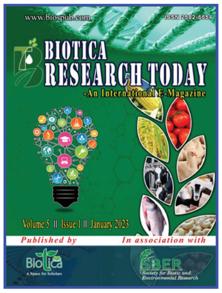
Article: RT1205



Biotica Research Today
Vol 5:1 2023
59/61

How to cite this article?
Prakash *et al*., 2023. Fish Protein Hydrolysate (FPH): Excellent Protein Source for Aquafeeds. Biotica Research Today 5(1):59-61.

Fish Protein Hydrolysate (FPH): Excellent Protein Source for Aquafeeds

Patekar Prakash[1*], Banlam J. Marbaniang[2], Satheesh M.[1] and R.S. Baraya[3]

[1]Fish Nutrition, Biochemistry and Physiology Division, [2]Division of Aquaculture, ICAR-Central Institute of Fisheries Education, Versova, Mumbai, Maharashtra (400 061), India
[3]Dept. of Fish Processing Technology, KUFOS, Kerala (682 506), India

Open Access

Corresponding Author
Patekar Prakash
e-mail: patekarprakash476@gmail.com

Keywords
Aquaculture, Feed, Feed Attractant, Fish Protein Hydrolysate (FPH)

Article History
Received on: 06th January 2023
Revised on: 20th January 2023
Accepted on: 21st January 2023

E-mail: *bioticapublications@gmail.com*

Abstract

Fish are maintained at high densities in intensive farming, which may raise stress and contribute to disease susceptibility and economic losses. As a result, some of the objectives for sustainable aquaculture development include effective feeding techniques that incorporate health-promoting components such as proteins hydrolysates and bioactive peptides that can boost fish defense systems and achieve higher growth. Every year, the fish processing industries create and discard a considerable volume of the trash, estimated to be up to 60% of collected biomass. With the addition of different proteolytic enzymes, this waste may be transformed into value-added products such as fish protein hydrolysate (FPH). FPH can enhance fish development, feed utilization, immune system function, and disease resistance when used moderate aquafeeds. FPH production offers superior functions that are highly desired and is aimed at more precise molecular weight ranges. The use of processing fish waste is also highlighted, as well as the potential limits of employing FPH and future research opportunities.

Introduction

The aquaculture industry is a fast-growing food-producing sector that ultimately relies on quality aquafeeds. For excellent quality feed, protein is the primary nutrient that has a direct influence on the growth and well-being of fish. Among the protein-rich feed ingredients, we still depend on fishmeal (FM) produced from wild-harvested fish. Conventional plant-based protein ingredients have a lot of difficulties in the production and utilization of finfish aquaculture due to imbalanced amino acid profiles and antinutritional factors (ANFs), which are present in the plant protein sources,which can affect the growth performance, feed utilization, digestibility, and overall health of the fishes.

Every year, the fish processing industries generate and discard a large volume of waste estimated at up to 60% of the harvested biomassworldwide. Waste from seafood processing industries may be over 60 percent by weight of byproducts, including skin, trimmings, viscera, fins, head, frames and roe. There is massive potential to use this protein-rich waste by converting them into valuable, bioavailable nutritional food products such as FPH (Fish Protein Hydrolysate).

FPH from fish processing waste, including skin, head, muscle, viscera, liver, and bones, is a good source of protein, amino acids, peptides, and antioxidants and has been found to possess desirable functional and bioactive peptides which can act as potential feed attractants.

Fish Protein Hydrolysate (FPH)

FPH, a fish waste rendered product, is available in liquid or powdered form and has a higher proportion of short peptides ranging from 2 to 20 amino acids. FPH has good physicochemical qualities such as enhanced solubility, emulsifying capabilities, foaming properties, water-holding capacity, and fat binding capacity, improving feed palatability and facilitating biological nutrient intake.

When eaten in vivo, FPH has demonstrated antioxidant, antihypertensive, antibacterial, immunomodulatory, and anticancer properties. Dietary inclusion of short-chain peptide-rich FPH at adequate levels has been proven to stimulate growth performance, nutritional utilization, antioxidant activity, and immunological response in fish especially for larvae and juveniles (Ospina-Salazar *et al.,* 2016).

Sources of FPH

Muscle, skin, fins, frames, head, dark muscle of fish, viscera, trimmings, and roe are examples of byproducts that are classed as fish waste and are not used for human use. FPH can occur due to such discards in both marine and freshwater species.

Production Methods of the FPH

The methods used to produce FPH, include:

1. Chemical hydrolysis (acid and alkaline hydrolysis) - low cost, rapid and results in a high protein recovery method.

2. Autolysis - Highly seasonal and age-specific, end products having inconsistent molecular profiles.

3. Bacterial fermentation - Proteolytic bacteria strains were used, and bacteria produce acid and antimicrobial factors, which inhibit competing bacteria.

4. Enzymatic hydrolysis - Proteolytic enzymes including alcalase, neutrase, papain, pepsin and trypsin, which are commonly used to produce FPH.

Among them, enzymatic hydrolysis and chemical hydrolysis are the most commonly used methods due to several advantages. In this article, the production process and the utility of FPH produced by enzymatic hydrolysis are summarized below.

Chemical Composition of FPH

Depending on the types and sources of raw material and hydrolysis protocol followed, the nutrient composition of FPH will vary accordingly.

Production Process

Fish Wastes Collected and Cleaned With Tap Water

↓

Mincing Homogenization, Substrate: Distilled water @ 2:1 (w/w)

↓

Maintain ApH OF 6-7: By using NaOH/ HCL

↓

HYDROLYZATION, Enzyme: Papain (1% w/w)
(@ 60 °C for 3 hours in shaking water bath)

↓

Deactivate Enzyme @ 90 °C for 10-15 min

↓

Centrifugation @ 3000 rpm for 15 min

↓

Layer Separation: Oil and sludge

↓

Freeze Drying/ Oven Drying (60 °C, 24 hr)
FISH PROTEIN HYDROLYSATE

↓

Scrap it and Grind it With Grinder to Get Powder

Role of FPH in Aquaculture Production

The possible positive effects of FPH supplementation in aquafeeds include enhanced feed intake and utilization, growth performance, and metabolic reactions which are discussed below.

Attractant in Fish Feed

Enzymatic hydrolysis during FPH generation may result in peptides of low molecular weight, which may operate as a fish attractant activating the gustatory and olfactory senses of the fish.

Palatability and Digestibility Enhancer

Feed palatability is frequently associated with the presence of small molecular weight peptides and free amino acids in the hydrolyzed protein, which may stimulate fish feed consumption.

The use of FPH in diets containing low molecular weight fractions promotes the nutrient digestibility of fish. The molecular form of protein in FPH could positively affect the assimilation of dietary protein (Bakke *et al.,* 2010).

Growth Performance

Many studies indicated the use of FPH at moderate levels (5-10% replacement of FM) to improve fish's growth performance. The improved growth performance isdue to the increased palatability of the feed (Refstie *et al.,* 2004) and the enhanced availability and subsequent uptake of free amino acids and suitable peptide fractions produced during the enzymatic process. FPH comprising free amino acids and appropriate peptides plays a vital function in fish health maintenance. However, fish fed with higher FPH (≥ 20%) diets have been reported to decrease growth performance.

Biochemical and Physiological Responses

FPH supplementation increases a variety of hematological and immunological markers in fish. Hematological measures are important physiological indicators for measuring fish overall health and nutritional condition. The presence of FPH in the diet improves the absorption of hydrolyzed protein and improves the overall health of fis. Lysozyme activity, complement components, active phagocytes, and antibody molecules such as immunoglobulins are all thought to be essential characteristics in fish immune defense. Lysozyme protects fish from viral, bacterial, and parasite illnesses, and a greater level of activity is detected in fish blood in response to infection (Puangkaew, 2004). Fish given FPH have been reported to boost innate immunity and disease resistance in response to particular conditions against viral, bacterial, and parasitic diseases (Chaklader *et al.,* 2020). FPH incorporation in fish diets may activate the fish immune system. The FPH is also showing very good proximatge profile as shown in table 1.

Table 1: Proximate composition of FPH

Proximate composition	Values (%)
Moisture content	03.03
Crude Protein	69.94
Crude lipid content	01.77
Total ash content	17.50

Limitations

Despite the numerous and promising applications of enzymatic FPH derived from seafood processing residues in aquaculture feed, some limitations include the following:

• Although animal by-products are regarded as a rich source of protein, their use in aquafeeds is still limited due to a variety of problems such as a lack of certain important amino acids, excessive moisture, indigestible particles, microbial contaminates, and the danger of transmission of disease.

• The enzymatic hydrolysis procedure generated high-yielding, highly pure FPH by small-scale operations; however, to improve FPH production and eliminate post-harvest discards, commercial, technological large-scale systems must be tried.

• Because of the variations in the raw materials from various fish processing industries, the end product quality also has variations in terms of nutritional profile and bioactive compounds.

• There is a massive gap *in vivo* studies about the FPH and their functionalities in aquafeed as functional feed additives.

• In the enzymatic hydrolysis process after the hydrolysis temperature was increased for inactivating the enzymes that may result in the destruction of some aminoacids and heat-labile compounds.

Conclusion

Because of its excellent functional properties like antioxidant, anti-hypertensive, antimicrobial, immunomodulatory, and anticancer activities, FPH has enormous potential in the aquaculture sector and pharmaceutical industry and food production sector. But the lack of *in vivo* studies on animal models and humans is the only constraint in the utilization of hydrolysates. Modifications in the production processes and the animal studies will bring massive scope for this product which is entirely produced from seafood waste.

References

Bakke, S., Jordal, A.E.O., Gómez-Requeni, P., Verri, T., Kousoulaki, K., Aksnes, A., Rønnestad, I., 2010. Dietary protein hydrolysates and free amino acids affect the spatial expression of peptide transporter PepT1 in the digestive tract of Atlantic cod (Gadus morhua). *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 156(1), 48-55. DOI: https://doi.org/10.1016/j.cbpb.2010.02.002.

Chaklader, M.R., Siddik, M.A., Fotedar, R., 2020. Total replacement of fishmeal with poultry byproduct meal affected the growth, muscle quality, histological structure, antioxidant capacity and immune response of juvenile barramundi, *Lates calcarifer*. *Plos One* 15(11), 20-79. DOI: https://doi.org/10.1371/journal.pone.0242079.

Ospina-Salazar, G.H., Ríos-Durán, M.G., Toledo-Cuevas, E.M., Martínez-Palacios, C.A., 2016. The effects of fish hydrolysate and soy protein isolate on the growth performance, body composition and digestibility of juvenile pike silverside, *Chirostomaestor*. *Animal Feed Science and Technology* 220, 168-179. DOI: https://doi.org/10.1016/j.anifeedsci.2016.08.011.

Puangkaew, J., 2004. Nonspecific immune response of Rainbow trout (*Oncorhynchus mykiss Walbaum*) in relation to the different status of vitamin E and highly unsaturated fatty acids. *Fish and Shellfish Immunology* 16, 25-39. DOI: https://doi.org/10.1016/s1050-4648(03)00028-7.

Refstie, S., Olli, J.J., Standal, H., 2004. Feed intake, growth, and protein utilisation by post-smolt Atlantic salmon (*Salmo salar*) in response to graded levels of fish protein hydrolysate in the diet. *Aquaculture* 239, 331-349. DOI: https://doi.org/10.1016/j.aquaculture.2004.06.015.