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**More Aditi**

College of Fisheries Science,  
JAU, Gujarat, India

**Likhar Varsha**

College of Fisheries Science,  
JAU, Gujarat, India

## Fish processing: Product and by-product, processing and marketing

**More Aditi and Likhar Varsha**

### Abstract

Fish is one of the protein foods that needs careful handling. This is because fish spoils easily after capture due to the high tropical temperature which accelerates the activities of bacteria, enzymes and chemical oxidation of fat in the fish. To avoid this processing of fish need to be carried immediately after its catch. The purpose of processing and preserving fish is to get fish to an ultimate consumer in good, usable condition. Value addition is the most talked about word in the industry, particularly in fish processing industry, mainly because of the increased opportunities, the activity presents for earning foreign exchange. Besides, value addition is one of the possible approaches to raise the profitability of fish processing industry, which now lays greater emphasis on quality assurance. A large number of value added and diversified fish products both for export and internal market based on shrimp, lobster, squid, Cuttle-fish, bivalves, farmed fish and minced meat from low priced fish have been identified and discussed in the review. A basic description of a few of the value added fish and fishery products has been discussed. Other than fish products several fish by-products are also discussed. Some material of fish and shrimp are discarded during preservation and processing of it. Similarly some trash and distasteful fishes are unsuitable for human consumption. These waste material and above fishes become an important source to produce fish by-products, which in turn are used to produce different useful fish by-products. Furthermore, processing and marketing of these products and by-products is important to increase its export. Also fishery products are essential component in dietary composition, therefore it's processing and marketing is important.

**Keywords:** Fish, processing, preservation, products, by-products, marketing, value addition

### 1. Introduction

Value addition is the most talked about word in the industry, particularly in fish processing industry, mainly because of the increase opportunities the activity presents for earning foreign exchange. Besides, value addition is one of the possible approaches to raise the profitability of fish processing industry, which now lays greater emphasis on quality assurance. There appears to be a good potential for India to increase its share in international fish trade by exporting value added fish products. A large number of value added and diversified fish products both for export and internal market based on shrimp, lobster, squid, cuttle-fish, bivalves, farmed fish and minced meat from low priced fish have been identified. The technology for their production is readily available. After value addition, waste of fish and the trash fish which are not used for human consumption are used for by-product preparation. A brief description of a few such products and by-products and related process of producing them is given hereunder.

### 2. Fish products

- 1. Individual quick freezing (IQF):** Some of the IQF products in demand are shrimp/prawn, whole cooked lobster, lobster tails, lobster meat, cuttlefish fillets, squid tubes, squid rings, boiled clam meat and skinless and boneless fillets of white lean fish etc. so far as shrimp is concerned, it is particularly in demand in different forms such as whole, peeled and de-veined, cooked, headless shell-on, butterfly, fan tail and round tail-on.
- 2. Accelerated freeze dried products:** Accelerated freeze-drying is now being increasingly used for the preservation of high value food products. In this process the product in frozen condition is subjected to very high vacuum causing the ice crystals to sublime. The product has the advantages like absence of shrinkage, quick re- hydration up to 95%, minimum heat induced damage etc. In India this technique is now applied for processing shrimp, squid

**Corresponding Author:**

**More Aditi**

College of Fisheries Science,  
JAU, Gujarat, India

rings etc. the possibilities for various ready- to-eat products based on fish and shellfish employing this technique are immense.

3. **Heat processed products:** The product mixes up in the heat-processed category of seafood includes several 'convenience' ready-to-serve products such as fish curry, fish-in-rice etc. these products can conveniently be processed in retort pouches using an over pressure autoclave. Because of the smaller cross-sectional profile of retort pouches such products need to be maintained only for a shorter time in the retort and hence temperature induced changes on the quality parameters of the product will be minimum.
4. **Coated products:** The most prominent among the group of value added products is the battered and breaded products processed out of a variety of fish and shellfish. Battered and breaded products offer a 'convenience' food, valued widely by the consumer. These are products which receive a coat or two each of a batter followed by coating with bread crumbs, thus increasing the bulk and reducing the cost element. A variety of battered and breaded products can be prepared from shrimp, squid, clams, fish fillets, minced meat from low cost fish etc.
5. **Fish Mince and Mince based Products:** Minced meat is the meat separated from fish in comminute form free of bones, skin etc. in principle, meat separation process can be applied to any species of fish, but when it is applied to low cost fishes significant value addition will accrue. Flesh can be separated from filleting waste also. Minced meat can be used as a base material for the preparation of a number of products of good demand. The properties of minced meat, to a large extent, are determined by the nature and quality of raw material. Meat-bone separators (meat picking machines) are generally used for the preparation of minced meat. Minced fish can be used for the preparation of a number of products like fish sausage, cakes, cutlets, patties, balls, pastes, surimi, texturized products etc
6. **Kneaded Products:** Several kneaded products like kamaboko, chikuwa, hampen, fish ham and sausage are processed using surimi and incorporating other ingredients. The ingredients used in most of these preparations are identical; however, the classification is principally based on the manufacturing process involved.
7. **Fibreized products:** Fibreized products are the greatest in demand among the surimi based imitation shellfish products. The ingredients used in the formulation of fibreized products include, besides surimi, salt, starch, egg white, shellfish flavor, flavor enhancers and water. All the ingredients are thoroughly mixed and are ground to a paste. The paste is extruded in sheet form on the conveyor belt and is heat treated using gas and steam for partial setting. A strip cutter subdivides the cooked sheet into strings and is passed through a rope corner. The final product is formed by steam cooking of the coloured and shaped material.
8. **Frozen fish fillets:** Skinless and skin-on fillets from lean/medium fat white meat fish have enormous market potential. Many varieties of deep sea fishes such as grouper, red snapper, reef-cod, breams and jewfish are suitable for making fillets both for domestic market and for export to developed countries in block frozen and IQF forms. In the importing countries, these fillets are mainly used for conversion into coated products. Fish fillets can

also be used for the production of ready-to-serve value added products such as fish in sauce and fish salads

9. **Chilled fish:** Chilled fish is another important value added item of international trade. The most prominent among this group is sashimi grade tuna. Sashimi is a Japanese term for raw fish fillets mainly from tuna and it is a traditional delicacy in Japan. Three species, blue fin, big eye and yellow fin are mainly used for this purpose. The best quality sashimi tuna is that which is chilled at all stages from capture to final consumption. Other important products of this group are pomfret, shrimp, lobster and crabmeat.
  10. **Stretched shrimp (Nobashi):** Increasing the length of peeled and deveined shrimp and minimizing its curling by making parallel cuttings at the bottom, and applying pressure using simple mechanical devices is a new technology adopted by the seafood processing industry in recent years.
  11. **Barbecue:** Shrimp is washed in chilled water containing 5 ppm chlorine, beheaded, deveined, peeled and again washed in chilled water. Bamboo stick is then pierced into the meat from head portion to tail. It is then packed in thermoformed trays under vacuum and frozen at -40 °C.
  12. **Sushi (cooked butterfly shrimp):** Shrimp is washed in chilled water containing 5 ppm chlorine, beheaded, deveined and again washed in chilled water. Bamboo stick is then pierced between the shell and the meat from head portion to tail and then cooked in 1% brine for 2 minutes at 100 °C. The cooked shrimp is then cooled in chilled water, bamboo stick removed and then peeled completely, including the tail fans. The ventral side is then gently cut down length wise completely using a sharp scalpel. The cut surface is then gently opened up to form the butterfly shape, packed in thermoformed trays under vacuum and frozen at -40 °C.
  13. **Skewered shrimp:** The process is similar to that of barbecue, but piercing of shrimp is carried out in such a way that 4-5 shrimps are arranged in a skewer in an inverted "U" shape. It is then packed in thermoformed trays under vacuum and frozen at -40 °C.
  14. **Shrimp head-On (Central Peeled):** Shrimp is washed in chilled water containing 5 ppm chlorine, peeled at the centre keeping the head and the last two segments intact, deveined, and the tail is trimmed. It is again washed in chilled water, packed in thermoformed trays under vacuum and frozen at -40 °C.
  15. **Shrimp head-on cooked (Centre Peeled):** Shrimp is washed in chilled water containing 5 ppm chlorine, deveined and then cooked in 1% brine for two minutes at 100 °C. It is immediately cooled in chilled water and peeled keeping the head and the last two segments intact. The tail is trimmed and again washed in chilled water. It is then packed in thermoformed trays under vacuum and frozen at -40 °C
3. **Fish by-products**
    1. **Gelatine:** Gelatine is a protein that lacks in an essential amino acid tryptophan, and hence cannot be considered as a sole source of protein in animal or human nutrition. But it is a relatively high source of lysine and methionine, which are deficient in cereal proteins. However, gelatine finds extensive use in food as also in the formulation of some industrial products. Gelatine can be extracted from the skin and bones of fish. Gelatine is used in the food

- industry as a gelling, stabilising, emulsifying, dispersing or thickening agent.
2. **Insulin:** Insulin is a hormone used for correcting the condition called diabetes mellitus in humans. Fish insulin is more stable as it is not subjected to decomposition by protein splitting enzymes of pancreas.
  3. **Fish Albumin:** Fish albumin is a product similar to egg albumin in physical and chemical properties. It can be processed out of proteinaceous residue from fish scrap or fish waste. Two grades of fish albumin are produced, the technical grade and the food and pharmaceutical grade. Fish albumin is widely used in food and pharmaceutical products as whipping, suspending or stabilizing agent. Food grade albumin is an additive in ice cream, soup powder, puddings, confectionery, bakery products, mayonnaise, custard powder etc.
  4. **Fish Protein Concentrate:** Fish protein concentrate (FPC) is a stable protein concentrate prepared from whole fish or other aquatic animals or parts thereof. Protein concentration is increased by removal of water, oil, bones and other materials.
  5. **Squalene:** Squalene is an unsaturated hydrocarbon found in the unsaponifiable fraction of fish oils, especially of certain species of sharks. Liver oil containing high proportion of Squalene is distilled in a stainless steel glass lined vessel under a vacuum of 2 mm bar. Fraction distilled between 240 and 245°C is collected. All operations are to be carried out preferably in an inert atmosphere, as Squalene is easily oxidisable. Squalene is widely used in pharmaceuticals and cosmetics.
  6. **Tuna eyes:** Tuna eyes are an item of commerce. The high demand for them is attributed particularly to their content of polyunsaturated fatty acids like decosahexaenoic acid. This fatty acid is valued for its medicinal properties in combating atherosclerotic and thrombotic problems of chronic heart patients. Extraction and preservation of eyes of tuna and its marketing stand good prospects.
  7. **Fish calcium:** Calcium powder processed from the backbone of tuna can be used to combat calcium deficiency in the diet of children. Calcium deficiency can lead to bone failure and spine curvature. The method of production of calcium mainly involves removing the gelatin from the crushed bones and pulverizing the remaining portion
  8. **Shark cartilage:** Shark cartilage assumes importance because of the presence of chondriotic sulphate, which is a mucopolysaccharide. Chondriotin sulphate has therapeutic uses and is effective in reducing cancer related tumours and inflammation, and pain associated with arthritis, psoriasis and enteritis. Oral intake of shark cartilage is reported to be effective in the above cases. The bones separated from the shark are cleaned for removing the adhering meat, blood stain etc. after washing well; the bones are preserved by drying at a temperature not exceeding 70°C to a moisture level below 6%
  9. **Chitin and Chitosan:** The body peelings from shrimp processing plants are a major and economical source of chitin. Lobster and crab shell waste also contain sizeable quantities of chitin. The shells are deproteinised with alkali and demineralised with dilute hydrochloric acid. The fibrous portion obtained after washing is chitin. Chitin can be deacetylated with caustic soda to give chitosan. The deacetylation is achieved by treatment of chitin with (40% W/W) aqueous potassium or sodium hydroxide at about 100°C. The production obtained is dried in hot air dryer to a temperature not exceeding 60°C. Chitosan finds extensive applications in many industries such as pharmaceuticals, textile, paper, water purification etc.
  10. **Fish maws/Isinglass:** Air bladders of hake, sturgeon and carp are the main sources of isinglass. In India it is obtained from air bladders of eel, catfish, carp etc. the dried bladders are softened by soaking in water for several hours. They are mechanically cut into small pieces and pressed between hollow iron rollers, converted into thin strips of 3-6 mm thickness and then dried. It is used mainly for clarifying beverages, as an adhesive base in confectionery products, glass pottery and leather and also as an edible luxury. Its exports are mainly confined, at present, to Hong Kong, Singapore and Germany
  11. **Shark fins/fin rays:** Shark fin soup is considered as a great delicacy in Singapore and Hong Kong and hence our exports of shark fins are confined to these countries. The commercial value of the fins depends on their colour, size, variety and quality. Depending on the quality and quantity of rays present in the fins they are broadly classified into two varieties, generally known as black and white. The white fins usually fetch a better price compared to black fins. Fins are generally marketed in dried form. The preparation of shark fin does not require any elaborate treatment, but care is needed in cutting, trimming and drying operations. The dried fins are further processed, for the 'rays'. The price of fin rays depends mainly on colour, length and thickness of the individual strands, quantity of connective tissue, cartilage present and physical appearance.
  12. **Fish Oil:** Fish oil is obtained as a by-product in the wet reduction process employed for fish meal production from oil sardine. Fish is boiled, oil that separates is skimmed off and the cooked fish is put in coir mat bag and pressed in country type vertical process. The mixture of oil and stick water is collected in large settling tank and allowed to settle for about 2 days when all the oil floats. The oil is then separated and heated to remove water from it.
  13. **Fish meal:** It is traditionally used as fish and livestock feed supplement. Fish meal has high quality protein containing high levels of lysine, methionine and cysteine, three of the essential amino acids. It is also a good source of B group of vitamins like cyanocobalamin (B12), choline, niacin, pantothenic acid and riboflavin.

#### 4. Processing and marketing

Recent developments in fish processing technology are oriented towards technology up-gradation, diversification and quality assurance. These have led, among others, to a great demand for seafood/seafood-based convenience products in ready-to-eat or ready-to-cook forms. There are several factors, which have influenced this demand. One is the increasing affluence and the consequential changes that have influenced the eating habits, particularly in the western countries, which have resulted in the demand for diversely processed value added convenience products based on fish. There is also an increasing trend of eating away from home and this has triggered the growth of fast food trade serving value added fish based products.

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approaches to raise the profitability of fish processing industry, which now lays greater emphasis on quality assurance.

It is axiomatic that the development of export market should have the backing and support of a strong domestic market. The rapid industrialization and the consequent urbanization of rural India provides ample scope for the development of such markets. Increasing number of working women, shrinking family size, education and general consciousness about hygiene and health are the other favourable factors.

## 5. Recommendation

- Realization of the importance of Fish processing and value addition in the mind-set of fish producers and farmers from Inland sector Through Training and demonstration.
- Establishment of pilot Fish processing plant with requisite infrastructural facilities at production centres of Fresh water fishes.
- Introduction of efficient transportation like refrigerated and insulated Trucks and wagons for rapid disposal of harvest to distant destinations of demand places.
- Introduction of efficient transportation like refrigerated and insulated Trucks and wagons for Strengthening of marketing infrastructure with development of new fish markets in the near and around areas of catchments.
- Avenues of finding viable markets at metropolitan and urban township of national importance.
- Framing of comprehensive policy for finding export opportunities of fresh water fishes internationally to generate foreign exchange earnings.

## 6. Conclusion

Marketing of value added products is completely different from the traditional seafood trade. It is dynamic, sensitive, complex and very expensive. Marketing surveys, packaging and advertising are a few of the very important areas, which ultimately determine the successful movement of the new product. Most of the market channels currently used is not suitable to trade value added production. A new and an appropriate channel would be the super market chain. Appearance, packaging and display are all important factors leading to successful marketing of any new value added product. The material and method of various value added fish products for both export and domestic market is discussed. The retail pack must be clean, crisp and clear and make the contents appear attractive to the consumer. The consumer must be given confidence to experiment with the new product launched in the market. Packaging requirements change with product form, target group, market area, species used and so on. The latest packaging must also keep abreast with the latest technology.

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