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Potential Uses of Fish: A Review

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ABSTRACT: In recent years, human beings are consuming more amount of fish. Globally for a year almost 91 million tons of fish is caught for human consumption. But only 60% is used and rest are thrown as waste. Instead of just throwing them, they can be used as a potential source for extracting many useful by-products. Even though several valuable compounds are present in fish processing discards, they are dumped into landfills or inside sea. Disposal of fish processing discards causes a major problem. These by-products act as an alternative raw material for the production of high protein ingredients mainly for the production of gelatin due to the presence of large amount of collagen in fish skins, scales and bones. Marine by-products are very reactive and will be degraded easily by microbial spoilage.

KEYWORDS: Fish scales, gelatin, collagen, fish oil, bioactive peptides.

I. INTRODUCTION

Every year a considerable amount fish catch is discarded as waste which includes trimmings, frames, fins, heads, skin and viscera. Recent studies have revealed that current disposal from the global fisheries exceed 20 million tons equivalent to 25% of total production of capture fisheries [FAOSTAT 2001]. The term by-products is generally defined as left overs and not as waste, which have to be treated before using them for industrial purpose

Nearly 40% of fish is thrown as waste which can be used for the extraction of various by products. In addition to fish processing, majority of fisheries by-products are employed to produce fish oil, fishmeal, fertilizer and also pet food. From the fish muscle it has been found to produce fish muscle protein like Collagen and Gelatin [Se- -Kwon Kim et al, 2006].

The processing of fish produced large amount of waste and it has been reported that the waste after filleting was only 75% of the fish weight whereas remaining 25% of the waste was bones and skins. Due to abundant sources of fish by-product, it is widely used in the production of various bioactive compounds. These bioactive compounds have found to possess nutraceutical potentials that are useful in improving human health [Defelice 1995].

By-products are highly perishable and hence enzymatic processes are important feature of consideration for the quality of the raw material. The important aspect to be considered is controlling autolysis of by-products. The quality and freshness limits the utilisation of by-products [Rustad 2003].

Fish bones and scales are most preferred because the high amino acid content will lead to the production of large quantity of bioactive compounds which mainly includes gelatin [Salamiah Zakaria et al., 2015]. The objective of this article is to summarize about the potential uses of fish and its by-products.

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II. FISH OIL

Better utilization of fish by-products can be achieved by converting them into fish oil. Generally fat content of fish is between 2-30% and it mainly depends upon the species and also the environmental conditions. Composition of fish oil is generally different from other oils due to the presence of two types of fatty acids which include eicosapentaenoic acid and docosahexaenoic acid. They are polyunsaturated fatty acids classified as omega 3 fatty acids [Se- -Kwon Kim et al, 2006].

Polyunsaturated fatty acids are readily digested for energy production and reported to have various bioactive activities when compared with saturated fatty acids. The methods and conditions employed for fish oil extraction is vital for the quality of fish oil [Hirata et al., 1993 & Se- -Kwon Kim et al, 2006]. Due to the presence of complex mixture of triacylglycerols, separation of fatty acids become complicated. Hence chromatographic techniques and urea crystallization methods are combined for the successful separation of fatty acid [Hidajat Ching & Rao 1995].

III. FISH BONE

Fish bone is separated after the removal of muscle proteins which is another potential source for various health promoting components [Se- -Kwon Kim et al, 2006]. The organic component of fish bone is mainly made up of collagen. Hence it can be a potential source for the extraction of collagen and gelatin [Nagai & Suzuki 2000]. In contrast, if inorganic substances are to be considered then the fish bone is rich in calcium, phosphate and hydroxyapatite. Fish bone derived from processing of fish yields a large quantity of calcium.

To make it into an edible form the structure is further softened and incorporated into calcium fortified food. This can be done by hot water treatment and also by using hot acetic acid solutions. Due to the presence of inorganic substances it has a huge application in the field of biomedical [Se- -Kwon Kim et al, 2006]. Hydroxyapatite is generally derived from corals and fish bone. Hydroxyapatite is now been used as a bone graft material in medical and dental applications. Hydroxyapatite does not break under physiological conditions and it is also thermodynamically stable. At optimum pH it actively takes part in binding hence it has been opted for rapid bone repair after major trauma or surgery [Jensen et al., 1996].

IV. FISH ENZYMES FROM INTERNAL ORGANS

Fish internal organs are potential sources of enzymes which exhibit high catalytic activity at very low concentrations [Haard 1998]. Almost different variety of enzymes especially proteolytic enzymes like pepsin, trypsin, chymotrypsin and collagenases are extracted from fish viscera. Since the marine fishes have been adapted to live in various environmental conditions, the enzymes have the capacity to withstand both high and low temperature, high pressure and also less availability of nutrients. It has been also proved to have good characteristics and therefore it has a wide range of applications in food industries. Chitinases are another group of enzymes that can be produced from different parts of fish like digestive tract. This will help in promoting the recovery of chitin from the marine by-products [Se- -Kwon Kim et al, 2006].

Fishes from cold environment have been the most important topic in the last decade. These fishes are capable of producing proteolytic enzymes and these enzymes have found to be more catalytically active at low temperatures compared to proteolytic enzymes from mammals, thermophilic organisms and also plant sources [Gudbjarnason, 1999]. Fish enzymes have potential use as digestive enzymes in feeds for fish larvae.

V. FISH MUSCLE PEPTIDES

The mechanically deboned fish contains considerable amount of fish protein. They are rich in nutrients and can be easily digested due to well found amino acid composition [Venugopal et al, 1996]. Fish proteins obtained from processing of by-products can be hydrolysed enzymatically to recover protein biomass. Or else it is discarded as waste.

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Protein hydrosylates from by-products of different fish species have been studied for their nutritional and functional properties. Researchers have identified the possibility of obtaining the protein peptides [Benkajul et al, 1997]. The peptides present in enzymatically digested protein hydrosylates have shown to possess different physiochemical properties based on the molecular weight of the peptide fragments. The molecular weight of peptide fragments determine the biological activities. Hence different methods should be developed to separate peptide fragments based on their molecular weight [Rustad 2003]. An ultrafiltration membrane system equipped with the appropriate cut off is effective in separating protein peptides based on their molecular weight [Jeon et al, 2000].

There are various bioactive peptides among them Protamine is a basic peptide which contains more than 80% of arginine. Protamine is located or present in the testicles of more than 50 marine species. The characteristic feature of protamine is to prevent the growth of Bacillus spores. It is also employed as an antibacterial agent in food processing and food preservation [Rustad 2003, Amarowicz and Shahidi 1997].

VI. FISH SKIN COLLAGEN AND GELATIN

Fish skin waste is a potential source for extracting gelatin and collagen which are currently used in diverse fields like food, pharmaceuticals and also in photographic films. The demand for collagen and gelatin is considerably increasing worldwide. Collagen is the main component of the fish skin [Norland 1989]. Collagen in its purest form along with hydrolysed form of collagen which is gelatin has wide range of applications like cosmetics, food and pharmaceuticals. Gelatin is a food additive which increases the texture of the food [Rustad 2003].

Gelatin and collagen can be derived from both fish skins and bones but it is less studied when compared with mammalian gelatin. The quality and specific use of collagen and gelatin is related to the functional properties and purity of the proteins. Due to the odour produced and the presence of pigments restrict the extraction of collagen and gelatin from the fish skin [Abdalbasit Adam Mariod et al.,]. The gelatin obtained from fish is not producing strong gels but it can be used for industrial applications like micro encapsulation, light sensitive coatings and low set time active ingredient. The non gelling gelatin can be potentially used in cosmetic industry for producing active ingredients i.e., for shampoo with protein [Rustad 2003]. Mammalian gelatin due to its religious constraints it cannot be used in food hence fish derived gelatin and collagen can act as food ingredient [Rustad 2003]. Collagen can also be used as a clarifying agent in alcoholic beverages [Maya Raman et al., 2018].

VII. FISH EGGS

Fish eggs resulted from fish processing can be easily processed into fish bait. There exists potential nutraceutical properties in fish eggs because they are rich sources of lectins. Lectins are naturally occurring glycoproteins which has the capacity to bind with carbohydrates and can form stable complexes. Due to this, it can be used as an alternate for antibiotics to make pathogens incapable of causing disease. [Se- -Kwon Kim et al, 2006]. Reproductive resources like egg, sperm have found to be rich sources of lectin because of its role in fertilization. Recent research has concluded that lectin derived from fish eggs has nutraceutical benefits and various methods can be developed to extract those nutraceutically active compounds [Bazil&Entilcher, 1999].

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VIII. CONCLUSION

Fish is one of the majorly consumed foods all over the world. A huge amount of fish catch is getting waste every year which is thrown or dumped in landfills and results in land pollution. Instead of causing land pollution, fishes can be processed using various techniques to obtain potential bioactive compounds which has various industrial and

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commercial applications. These bioactive compounds are also a rich source of nutraceuticals. So far only limited research have been done to isolate bioactive compounds from different waste products. Still more researches are being carried out to find many more bioactive compounds which can be used for commercial purposes.

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REFERENCES

1. Rustad, T., "Utilization of marine by-products", *Electronic Journal of Environmental, Agricultural and Food Chemistry*, pp. 458-463, 2013.
2. Panayotis D. Karayannakidis, Anastasios Zotos, "Fish Processing By-Products as a potential source of Gelatin: A Review", *Journal of Aquatic Food Product Technology*, vol-25, pp. 65-92, 2016.
3. Se-Kwon Kim, Eresha Mendis, "Bioactive compounds from marine processing by-products- A review", *Food Research International*, pp. 383-393, 2006.
4. Karim A.A, Rajeev Bhat, "Fish Gelatin: properties, challenges, and prospects as an alternative to mammalian gelatins", *Food Hydrocolloids*, pp. 563-576, 2009.
5. Abdalbasit Adam Mariod, Hadia Fadol Adam, "Review: Gelatin, Source, Extraction and Industrial Applications", *Acta Sci. Pol., Technol. Aliment.*, pp. 135-147, 2013.
6. Nagai, T, Suzuki, "Isolation of collagen from fish waste material-Skin, bone and fins", *Food Chem*, pp. 277-281, 2000.
7. Salamiah Zakaria, Nurul Hidayah Abu Bakar, "Extraction and Characterization of Gelatin from Black Tilapia Scales and Bones", *ICASETNR*, pp. 27-28, 2015.
8. Muhammed Arif Hossain et al., "Amino Acid Profile of the Gelatin Extracted from the scales of Catla, Rohu, Grass Carp And their Mixed Type", *Bangladesh J. Zool.*, pp. 185-195, 2016.
9. Venugopal V, Chawla S.P, "Spray dried protein powder from threadfin beam: Preparation, Properties and comparison with FPC type B", *Journal of Muscle Foods*, pp. 55-58, 1996.
10. Benkajul S, Morrissey M.T, "Protein hydrolysates from Pacific whiting solid wastes", *Journal of Agricultural and Food Chemistry*, pp. 3423-3430, 1997.
11. Norland P.E, "Fish gelatine: In Advances in Fisheries technology and Biotechnology for increased Profitability", *Technomic Publishing Co. Inc.* pp. 325-333, 1989.
12. Defelice S.L, "The nutritional revolution: Its impact on food industry R&D", *Trends in Food Science and Technology*, pp. 59-61, 1995.
13. Hidajat, K, Ching C.B, Rao M.S, "Preparative scale liquid chromatographic separation of omega 3 fatty acids from fish oil sources", *Journal of Chromatography*, pp. 215-221, 1993.
14. Hirata H, Saeki H, Nonaka M, Kawaski K, Ooizumi T, & Motoe k, "Recovery of fish oil from the manufacturing process of highly nutritional fish meat for foodstuffs and sardine", *Nippon Suisan Gakkaishi*, pp.111-116, 1993.
15. Jensen S.S, Aaboe M, Pinhold E.M, Hjrting-Hansen Z, Melsen F, & Ruyter I.E, "Tissue reaction and material characteristics of four bone substitutes", *International Journal of Oral & Maxillofacial Implants*, pp. 55-66, 1996.
16. Haard N.F, "Speciality enzymes from marine organisms", *Food Technology*, pp. 64-67, 1998.
17. Jeon Y.J, Byun H.G, Kim S.K, "Improvement of Functional properties of cod frame protein hydrolysates using ultrafiltration membranes", *Process Biochemistry*, pp. 471-478, 2000.
18. Gudbjarnason S, "Bioactive marine natural products", *RitFiskideildar*, pp. 107-110, 1999.
19. Bazil V, & Entilcher G, "Complexity of lectins from the hard roe of perch", *International Journal of Biochemistry and Cell Biology*, pp. 431-442, 1999.
20. Amarowicz R, Shahidi F, *Food Chemistry*, pp. 355-359, 1997.
21. Maya Raman, Gopalkumar K, "Fish collagen and its applications in food and pharmaceutical industry: A review", *EC Nutrition*, pp. 752-767, 2018.