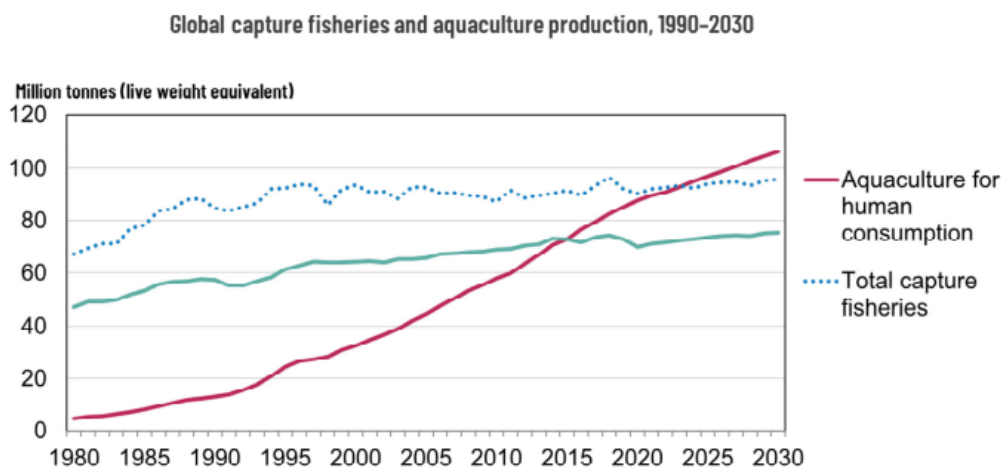
Aquaculture is world's fastest-growing sector in food production, since, 1970 the sector is continuously growing with an average growth rate of 9 % on yearly basis (Tacon, 2020). The sector is playing an important role in the economic development front on account of its contribution to food and nutritional security, national income, employment opportunities as well as generating livelihood options (Kumar and Shivani, 2014). The sector is acting as the primary source of animal protein for billions of people worldwide, in addition, capture and culture sector serves the livelihoods of more than 10% of the global population (Anonymous, 2020b). Worldwide the demand for the fish and fishery product is continuously increasing due to many health beneficial aspects (Delgado et al. 2003, FAO 2010). India currently ranks 3rd in fisheries and 2nd in aquaculture production in the world, contributing 6.3% to the total global fish production. As sector has adopted intensive and super intensive farming technique to improve the production of per unit area. This fast growth has resulted for selling farm produce at lesser. As per the recent survey, price of all the aquaculture inputs such as fishmeal, fish oil, vegetable proteins and fats, wheat flour, feed phosphates, additives, vitamins and minerals have shown significant price increases over the past years. The prime ingredient in the aqua feed sector is fishmeal, the cost has gone up due to non-availability of fish preparation of fishmeal. Fishmeal is being considered as one the gold standard ingredient due to the presence of quality protein with all essential micronutrients and also known to have unknown growth promoters which helps fish and shellfish growth. As the cost of all the essential feed ingredients are going up and anticipating the adverse effect of intensification in culture system, the bioactive compound isolated from marine and agri-based source have been used as bio-functional feed supplement and these bioactive compounds known to have properties like antioxidant, antimicrobial, growth promoters and immune system modulation.

Freshwater aquaculture production in the global context

Global fish production stands at 178 million tonnes, of which aquaculture sector has contributed to tune of 87.5 Mt and 90 mt from the capture fisheries sector (FAO, 2022). In addition, algal production has increased and contributed around 36 Mt. Fisheries and aquaculture continue to have a significant contribution to local economies, proportionally more significant in developing countries. The total first sale value of the sector was estimated at 424 billion USD in 2020. Aquaculture is the fastest growing animal food-producing sector, growing at a rate more than 7% annually. Many studies have pointed towards a positive scenario for the role of aquaculture in providing the much-needed animal protein to the world population (Tidwell and Allan, 2001; Sugiyama et al., 2004).

Based on the FAO report, the fisheries and aquaculture production is expected to reach 202 Mt by 2030, and it is anticipated to have 14% increase compared to today. While capture fisheries is projected to increase slightly as a result of management improvements, most of the growth in the sector will come from aquaculture, which is expected to growth by 22% by 2030.

PRODUCTION OF AQUATIC ANIMALS EXPECTED TO GROW BY 14% BY 2030, TO REACH 202 Mt



Source: FAO, 2022

Innovative Fish Feed Ingredients from Marine Sources

Fish, shellfish, macroalgae, microalgae, and other varied organisms make up marine ecosystems (Thorpe et al., 2000). Marine habitats are frequently referred to as one of the richest treasure houses of biomolecules and these biomolecules from marine habitats may possess

bioactive properties like antioxidant, antimicrobial, antiviral, antiparasitic, anti-inflammatory, antifibrotic, and anticancer activity. Due to their bio-functional properties, these bioactive compounds find its applications in field of pharmaceutical, nutraceutical, biomedical, and cosmetic industries (Barrow and Shahidi, 2007). As the demand for the fish increasing constantly and culture sector are adopting new methods of farming to meet the present and future requirements. Meanwhile, fish processing sector tends to generate huge quantity of waste which includes head, skin, trimmings, fins, frames and viscera, and these generated biomasses can be utilized for the extraction of bioactive compounds (Dekkers et al., 2011).

Fish protein hydrolysate: fish protein hydrolysates find application fish feed ingredient or as a supplement to replace fishmeal. Fish protein hydrolysate found to have desirable bio-functional properties like antihypertensive, antithrombotic, immune modulatory and antioxidative properties. Various studies have shown that dietary supplementation of fish protein hydrolysate had positive influence on growth performance and immunity parameter in fish and shellfish (Quinto et al., 2018, Tejpal et al., 2021).

Chitin and chitosan

Chitin is natural biopolymer and it is a cationic amino polysaccharide composed of N-acetyl-d-glucosamine with β (1 \rightarrow 4) glycosidic bonds between each monomer. Similar to chitin, chitosan is also a biopolymer and it consists of d-glucosamine units obtained during the deacetylation of chitin by adopting hot alkali treatment (Beaney et al., 2005, Se-Kwon, 2010). Chitin and chitosan are mainly present in many aquatic, terrestrial organisms and also found in some of the microorganisms. Bio-waste generated from aquatic and terrestrial source can be used as raw material for production of chitin and chitosan (Tokura and Tamura, 2007 and Se-Kwon, 2010). These biomaterials are reported to have wide range of applications. The chitin found to improve the growth performance, feed conversion and modulates the immunity of the aquatic animals. However, inclusion of chitin at excess in feed had adverse influence in the aquatic animals. Whereas chitosan, interesting bioactive polymer, found to have application in aqua feed sector as biomaterial for encapsulation of bioactive compounds. In addition, chitosan supplementation in the feed improve growth performance in aquatic animals.

Pigments

Pigments such as astaxanthin, fucoxanthin, melanin etc. are available in the marine source and found to have bio-functional properties. Generally, waste generated from the shellfish processing waste contain good amount of carotenoid pigments such as astaxanthin

and canthaxanthin. The supplementation of these pigments will increase the palatability of the feed and improve the immunity of aquatic animals. Carotenoids, caramel, curcumin, and spirulina are feed pigments that are majorly available in the market.

Macroalgae

Macroalgae known to have wide range of nutrients depending on species, season of harvest, geographic origin, and environmental conditions (Patarra et al., 2011). These marine macroalgae are rich in bioactive compounds known to have bio-functional properties (Mohamed et al., 2012). As per the recent findings, the macroalgae e proven to have growth prompting and enhancing immunity in fish and shellfish.

Shrimp head waste

The shrimp head meal has been used as alternative to replace fish meal. The protein content varies from 40 to 55% and acts good attractant in fish and shellfish. In addition, it is known to contain unidentified growth promotes and other bioactive properties, which enhance the growth of fish and shellfish.

Circular use of available resources for development of innovative value chain.

In the recent past the aquaculture sector is competing with for crop resources with livestock and energy industries and human consumption, though the sector is very small in comparison to the livestock sector, but global food shortage would the major concern for the aqua farming community. In this connection, researcher and scientific community has to find more economic and sustainable protein and lipid sources to underpin the increasing demands for aqua-feed based on sustainably sourced ingredients.

Developing an alternative to existing ingredients with newer concept of circular economy, the alternative ingredients should be assessed in terms of aquaculture strategies, environmental, economic, social, legislative and technically. Based on the assessment, innovated product developed in relation to existing products will judge for the suitability to sector. The novel view on the circular use of available resources is converting the available waste in to value added novel aqua feed ingredient with added bio-functional properties.

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