Fish Skin: A Valuable Raw Material for Developing High-Value Added Products

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Introduction

Seafood is considered an excellent source for proteins, essential fatty acids, vitamins, and minerals. Due to its health benefits, the consumption of seafood is globally increasing, which leads to an increase in global capture and culture fisheries production. The global fish production reached 185.4 million tons during 2023 (FAO, 2024). In order to meet consumer demand, the seafood is processed into different convenient food products by the seafood industry, which generates a huge amount of seafood processing discards. During fish processing, 30–40% are edible parts as fillets or chunks. Almost 60–70% are discarded as waste, which comprises skins, fish scales, stomach contents, bones, etc. Among these is fish skin, which accounts for around 8–10% of the total weight of the fish. These organic wastes aren't explored well. Hence, the conversion of fish skin into valuable products is more important to reduce the fish skin discards. Fish skin can be utilized as a raw material for the production of high-value added products such as collagen, gelatin, hydrolysate, collagen peptide, biodegradable film, leather, etc.

Compositional profile of fish skin

Fish skin is a rich source of beneficial proteins, lipids, vitamins and minerals. Proteins from fish skin is found to rich in essential and non-essential amino acids. The chemical constituents of fish skin contain 69.6% moisture, are water, 26.9% protein, 0.7% fat and 2.5% ash. The main minerals found in the fish skin are phosphorus (P), potassium (K), and calcium (Ca). It has been reported that the biochemical composition of fish skin may with respect to species, season, age, weight and environment conditions etc. (Muyonga et al. (2004) Abustam et al. (2018))

Value added products from fish skin

Collagen

Collagen is a fibrous and insoluble protein, representing about 30% of the total animal protein from vertebrates and invertebrates (Boran and Regenstein, 2010). Collagen is one of the major structural proteins present in skin. The major amino acid present in the collagen or gelatin includes glycine, proline and hydroxyproline. Glycine represents 30% of total Amino acids in the collagen. Moreover, proline and hydroxyl proline found to be 40-48% as close to collagen from mammals (45%). The collagen from fish skin categorized under type I collagen which finds biomedical applications. The commercial form of marine collagen available in the markets includes capsules, powder and syrups etc. The marine collagen also used as scaffold for tissue engineering, drug carriers and surgical sutures etc.

Gelatin

Gelatin can be prepared from skin, scale bone of fish by heating or acid/alkali treatment Fish gelatin is rich in protein and it also considered as an alternative of gelatin from animal sources such as beef or pork. The term "gelatin" originates from a Latin word "glare", which means frozen. Based on various processing methods, gelatin is divided into two types – type A and B. Type A gelatin is the most common type of gelatin made from fish. In comparison to an alkaline treatment, an acid one takes less time. It can be used as food additive, edible coating and film, encapsulating agent, thickening agent, and emulsifier in the food industries. Gelatin can also be used as a colloidal protector in the electroplating and photography industries for coating metal.

Collagen peptide

The collagen peptides are produced by hydrolysis of collagen or gelatin. During hydrolysis process, larger molecules of collagens are breakdown into smaller molecule in the range 1-5Kda. The hydrolyzed collagen enhances the absorption and bioavailability. The major aminoacids present in the collagen peptides includes histidine, methionine, cysteine, tyrosine and phenylanine. Collagen peptides find wide applications in dairy, bakery, confectionery and beverage products. It is often used as dietary supplements for skin and bone health.

Fish protein hydrolysate

Fish protein hydrolysate can be prepared from fish skin by acid/alkali hydrolysis or enzymatic hydrolysis. Fish protein hydrolysate will have mixture of amino acids and peptides of different molecular weight. The powder form of hydrolysate will have a protein content of 81-93% and less than 5% fat and 3-8%

moisture. It has been reported that protein hydrolysate or peptides in the fish protein hydrolysate found to have antioxidant, anticoagulation, antimicrobial, anticancer, ant obesity, antihypertension activities etc. (Elavarasan et al. 2016). Due to its various bioactive properties fish protein hydrolysate finds wide range applications in food, cosmetics, pharmaceuticals, nutraceuticals, aqua/pet feed Industry.

Biodegradable film

Biodegradable films have obtained attention because of their advantages over traditional synthetic films. The gelatin from fish processing discards can be used for making biodegradable film for food packaging. However. Fish gelatin has poor mechanical and barrier properties which needs improvement for packaging applications. It has been reported that composite fish gelatin films can be prepared by chitosan, montmorillonite, soy protein isolate, carboxy methyl cellulose and chitosan possessed to achieve favorable mechanical and barrier properties, making them natural biodegradable films (Jeya Shakila et al.,2012; Hu et al., 2020; Wang et al., 2021).

Fish collagen also can be used for active and intelligent packaging to improve the barrier properties of films and extend the shelf life of the product. Fish collagens has lower thermal stability due to presence of lower amount of imino acids. It has been reported that blend of collagen with other biopolymers, mainly chitosan and the addition of active compounds will provide the improved functional properties suitable for active packaging (Sommer et al., 2021).

Fish skin leather

Currently, the leather industry is fully dependent on animal sources for leather production. There is also necessity to find the alternative resources to meet the market demand and for the sustainability of leather Industry. Moreover, the expansion in aquaculture, for various species, has increased the availability of fish skin. Hence, the Fish skin will serve as alternative raw material for production of exotic Leather and it also reduces fish skin discards in to land. FAO also encourages the production of fish skin leather in order to support the fishing communities as a part of its blue growth initiative. Fish skin leather can be used for making consumer goods like hand bag, wallet, belt, footwear etc.

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