

16. Development of value-added fish products

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During recent decades, several development plans have focused on the aquaculture and fisheries sectors. Convenience plays important role in fish and fishery product marketing. Clean, cut ready to cook or ready eat forms of fish is demanding more and consumers are willing to pay extra premiums on it. value-added fish products are usually perceived to be those that have added ingredients such as a coating or sauce, are prepared, trimmed or in some way provide more convenience to the user. Value is a combination of quality, service, and price. The basic benefits of value addition as far as food is concerned include the functional and emotional benefits related to quality and nutrition, convenience in preparation and high sensory appeal at a reasonable cost. The dual advantages namely, finding ways for better utilization of low-value fish species and providing protein-rich convenience foods, have been pointed out as the main outcome of value addition. Value can be added to fish and fishery products according to the requirements of different markets. A number of such diverse products have already invaded the western markets. These products range from live fish and shellfish to ready to serve convenience products. As far as fish processing industry is concerned value addition is one of the possible approaches to raise profitability since this industry is becoming highly competitive and increasingly expensive.

The changing consumer pattern has created opportunities for RTE fishery products and fortified foods with fish ingredients which require minimal preparation time. While battering and breading are the most common techniques, other processing methods include chilling, freezing, canning, frying, drying, extrusion, and fermentation. Even though landings from small-scale fisheries are scattered, small in volume, and mixed in terms of species caught, they can be prepared in innovative value-added forms for domestic and export markets. In the case of finfish, the major species of economic importance produced by the small-scale capture fisheries sector in significant volumes are skipjack tuna, yellowfin tuna, croaker, kingfish, ribbonfish, seabass and pomfret, plus a host of fishes caught by seine nets such as sardines, mackerels and anchovies. Skipjack and yellowfin have good potential for value addition. The present range of skipjack products could be further expanded to include improved smoked/dried forms such as katsuobushi and arabushi for the Japanese market, dried and smoked fish flakes, fish extracts and bouillon. With proper on-board handling, yellowfin tuna loins, steaks and sashimi could also be prepared by the smallscale sector for export. Pelagic fishes like sardines, mackerels and anchovies, caught by traditional fishermen using local gears, could be processed into different products for the local and export markets. Dressed and marinated mackerels and sardines have a potential market in the Middle East. If anchovies could be better handled on board, they could be boiled and dried, as there is a good market for the product in the coastal provinces and the Persian Gulf countries.

Being one of the fastest growing economies and the second largest consumer market in

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the world, India offers a strong platform for processed seafood industry. Fish and fish-based meals are popularizing all over the world due to health concerns. Product development can play a great role in this endeavour. The adequately skilled manpower pool and the upper-hands in several agri-commodities are added advantages to make strong market capture. The prevalent methods in global processed seafood market are segmented into salting, smoking, drying, canning, freezing, curing, dehydration, pickling and blanching, surimi processing etc. Minimal processing, souz-vide and irradiation technologies are certain high-end technologies, but limitedly adopted by the industry. Yet, most of our exports currently are in the frozen form. By doing so, we are not extracting full benefits from our aquatic resources (FAO, 2005). A value addition level of 23% is reported for seafood in India but not beyond the level of dressed fish (deveined/ blanched in the case of shrimp). The increased production of Vannamei shrimp, increased productivity of Black tiger shrimp and increased export of chilled items have helped to achieve higher exports. However, the bulk of the fishery products exported come under the category of frozen products. Value addition is the key word in the Indian context of industrial fish processing to ensure maximum returns through diversification. Hence new processes and protocols have to be developed and standardised for better utilization of fishery resources. Development of indigenous processing machinery is a felt need for cost effective value addition in fisheries sector. Value addition has opened a new field for the profitable utilization of by-catch and low value fish catches. In India even now, majority prefer fresh fish. However, there is an increasing trend in the utilization of value-added fish products as evidenced by their availability in modern super markets as well as malls which are becoming popular. Empowerment of women and formation of self-help groups also have led to the increased small-scale level production of value-added items in recent times.

Price, quality, convenience, year-round availability, variety, nutritional concerns, safety and hygiene are principal determinants of consumer demand on fish. Food habits and food consumption behaviour directly affects the consumer concerns on price and quality. World's biggest fish consumer, Japan concerns more on fresh produce and they fetch highest prices for freshest form of the fish. Raw fish is centred for their diet and in general, they used shop daily for fresh fish. On the other hand, western markets consume cooked forms and their concerns are more on quality and food safety. Weekend shopping behaviour is popular in Western destinations and places much attention on convenience. Quality standards add extra cost to the production process and quality requirements differ from market to market. i.e. European Union market based on EU directives food safety and sanitation, US market based on United States Food and Drug Administration (USFDA) requirements and Japanese market based on Food and Sanitation Law. Especially quality concern markets are willing to pay extra for the maintenance of quality standards.

value-added fishery products primarily fall under the following categories

- i) Speciality products
- ii) Mince or mince-based products
- iii) Battered and breaded or coated products



- iv) Surimi based products
- v) Ready to serve fish products in retortable pouch
- vi) Extruded products
- vii) Intermediate moisture products (IMF)
- viii) Pickled products

- **Speciality products**

The most popular products under this category includes

- ✓ Stretched shrimp (Nobashi)

Increasing the length of peeled and deveined shrimp and minimising its curling by making parallel cuttings at the bottom and applying pressure using simple mechanical devices is a new technique adopted by the seafood processing industry in recent years. Increasing the length by about 1-2 cms depending on the size of the shrimp is possible by this method. The stretched shrimp will have better appearance compared to conventional PD shrimp and it also fetches higher unit price. The stretched shrimp because of its increased surface area will have more pickup of coating during battering and breading and also good appearance.

- ✓ Sushi (Cooked butterfly shrimp)

Shrimp is washed in chilled water containing 5ppm 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 two 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 lengthwise 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.

- ✓ Skewered shrimp

The process is similar to that of barbecue, but piercing 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.

- ✓ 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.

- **Battered and breaded fish products**

Consumers are looking for better alternative for conventional fresh food that offers time-saving



preparation. Hence there exists an increased global demand for ready-to-heat frozen foods, especially breaded and battered products with high standards of quality. Battering and breading enhances the consumer satisfaction by improving the nutritional value, organoleptic characteristics and appearance of the products. The most important advantage of coating is value addition as it increases the bulk of the product. Also, this paves way for better utilisation of low cost or underutilised fishes. Coating is referred as the batter and/or breading adhering to a food product. Each ingredient in coating offers unique role in development of functionality and characteristics of the product. Polysaccharides, proteins, fat, seasonings and water are the commonly used ingredients. The method of product development differs with the type of product. The most popular battered and breaded products are fish nuggets, cutlet, balls, finger, patties etc.

- **Mince based products**

Fish mince separated from skin, bone and fins are comminuted and used for preparation of different products. Battered and breaded products like fish fingers, fish balls, cutlet etc. are produced. Fish cutlets fetch good demand in domestic markets while fish fingers are demanded in export market. Fish cutlets with partial replacement of fish meat with soy protein will increase the acceptability and storage stability of fish cutlets. A ready to eat novel battered and breaded snack product, 'Oyster pablano pepper fritter' have a good scope of attraction in value-added markets. Fish finger from Bombay duck adds on to the value addition potential of fish in our markets. Fish rolls with good shelf life can be developed from frame meat of fishes, eg: rohu. Fish sausage, ham and fish cakes are some other mince-based products.

- **Surimi and surimi-based products**

Surimi, term for the mince that are deboned and washed, also act as an intermediary in development of various products. It is one among the most consumed fish product. Low cost fishes can be conveniently used for the preparation of surimi. Block frozen surimi and surimi-based products are popular, especially in South east Asian countries. Shell fish analogue products from surimi fetches good demand in both domestic and export markets. The history of surimi in India starts in 1990's with the first surimi manufacturing plant was set up in 1994. The Indian company 'Gadre Marine' became the third largest manufacturer of surimi, exporting to 24 countries over the world. This shows the potential for production of surimi and surimi-based products in India. The demand of these products is less in domestic markets but is expanding nowadays. These healthy and simple products have great scope in Indian markets as people are moving towards different alternatives.

- **Ready to serve fish products in retortable pouch**

Ready to serve fish products viz. curry products, in retortable pouches are a recent innovation and are gaining popularity in the local market. The most common retortable pouch consists of a 3-ply laminated material. Generally, it is polyester/aluminium/cast polypropylene. These products have a shelf life of more than one year at room temperature. As there is increasing demand in National and International market for ready to serve products the retort pouch



technology will have a good future. The technology for retort pouch processing of several varieties of ready to serve fish and fish products has been standardised at ICAR-CIFT and this technology has been transferred successfully to entrepreneurs.

- **Extruded products**

Fish based extruded products have got very good marketing potential. Formulation of appropriate types of products using fish mince, starches etc., attractive packaging for the products and market studies are needed for the popularization of such products. However, technological studies involving use of indigenously available starches like cassava starch, potato starch, cornstarch and the associated problems need thorough investigation. Such products can command very high market potential particularly among the urban elites. The technology can be employed for profitable utilization of bycatch and low value fish besides providing ample generation of employment opportunities.

Opportunities in culture sector

The long coastline of the country along with large number of calm bays and lagoons offer good scope for the development of coastal farming. At present, coastal farming is largely restricted to mussel and oyster farming along the selected coastal belts. In view of the available potential that exists for brackish water aquaculture and mariculture, developmental measures are being initiated recently in large scale to make these activities significant contributors in seafood production. During the last couple of decades, brackish water aquaculture sector has witnessed overwhelming growth and is now almost synonymous with Pacific white shrimp (*L. vannamei*) culture. Captive breeding and rearing of Asian seabass (*Latescalcarifer*), pearlspot (*Etroplus suratensis*) and Nile tilapia (*Oreochromis niloticus*), Hilsa (*Tenualosa ilisha*) and captive broodstock development of grey mullet (*Mugil cephalus*), are yet another milestones in the brackish water farming. Lately, the intense research efforts from R&D Institutions have led to development of the base technology for the captive breeding and rearing of commercial finfishes including cobia, *Rachycentron canadum*, silver pompano (*Trachinotus blochii*) and orange spotted grouper (*Epinephelus coioides*), with which open sea farming has gained a huge mileage in the run towards blue economy. The results are highly encouraging for the coastal cage and pen culture trials initiated with cobia, seabass, silver pompano, groupers, red snapper, breams, Nile tilapia, lobsters and mud crab. Countries such as China, Vietnam, Thailand and Indonesia have gone far ahead in coastal farming while India is yet to make a mark. Mud crab is yet another sought after variety and fetches INR 1000 - INR 1400 per Kg in the world market. Canned crab meat, chilled pasteurised crab meat, crab cut, fresh whole cooked, frozen whole-cooked, frozen sections or clusters and frozen "snap and eat" legs are some of the crab-based products available in market. As all these resources have good export potential, the present scenario demands a promissive protocol for processing and value addition so as to identify them as money spinners in export market.

Value addition: future dimensions

Value addition is not widely attempted with farmed varieties, compared to the enormous



reports available on wild varieties. The concept of value addition in seafood sector covers the range of products from live fish and shellfish to ready-to-eat/serve convenience products. Being the largest producer of several agri-commodities, there are ample opportunities for value addition and product development, especially Ready To Eat/ Ready To Cook (RTE/RTC) products for the domestic as well as export market. Ethnic recipes of Indian taste like fish/shrimp pickle, fish/shrimp dishes of different cultural populations, marinated fish with Indian spices etc. offer attractive opportunities for seafood processors. However, these attractive elements are flattened by the poor infrastructure development and capital investment which considerably retarded the growth of processed seafood market of the country in the past years, both in domestic and export domain.

Surimi and surimi-based products are yet another least explored area of value addition in the country, in spite of having a number of lean varieties of candidate species globally identified for surimi manufacturing. Surimi, a wet concentrate of myofibrillar protein, is an intermediate product in the line of globally high demanded candidate products such as sausage, analogue products, and imitation products. Worldwide, there is a continuous search of raw material which is suitable for surimi production. Surimi production from farmed species shows promising potential for a variety of value-added products, and indirectly the better utilization of locally reared species. Furthermore, the utilisation of farmed varieties for surimi and surimi-based products will strengthen the link between increased production and resource utilization.

Thermal processing, though an investment intensive process, can fetch higher margins in export market. It is a process of great technological importance in many advanced countries. However, some species do not adapt to thermal processing as the flesh disintegrates under the severe thermal processing conditions. Thus, the consumer is accustomed to a limited variety of canned marine species such as tuna, crab, lobster and shrimp. Hence, a detailed investigation on the suitability of brackish or saline water raised emerging species for thermal processing is demanded which will further broaden the scope of value addition.

Over the years, consumer demand has been changed into more convenient on-the-go products, having superior nutritional value. In this line, a series of intermediate or low moisture foods such as nutritional bars, meat flakes, pasta, noodles etc, have invaded the supermarket shelves. The intermediate foods are foods having low water activity (0.7-0.9), which can be used with/without rehydration and are shelf stable for longer period without refrigeration. Many farmed species such as Nile Tilapia and Asian Seabass is said to have whiter, and tastier flesh, which is best suitable for the product development. The conversion of white meat to suitable convenient ready to eat products will pave a way for value addition to these species.

Although fermentation has traditionally been used to preserve fresh fish, especially in tropical climates, today it is used to enhance nutritive value, improve appearance and taste, destroy undesirable factors, and also to reduce the energy needed for cooking. However, it takes long duration to develop the characteristic features of fermentation. Similarly, smoking of fish is done primarily for the unique taste and flavour, however the texture of flesh may be affected during the smoking process. Hence, preparation of flavoured products with typical flavour extracts may be advised to reduce the process time and can be projected as a minimal



processing protocol with product diversification scope for chilled high value fishes like sea bass, cobia, pompano, and grouper. Also, this opens up value addition opportunities in terms of less intense flavour of cultured species owing to the difference in food chain followed in captive condition compared to the basic seaweed-based food pyramid in marine ecosystem.

Curing and drying, even though an age-old practice, opens up new dimensions and possibilities towards value addition in domestic as well as overseas markets. In India as per the estimates, about 17-20% of the total catch is converted to dried products and dry fish export contributes to about 7.86% of total fish exports. The major importing countries are Sri Lanka, Malaysia, Indonesia, Singapore and United Arab Emirates. However, there are several factors hindering the addition of dried fishery products to the product profile. The major one being, drying is still considered a traditional method of processing, and hence standard operating procedures are seldom followed. Moreover, there is a general conception that drying is a secondary method for preserving low value varieties and quality compromised materials. Attempts towards improving the handling practices right from the point of raw material harvesting till marketing, popularisation of improved packaging practices, use of hygienic energy efficient mechanical driers, and adequate extension services can facilitate better adoption of drying practice in seafood sector.

Marketing of value-added products

Marketing of value-added products is completely different from the traditional seafood trade. It is dynamic, sensitive, complex and very expensive. Market surveys, packaging and advertising are a few of the very important areas, which ultimately determine the successful movement of a new product. Most of the market channels currently used is not suitable to trade value-added products. A new appropriate channel would be the super market chains which want to procure directly from the source of supply. Appearance, packaging and display are all important factors leading to successful marketing of any new value-added product. 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 a 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.

Future perspectives

The current status of captive farming in Asia, especially in cages and pens, and the developments witnessed globally suggest that the farming of high value fishes such as seabass, mullet, pearlspot, silver pompano grouper, cobia and red snapper has a bright future. They have several desirable traits, most importantly a rapid growth rate under tropical climate and good flesh quality. Similarly, many of the molluscan candidates, in particular, mussels and oysters have captured wide popularity in recent years. As the top leading countries in aquaculture, the future production from China and India is likely to be a major factor in popularisation of these species for commercial processing operations. Countries such as Vietnam, Thailand and Indonesia have gone far ahead in coastal farming, while India is yet to make a mark, even though we are having a vast coastal line and all the favourable climatic advantages of a



tropical country. This increasingly demands viable processing, product diversification, value addition and live transportation options for channelizing the harvested resources to domestic and international markets, which is expected to make significant increase in the country's foreign currency earning. The immediate benefit expected through brackish water/saline water farming promotion is minimisation of the dependency on marine capture fisheries for raw material supply, which is already in a highly stagnated and more or less in a depleted status. A long-term benefit envisioned is to present a viable option for the minimisation of use of hazardous preservatives, as practiced nowadays for extending the holding time of raw material with vendors. In the case of capture fisheries, which relay on multiday fishing operations, the material is stored for more than a week before it reaches the landing centres. Unlike this, in culture fisheries the processor or the vendor is on a beneficial side that the harvest operations can be scheduled according to the market demand so as to get the material on-board at 'zero storage time'. This delivers them more retainable period, and in turn can refrain from the use of hazardous preservatives. ICAR-CIFT has initiated a three-year project on developing handling and processing protocols for emerging farmed fishery resources with emphasis on coastal enclosure systems. The project covers the various aspects on species specific on-farm handling protocols for brackishwater and mariculturespecies, novel value addition options and live transportation protocols.

Undoubtedly in long run, technology up-gradation will continue to remain as the key element in value addition domain, supported by minimal processing options for maximum nutritional retention, innovative ideas of packaging, intelligent systems for quality monitoring etc. High Pressure Processing, eventhough not increasingly invaded in seafood sector currently, is expected to gain fast pace in coming years as a non-thermal mean to extend shelf life. Out of box thinking and product development addressing niche markets is an important strategy for improving farm income. Transferring such technologies with a viable business model has the potential to start new industry and generate additional income to the farmers. Inevitably, a solid effort for encouraging value addition in seafood sector emphasises the primary requirement of appropriate mechanisation for reducing drudgeries, upgradation of capacity and efficiency for cold chain system, as well as development of intelligent and smart transportation techniques for increased shelf life. Moreover, parallel developments should be reflected in Government policies and investor friendly incentives, in order to make the industry globally competitive.

Different institutional contexts of end-markets are linked to different forms of coordination and control of global value chains. Economically and socially important species and value chains are differing widely across Asia. Networks both local and regional enhance the value addition, brand creation and brand strengthening,, technology enhancements, profitability and market access. Value chains of the most economically important species and destinations are need to develop vision on; learning, investment, market access, sales, and exports. Sooth functioning of value chains need to assure the favorable policy environment as well as good governance system. There is an important need to identify and support promising value chains with assistance at key point in the supply chain based on collaborative analysis of challenges, joint definition of priorities, and expert assistance from industry-experienced people. Take a cluster approach only as the starting point for value chains, not as an end in itself. All actors or



stakeholders of the value chains should concentrate on competitiveness and productivity and look for and exploit multiple ways to add value once initial success has been attained with a single deal. Ensure sustainability within the value chains are key important feature to cater for ever changing demands. An important need recognizes that some keys to success require mainly public sector intervention, others only private, and some a mixture of the two. Moreover, fisheries industry needs to seek private sector alliances at all stages of supply and value chains for better future.

Strengthening the weak financial structure, focus more on formal financial systems, reducing power imbalances in the governance structures and low political intervention in community level organizations, and resolving socio-cultural and environmental concerns are the major concerns on development of value chains in developing countries. The high levels of post-catch losses indicate that the urgent need of an introduction of coolers and improved ice distribution systems, proper harbors, landing sites and markets would be an upgrade strategy that could stimulate value chain growth. While this could indeed lead to higher profitability at first, without retaining these profits and reinvesting them back in to their business, value chain actors will not be able to grow their business. Good governance systems, protection of remaining stocks and stock enhancements, stop illegal and unregulated fishing practices, improve welfare of the fishing communities, mitigation measures to climate change, etc. are the crying needs of the hour. This risk needs to be addressed through a systemic enforcement of environmental protection measures and a diversification strategy.

