

Value Added Fish Products

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Introduction

Adding value to fishery resources is one of the most prominent approaches in fish processing. The process of value addition increases the market value of low value fish along with the creation of employment opportunities. Furthermore, the export of fish-based value added products is an attractive business for foreign earnings by extending the sale to global markets. The popularity of fish products in the domestic, as well as the international market, is on an increasing trend as there is a rising need for diets rich in protein to substitute high calorie foods. Value addition is a strategy to increase the pace with diversity in terms of market forms. The term value addition is defined as “any additional activity that changes the nature of the product which leads to an increase in price at the time of sale”. Value addition is the enhancement added to a product before it is offered to the customers. In other terms, value addition is a process through which a high price is realized for the same volume of the primary product utilizing any kind of processing, packing or upgradation of quality.

Value addition is a profitable strategy to enhance the consumption of fish for nutritional and health benefits. Fish is a superfood for humans because of its rich nutrient reserves such as high-quality protein content, n-3 polyunsaturated fatty acids (PUFAs), minerals, vitamins, and other trace elements. Considering the benefits, it provides it is recommended to consume fish at least two times per week as part of a healthy diet. To increase the popularity of value added fish products across the world, product diversification with international flavors including ethnic flavours are of great importance.

Ways of adding value

According to the market demand the existing products need to be modified over time to catch hold with the new customers and also to compete for the competition in business. The process is dynamic, sensitive, complex and very expensive. The value can be added by improving the market forms, developing convenience food and functional foods. A change in the appearance, display and packaging is also an important aspect for consideration. New product features are to be added to make the product more convenient. In addition, market surveys are to be conducted regularly to update and modify the existing product. Strong linkages to develop the marketing channel and proper advertisement are required to reach the customers. Innovative products with multiple formats or shapes or dimensions, flavours, texture profiles, and new packages will attract customers without any difficulty. The continuous invention, innovation and refinement is essential to stay in the business.

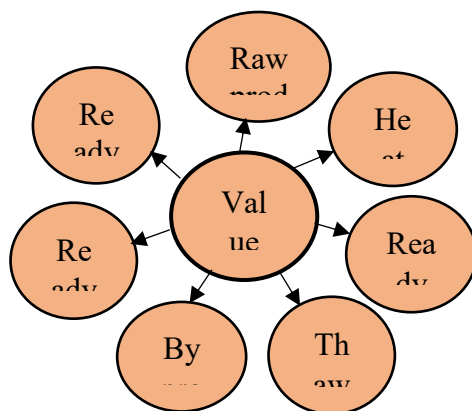
Why value addition is required?

- To increase the productivity

- To enhance the shelf life of the fish
- To improve the safety of the fish based products through processing
- To reduce the wastage and discard of the fishery resources especially the low value and low demand fish species in the market
- To enhance the profitable and judicious utilization of low valued fish
- To fulfil the consumers' demands for convenience foods with quality and longer shelf life
- To diversify the market forms
- To get a better income for the stakeholders
- To promote the nation's economic growth through domestic or international trade of different ready-to-eat or ready to cook or ready to serve products
- To create self-employment opportunities

As fish is a highly perishable commodity preservation by various means is of utmost importance to extend its shelf life. Preservation helps to keep the fresh fish edible for a longer period.

Categories of value added fish products



These products are gaining wide acceptance as modern customers prefer convenience products mostly ready-to-cook foods. Different categories of such value added products from fishery resources are discussed in this chapter.

Raw and processed fish in different product styles

Raw and processed fish are marketed in different appearances, shapes, dimensions, and formats for attracting customers and for increasing the convenience. Chilled and frozen fishes are available in a variety of such product styles in the modern market. Examples of such product styles of finfishes are cleaned whole fish, drawn fish (only the entrails removed), dressed or pan-dressed fish (fins, head, and tail removed), steaks, fillets, sticks, butterfly style (dorso-ventral cut), chunks, cubes, etc. A few examples of the product styles of shellfish include peeled & deveined shrimp, peeled, cooked & tail-on shrimp, headless shrimp, shrimp head on (centre peeled), shrimp head on cooked (centre peeled), barbecue shrimp (beheaded, deveined, peeled with a bamboo stick pierced into the meat from head to tail portion), sushi

(cooked butterfly shrimp), skewered shrimp (4-5 shrimps are arranged in a skewer in an inverted “U” shape), squid tubes, squid rings, live lobster, frozen lobster tails, whole lobster frozen or chilled, whole cooked and frozen lobster meat, whole or shucked molluscs, etc.

Chilled fish products

Chilled fish is an important value added product that dominates the market in terms of revenue. Prime quality chilled fish usually fetch a higher price than frozen fish. Chilling is a low-temperature preservation method in which fish is preserved using ice. It is the most common primary preservation method used for short-term preservation. In this method, the temperature is lowered to 1 to 4°C by packing the fish and ice in alternative layers in the ratio of 1:1 (1 Kg fish require 1 Kg ice). Lowering the temperature arrest the enzymatic and microbial changes taking place in fish thereby reducing the spoilage rate. Chilling should be done quickly as possible after the harvest of the fish to get high-quality end products. The most common type of ice used is flake ice or crushed block ice.

The shelf life of the fish stored in a chilled condition depends on the shape, size, fat content, and skin characteristics. Round, small fatty fishes with thin skin will spoil faster compared to large, flat, lean fishes with thick skin. Generally, lean fishes will have a shelf life of 12-16 days, fatty fishes 5-8 days, prawns 8-10 days, and cephalopods 4-8 days. The application of modern packaging techniques such as vacuum packaging, modified atmospheric packaging, and active packaging considerably increases the shelf life of chilled fish products. Chilled sashimi grade tuna from bluefin, bigeye, and yellowfin tuna is a major delicacy in the international market. Other than raw fish, chilled processed fish products like smoked and marinated fishes are also available in the market.

Frozen fish products

Frozen fish products are very popular in the trade. Freezing is a modern method intended for the long-term preservation of fish at low temperatures. It is considered as a gentle method as the organoleptic qualities of the properly stored frozen fish is as good as fresh fish. During the process of freezing the water in the fish is converted to ice unlike chilling. The ideal condition for fish to be frozen is -30°C for 2 hours. Further storage at cold storage (-18°C or below) is mandatory. Frozen fish fillets and steaks are popular in domestic markets whereas block frozen fish and individually quick frozen (IQF) fish play a major role in the international markets. In IQF technology, the fish is frozen individually in the highest quality possible. IQF Head on/Headless/Butterfly cooked/Blanched shrimp, IQF tray packed shrimp, IQF peeled tail-on cooked shrimp, IQF marinated shrimp, Skinless & boneless fish fillets, IQF cooked/blanched squid/cuttlefish, Stuffed squid IQF tray packed, IQF tray packed lobster meat, whole cooked lobster, lobster tails, lobster meat, squid tubes, squid rings, fan tail, round tail-on shrimp, stretched shrimp (Nobashi), skewered shrimp, boiled clam meat, etc. are few examples of frozen fish products popular in the market. The expected shelf life of frozen fish is 9 months to 2 years.

Traditional Fish Products

Traditional fish preservation methods are age-old practices used to preserve fish for long term storage. Mostly the methods are region-specific and are used to preserve the catch when available in glut. The methods include drying, salting, smoking, marination, and fermentation. These methods are altogether known as curing methods. All these traditional fish preservation techniques follow centuries-old indigenous knowledge of fish processing. The customer demand for ethnic flavors and cuisines is ever-increasing due to market expansion, globalization and hence they are upgraded as specialty food products. The important ethnic fish products are as follows:

Dry fish products

Dried fish with or without salt is popular in domestic markets as well as in overseas markets. The method of drying is one of the widely used fish preservation techniques in which the moisture content in fish is removed by evaporation to arrest the spoilage caused by the activities of microorganisms and enzymes. This is one of the oldest and cheapest method employed for preservation. Fish drying can be done by natural and artificial means. Natural drying or sun drying is the process in which fishes are dried under sunlight. Here solar energy is used to evaporate the water in fish. In artificial drying, the fish is dried mechanically in an enclosed atmosphere under controlled conditions, unlike natural drying where we have no control over the environmental condition. Drying under controlled condition is known as dehydration. The ideal temperature for fish drying is 44-55°C. There is high demand for spiced and dried products, flavour-incorporated products, coated and dried products in the modern market. Entrepreneurs are attracted to this business as it is highly profitable that requires less sophisticated machinery and storage facilities. The dried products can be stored in dry conditions at ambient temperature for a minimum of six months if properly dried and packed.

Salted fish products

Salting is a method in which common salt (sodium chloride) is used to preserve the fish. It is practiced as such or in combination with drying or smoking. The penetration of salt into the fish tissue removes the water inside, thus reducing the water activity which will help to inhibit spoilage by bacteria. Along with this, enzymes also get inactivated which further delays the spoilage. Generally, small-sized fishes are salted directly without removing the head, fins, and entrails, unlike large and medium-sized fishes. For attaining proper salting and drying, the fish can be cut into butterfly-style, small pieces or scoring can be done to increase the surface area. Layer salting is preferred for medium and large-sized fishes whereas small-sized fishes can be salted by dip treatment for uniform penetration of salt through flesh. Fish to the salt ratio for layer salting is in the range of 2:1 to 10:1 for big to small-sized fishes. Dip treatment can be done for 5-10 min in a 5% brine solution.

Smoked fish products

Smoked fishes are known for their unique aroma, texture and golden yellow colour imparted by wood smoke. The method of smoking is popular, especially in the Northeastern states of India. This method combines salting, drying, and preservation by smoke components

produced during the thermal breakdown of wood by smouldering. Charring of the wood is not preferred while the smoking process. In the smoked products, the characteristic colour and flavour are imparted by the phenolic compounds present in the wood smoke. Heavily salted fishes were used to smoke for a longer period to get 'Hard cures'. Smoking of fish is usually done as an intermediate step in fish canning also.

There are two type of smoked products available, cold smoked and hot smoked products. Cold smoked products are usually made in traditional chimney kilns by smoking the fish for 36-72 hours at a temperature maximum of 40°C. The fish is smoked and dried at 75°C -80° C in case of hot smoking, unlike cold smoking this high temperature gives cooking partial sterilization effect on fish flesh. More conveniently, commercially available liquid smokes can be used to impart the aroma to fish products. Masmin of Lakshadweep is a very popular smoked fish product.

Marinated fish products

The value of fresh, frozen, salted, and dried fish can be increased by the process of marinating it with spices, sugar solutions, oil, plant extracts, acids, wine etc. to enhance the flavour, tenderness and juiciness. In addition, the process also helps to extend the shelf life of fish. These products are attracting customers because of their typical flavour and textural properties. Traditionally, acetic acid and salt were used for the marination process.

Marinades are semi-preserves, in which acetic acid inhibits microorganisms, giving characteristics of succulence and tenderness. The addition of acid will favour the action of proteolytic enzymes and the partial breakdown of protein into amino acids. The addition of salt aids in the extraction of salt out from the fish tissues and helps in the coagulation of protein. The addition of plant extracts, spices, sauce, cream, oil, mayonnaise, etc. can increase the flavour and shelf life of marinades further. There are three types of marinades. Cold marinades or 'marinade proper', as the name indicates the process does not involve any heat treatment of fish or ingredients used. The product is having a shelf life of several months at chill storage. Cooked marinades or 'jellied products' are generally packed in a jelly. Here acid-salt treated fish is further heat treated for better preservation. Low pH is maintained to avoid harmful bacteria, especially *Clostridium botulinum*. The shelf life of such products is 6 months. In the case of fried marinades, the pre-treated fish with acid and salt is baked or broiled in oil with or without breading. Then this can be immersed in acetic acid or sauce. Higher temperature inhibits the growth of most bacteria. The shelf life can be up to one year if properly stored at 0-8°C.

Fermented fish products

Fermented fish products are mainly popular in the north-eastern states of India. They are upgraded as speciality fish products because of their unique aroma usually described as umami. Fermented products have a meaty flavour and they are rich in nutrients. The process of fermentation is an age-old practice of fish preservation in which complex protein molecules in the fish are broken down into simpler molecules by the action of organic catalysts, enzymes,

or ferments which are stable at normal temperatures of storage. The method is suitable for both freshwater and marine fishes. Fermented products are of three distinct types, products in which fish retains its original form eg. cured fish, products in the form of a paste, and products in the form of liquid that is fish sauce. Seedhal, Ngari, Hentak, Lona ilish, etc. are examples of fermented fish products from India.

Fish pickle

Fish pickle is a widely accepted ethnic product commercially and a common product in households. Pickling is also a curing method in which edible products are preserved through anaerobic fermentation in brine or immersion in acid with spices. People relish this spicy adjunct with sour flavour as a food accompaniment to make the food palatable and appetizing. Vinegar is the preservative and flavouring agent used in fish pickles. Acetic acid aids in preservation by restricting the growth of spoiling microorganisms. Vinegar pickles are known as fresh pickles or quick pickles. The added salt in the pickle can actually add flavour to it, helps in extracting the excess water from fish, unlocking the flavourful juices, concentrating the juices, and ultimately gives a firm texture to the fish meat. The oil content in the pickle seals off the air from the pickle which helps to enhance the shelf life. The flavour can be improved by adding seasonings. The process of pickling enhances the shelf life to six months and more. Any fleshy fish can be used for preparing fish pickles like tuna and seer fish. It is important to maintain the pH of fish pickles below 4.5 to reduce microbial activity.

Mince based products

Mince is the edible fish meat that is separated from the inedible portions like the scale, skin, fins, and bones. It can be prepared by manual hand picking or by mechanical deboning technique. The fish mince serves as an intermediate stage for the preparation of a variety of value-added products. The fish mince devoid of inedible portions is consumer friendly in usage. Low value fishes with white meat are mainly preferred for the preparation to increase the utilization and demand of such resources by adding value to them. Fish mince-based products available in the market include fish sausage, fish sandwich spread, fish wafers/crackers, fish cookies, momos, papad, spring roll, samosa, fish flakes, fish spirals, etc.

Extruded products

There is a greater demand for snacks and ready to prepare products in the market. The process of extrusion is one of the popular methods of processing wherein soft mixed ingredients are forced through a perforated die designed to produce products of the required shape, size, and texture. In the process, small granular food or powdered particles are reinforced into large pieces. The process of Extrusion cooking or thermoplastic extrusion is considered as a High-Temperature, Short-Time (HTST) process, used mainly for developing cereal-based products rich in calories. The nutritional value of such products can be further increased by the addition of protein rich fish. During the process material fed into the extruder gets compacted, softens, gelatinized, and/or melts to form a plasticized material. The combined effect of high

temperature and mechanical shear causes the gelatinization of starch and denaturation of protein. The technology is used to develop pasta, crackers, baby food, snack foods, dried soups, dry beverage mixes, etc. The utilization of low-value fishes can be enhanced through this technology to develop products stable at ambient temperature like fish kure.

Battered and Breaded Products

Battered and breaded products are convenient products of greater demand in which the meat protein component is covered by a cereal-based coating. These products are also called as enrobed products or coated products as one food material is coated with another stuff. A coating is referred to as the batter and/or breading adhering to food after cooking. The external coating forms a stable crispy layer retaining most of the sensory and nutritional quality of the fish product. Coating by battering and breading enhances the appearance, colour, flavour, texture, and nutritional value of the product. It also acts as a moisture barrier by minimizing moisture loss during frozen storage and microwave reheating. It seals the flavour in the product by acting as a sealant that prevents natural juices from flowing out. Wet coatings are referred to as a batter. The batter is made from wheat flour or corn flour. Coating ingredients generally include polysaccharides, proteins, fats and hydrogenated oil, seasonings and water. A typical ratio of the batter mix to water is 1:2. There are three types of batter. Adhesion batters are mainly starch based that designed to adhere to the product whereas cohesion batters are mainly flour based which forms a shell around the product. Tempura batter is starch/flour based with a raising agent (sodium bicarbonate) for a puffy appearance, usually not followed by breading. A wide variety of bread crumbs are also available in the market like reclaimed and industrial bread crumbs. Deep fried coated products are ready to eat products, it can be par-fried/flash fried for storage (30second at 190°C) to cement the breading. The shelf life of stored products under frozen storage is 9-24 months.

Fish finger, cutlets, balls, nuggets, coated shrimp, coated squid rings, coated bivalve products, coated fish fillets etc. are the most commonly available form of battered and breaded products. Coated Nobashi is a high value specialty product made from shrimp, literally means stretched shrimp. Nobashi is peeled, deveined tail on shrimp stretched by mechanical means. The length can be increased by about 1-2 cm depending on the size of the shrimp by making parallel cuttings at the bottom and applying pressure using simple mechanical devices. During the coating process, the product will have more pick up due to increased surface area and attract customers because of the aesthetic appearance.

Surimi based products

Surimi is a Japanese term for water washed fish mince. The fish mince devoid of any pigments or blood stains has excellent keeping quality with the added cryoprotectants. It is defined as mechanically deboned fish mince from white fleshed fish that has been washed, refined, and mixed with cryoprotectants for better frozen shelf life. The washed mince will be white and have a unique texture that often provides a viscoelastic nature to the end product. Surimi-based products form an important dish in Japanese cuisine. Due to its high gel strength, it is

used as an intermediate product used for the preparation of a wide variety of value added products. Most commonly white fleshed fish with very less fat content is chosen for the product preparation.

Analogue products or “imitation products” or “fiberized products” and moulded products like fish ball form an important category under surimi-based products. These products are prepared to mimic the texture, flavor, and appearance of shrimp, crab or scallops even when they are prepared from the commonly available fish from the market. This involves the use of sophisticated technology for preparation and has not gained much popularity in the Indian market. Surimi-based products are popular in developed countries. Kamaboko is a traditional Japanese product prepared from surimi. It is a steamed cake made out of surimi. This product is known by different names according to the regions of production, ingredients used, cooking method, and shape of the product. Chikuwa is broiled kamaboko in the shape of bamboo. Steamed Kamaboko is called Sumaki or Mushiita. Fried kamaboko is called Tenpura or Satsuma Age. Hampen is boiled kamaboko in a square shape.

Thermally processed fish products

The growing popularity of safe packed seafood with enhanced shelf life has fueled the demand for canned fish globally. Canned fish products are ready to eat products. The process of canning or retorting is high temperature long term preservation method in which the food is preserved by the application of heat in a hermetically sealed container to obtain commercial sterility. The filling medium usually used in cans is oil or light brine. The double sealed robust cans maintain sterility throughout the storage period at ambient temperature. Canned tuna, herring, mackerel, and sardines are popular in the markets. Instead of metal cans, now canned products are more common in retort pouches. 3-ply laminated flexible pouches consisting of polyester/aluminium/cast polypropylene are widely in use. Canned sardine in oil, tuna chunks in oil and brine, tuna flakes in oil, fish curry, etc. are a few examples of products available in the markets. The expected shelf life of canned fish is minimum of one to two years.

Accelerated freeze dried products

Accelerated freeze drying is a novel technology of food preservation in which water from the frozen product is removed by the process of sublimation under vacuum. The method is expensive and finds easy acceptance in the case of high value food products. Properly processed freeze dried products are comparable with the fresh material in case of flavor, color, and nutritive value as there will not be product shrinkage, case hardening, thermal degradation of proteins, deteriorative changes in color or flavor and products will get rehydrated rapidly. Further, freeze dried products can be stored under ambient storage conditions without any additional cost for storage and it is convenient to use. The reported shelf life of freeze dried products is more than two years. Instant fish soup mixes, prawn cakes, pre-cooked ready to serve salads are some products prepared using this technique having consumer acceptance. In India, freeze drying is employed for processing shrimp, squid rings, etc.

Live Fish

There is a greater demand for live fish for food purposes and it usually fetches a high price as the freshness is ensured in the marketing. Consumers often demand smaller and medium-sized fish in live form. Grouper, snapper, seabreams, seabass, red tilapia, reef fishes, air-breathing fishes, shrimps, lobster, crabs, clams, oysters, and mussels are examples of candidate fishes for live fish transport. The live fish trade of high-value fish is a lucrative business nowadays as it gives huge profits to the business. But the high rate of mortality of fish during transport is a big challenge in the trade. The ways to improve the survivability of fish are to be standardized for a continuous supply of fresh live fish to the consumers.

Speciality products from secondary raw materials

The term “fish wastes” in general indicates the non-edible portion of fish which includes the head, skin, bone, scale, visceral mass, and trimmings. Besides, fish species having mere or no market value, under-sized fishes as well as spoiled or physically damaged fishes will also be added to this category. By considering the potential for recycling, the term “fish wastes” has been replaced now as “rest raw material” and “secondary raw material”. These waste materials are having potential for recycling as they are good sources of high-quality protein, minerals, fat, etc. and thus they are important sources of different secondary products. The technology has a huge scope, as developed products can be used for human consumption, animal nutrition, and agricultural applications. Different secondary products such as fish meal, fish oil, squalene, collagen, gelatin, chitosan, hydroxyapatite, proteolytic enzymes, pigments, calcium, fish protein concentrate, etc. are of high value having wide acceptance market including the food industry.

Conclusion

The process of value addition has immense potential to uplift the livelihood of the stakeholders especially women by expanding the array of products available in the markets. There is an ever increasing demand for fish based products in the global markets. The modern market demands healthy, nutritious, and tasty convenient products to replace the high calorie food items from the diet. The flow of new entrepreneurs with novel value added seafood products all over the world makes the seafood processing and marketing sector more competitive every day. Value addition of the resources is needed for improving profitability, to empower the fish farmers and women stakeholders and to provide better quality, safe and branded products to the consumers.