

2. PREPARATION OF VALUE-ADDED FISHERY PRODUCTS

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What is Value addition?

Any additional activity that is one way or other changes the nature of product thus adding to its value at the time of sale. Products processed as ‘Ready to eat’, ‘Ready to cook’, ‘Ready to fry’, ‘Heat & Serve’ and ‘retail raw branded products’ and other fishery pharmaceutical and cosmetic products of high unit value in export market are considered as value added products.

Significance of value addition

- To provide variety of products
- For improved processing utilization
- Most practical way to increase profitability in fish processing
- Allowing income creation during off-seasons
- To keep in-phase with consumer needs
- Make use of excess produce.
- It has become a market requirement

Major forms of adding Value to Seafoods.

There are three major forms of adding value to Seafoods.

I. Improving market forms

- Fillets
- Steaks
- Customization

II. Processing convenience foods

- Peeled, in brine either chilled or heat - treated

- Battered and breaded products
- Extruded cooked products
- Breakfast/lunch/dinner packs

III. Functional foods

- Fortified with calcium, Beta carotene, vitamins, etc.

Major value added products prepared from fish, shell fish and cephalopods

I. Value added Fish products

Fish pickles, Fish curry Frozen Fish Fillets, Fish Loins/ Fish Steaks, Breaded fish fingers, Breaded fish fillets, Tray pack fish, Pre-cooked Loins, Fish powder, Fish soup, Fish cutlet, Fish ball, Fish soup powder, Fish wafer, Ready to serve fish curry in flexible pouches

II. Shrimp products

IQF Marinated Shrimp, Skewered Shrimp, Stretched Shrimp (Nobashi), AFD Shrimp, AFD Powder, Blanched/ Cooked Shrimp, IQF Head-On/ Headless /Butterfly cooked/ blanched shirimp, IQF Peeled Tail-on cooked shrimp, Cooked salad shrimp, Cooked and peeled shrimp, Sushi, Shrimp Pickle, IQF Tray pack shrimp and Shrimp Curry.

III. Cephalopods Products

Double Skinned Cuttlefish IQF Sashmi Grade, IQF Cooked/ Blanched squid Cuttlefish fillets Sashimi grade, Cuttlefish strips blanched, Squid strips blanched, Cuttlefish Pine Cut/ Diamond Cut, Stuffed Squid IQF Tray Pack, Squid Tube Tray Pack, Squid Ring Blanched IQF, IQF Tray Pack Squid, Cuttlefish Skewers, Vaccum Skin Packed Squid & Cuttle Fish Products in trays, Marinated Squid, Battered and breaded Cephalopod products, AFD Cuttlefish/Squid.

I. 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. Mostly this includes seven major steps.

Portioning / forming

A perfectly portioned product is the right starting point. Mechanically deboned fish meat is formed to different shapes and sizes after mixing with ingredients, if needed. The product should keep its consistency with proper weight and shape. The key factor in this production step is speed and accuracy of processing the frozen fish block at minimum costs without any compromise to the product quality.

Predusting

Predusting is usually done with very fine raw flour type material or dry batter itself, sprinkled on the surface of food substrate before coating. This helps to reduce the moisture on the surface of the product so that the batter can adhere uniformly. Flavourings such as salt and spices can be added in minimum amounts.

Battering

Batter is defined as the liquid mixture composed of water, flour, starch, and seasonings into which the fish products are dipped prior to breading. Two types of batter are there- adhesive batter and tempura batter. The adhesive batter is a fluid, consisting of flour and water. Tempura batter is the puff-type batter containing raising/leavening agents. This forms a crisp, continuous, uniform layer over the food. The predusted portions are applied with wet batter and excess batter can be blown off by a current of air. The batter mix helps in governing the amount of bread to be picked up and it contributes to flavour of the final product. Specific ingredients are used to aid viscosity, texture and adhesion.

Ingredients of batter mix

- a) Flour- Wheat flour provides structure to the product through gelatinisation of starch as well as through formation of gluten protein matrix. Higher protein levels in flour increases viscosity of batter and produce darker crispy coatings. Corn flour can be added to produce yellow colour and to enhance browning during frying.
- b) Water- The ratio of water to dry batter mix is 1.8:1. Formation of gelatinised starch phase, hydration of flow proteins, batter viscosity etc. depends on the purity of water used.
- c) Starch- Corn starch is added mainly to control batter viscosity and thus increasing the batter pickup and breading retention.
- d) Flavour and flavour enhancers- salt, sugar, spices etc. can be added to improve the organoleptic characteristics of the products.
- e) Sodium tripolyphosphate- This lowers the water activity of the product and has bactericidal property. It increases the hydration of proteins and reduces protein denaturation.

Breading

Breading was defined as the application of a dry mixture of flour starch, seasonings having a coarse composition to battered food products prior to cooking. Normally the battered fish portions are dropped in to dried bread crumbs and are turned over to ensure complete coating with bread crumbs. A fine layer or coarse layer of bread crumbs will contribute to structure and tastiness of the product. For soft products the crump depth should be fine so as to avoid the product damage on further processing.

Pre-frying/ flash frying

Pre-frying is the process of giving a shallow fry so as to coagulate batter over the product and lock the flavour and juices to the product. The time of frying and temperature of oil are crucial factors. This could be done at 180-200°C for 40-60 sec, thus restricting the actual heat transfer to the surface of the product. The term pre-frying is used as frying will be completed only when the consumers fry the product for 4-6 minutes depending on the product size.

Freezing

The fish portions are air cooled before freezing. This helps the coating temperature to drop while the batter can stabilise itself and recover from the frying shock. Freezing is done at a temperature of -10°C to -20°C in order to preserve freshness and quality of the product over longer storage periods.

Advantages of coated products

- Enhanced nutritional quality
- Moisture barrier during frozen storage and reheating
- Crispy texture and appealing colour and flavour
- Structural reinforcement of the substrate
- Prevents loss of natural juices
- Increased bulk of the substrate and reduced product cost
- Improved overall acceptability of the product

Battering and breading have contributed significantly to the value addition of fishes, shell fishes and molluscs. The first commercially successful coated fish item was fish fingers. Later several other products like fish cutlets, fish balls, fish nuggets, etc. came into the market. Coated butterfly shrimp, squid rings, stuffed squid rings etc. are among the fancy items that cater to the luxury markets. Sophisticated equipments like meat bone separator, meat strainer, portioning and forming equipment, preduster, battering and breading machine, fryer, freezer and packaging machineries are in the market for preparation of a wide variety of coated products.

Fish finger or Fish portion

Fish fingers, or portions or sticks are regular sized portions cut from rectangular frozen blocks of fish flesh. They are normally coated with batter, and then crumbed before being flash fried and frozen. They may be packed in retail or catering - size packs. The typical British fish finger normally weighs about 1 oz. (28 g) of which up to about 50% of the total weight may be batter and crumbs. Food Advisory Committee of the UK government has recommended a minimum fish content of 55% for battered and 60% for the fingers coated with breadcrumbs.

Fish fillets

The brined fillets are battered and breaded. Fillets from freshwater fish are also used for the production of coated products. The only problem noticed in this case is the presence of fin bones; its complete removal is still a major hurdle.

Fish cutlet

Cooked fish mince is mixed with cooked potato, fried onion, spices and other optional ingredients. This mass is then formed into the desired shape, each weighing approximately 30g. The formed cutlets are battered and breaded.

Fish balls

Fish balls are generally prepared from mince of low cost fish. Balls can be prepared by different ways. The simplest method is by mixing the fish mince with starch, salt and spices. This mix is then made into balls, cooked in boiling 1 % brine. The cooked balls are then battered and breaded.

Crab claw balls

Swimming legs of crab may be used for this purpose. Crab claws are severed from the body, washed in chilled portable water and the shell removed using a cracker. The leg meat is then removed and mixed with 2 % starch based binder. This is then stuffed on the exposed end of the claw. Alternatively the body meat mixed with the binder also can be used for stuffing. The stuffed claw is then frozen, battered and breaded and flash fried. The coated products are packed in thermoformed containers with built in cavities.

Clam and other related products

Meat shucked out from depurated live clams after boiling is blanched in boiling brine, cooled, battered, breaded, flash-fried and packed. Other bivalves such as oyster, mussels etc. can also be converted into coated products by the same method.

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, cakes and patties are some other mince based products

Surimi and Surimi Products

Surimi and surimi based seafoods are traditional products of Japan and occupy an important position in the dietary culture of the country. Today, the largest producers of surimi are the United States, Japan and Thailand. Surimi is also manufactured in China, Vietnam and Malaysia. The process of making surimi originated in Southeast Asia and was further developed in Japan in the 16th century. The Japanese word “surimi” means “ground meat.” In Chinese, it is called “yújiang,” which means “fish puree.”

Technically, surimi is the stabilized myofibrillar protein which is obtained by mechanically deboned fish flesh, which is washed, mixed with cryoprotectants, and stored frozen. Washing not only removes fat and undesirable matters such as blood, pigments and odoriferous substances but also increases the concentration of myofibrillar protein. A fish-based product serving the raw material for preparation of analog of seafoods like crab, lobster, scallop & other shellfish. Globally, Alaska Pollock is the main species used for the surimi production.

Raw material for surimi production

According to gel-strength Alaska Pollock has been the predominant fish species used for surimi production. In India, for the preparation of surimi, Gopakumar and co-workers utilized the mince of barracuda (*Sphyraena spp.*), threadfin bream (*Nemipterus japonicus*), croaker, Lizard fish, prawn (*Metapenaeus doobsonii*) and tilapia (*Oreochromis mossambicus*).

Kamaboko

The most typical surimi-based product in Japan is Kamaboko. Surimi paste is formed in to Quonset-hut shape on a wood board panel before any thermal treatment. Sometimes its surface is coated with colored paste for appearance. After its unique shape is formed, the surimi paste is subjected to a low temperature setting process (20-40°C for 30-60min), depending on species. or During this process, the gel-forming ability of solubilized myofibrillar proteins is highly enhanced, which yields a strong gel. Cooking by either steaming or baking is carried out to complete the gelation of fish proteins. The finished steamed product is called “mushi” (steaming) kamaboko.

Chikuwa

It is an original model of surimi-based products. Its shape is typically like a pipe or tube. Surimi paste is placed on to a grooved hole in a rectangle shape on the surface of a drum. The paste is rolled onto a metal stick on the conveyor. The rolled paste on the stick is baked rotationally in the oven on the screw conveyor for gelation. The finished products are packed, pasteurized and chilled before entering their marketing channel.

Satsuma-Age

It is fried kamaboko with various shapes and characteristics. Additional ingredients such as vegetables, shrimp, squid, and minced fish are sometimes mixed into the surimi paste for satsuma-age. The paste is then molded into various shapes (stick, patty, ball, nugget) before frying. In recent years, most satsuma-age is manufactured using a two step-frying process because it yields high gel strength and productivity. The first frying is done at 130°C and the second frying is subsequently done at 170°C

Hampen

The surimi paste is aerated compulsorily by the continuous mixer. Recently, gums, polysaccharides are used as a whipping and stabilizing agent. Vegetable oil is commonly mixed for the development of texture as well. The whipped paste is then boiled in hot water (80-85°C) to fix the soft gel texture.

Types of kamaboko

Based on heating method

- ✓ Steamed kamaboko (Itasuki)
- ✓ Steamed and broiled kamaboko
- ✓ Broiled kamaboko (chikuwa)
- ✓ Boiled kamaboko (Hampen)
- ✓ Fried kamaboko (Tempura, Satsuma age)

Based on shape

- ✓ Tubular shaped (Chikuwa)
- ✓ Ball, bar, square shaped (age kamaboko)
- ✓ Lead shaped (sasakamaboko)
- ✓ Noodle shaped (soba kamaboko)
- ✓ Rolled (date maki)
- ✓ Chipped (kezurikamaboko)

Fish sausage

Fish sausage is a product in which surimi is mixed with additives, stuffed into suitable casings and heat processed. Thus for the preparation of fish sausage, the thawed surimi is mixed with salt (3%), sugar (1.5%), STPP (0.3%), starch (8%), spice mixes (3%) (coriander, chilli powder, ginger garlic paste, pepper), vegetable oil (10%) and water 10%) in a bowl chopper to get a homogeneous paste. The mixing process should be ideally completed within 12-15 min. The paste is then stuffed into synthetic casings preferably PVDC and heat processed for 60 min at 90 °C followed by cooling for 15 min in chilled water. The sausage is consumed primarily as a snack and as an appetizer or used as an ingredient for salad and stir-fried food.

Crab analog

The frozen surimi is converted to imitation crab meat through various steps. First, it is tempered at -4°C, then shredded into coarse flakes and subjected to comminution during which, the surimi

flakes are mixed with other ingredients include starch, salt, natural crab meat, egg white, and flavors in a bowl chopper. Comminution results in the formation of thick surimi paste, which is then transferred to a hopper (holding tank). The paste is conveyed from the hopper to the sheet-forming machine. Continuous sheets of surimi, about 10 inches (25 cm) wide and 0.05 inch (1.2 mm) thick are extruded. Due to the functional nature of surimi protein, the extruded sheets are very smooth in texture. After the sheets are formed, they are passed to machines and subjected to initial cooking. This cooking mediates the setting of the sheets and prepares them to be suitable for the further slitting process. Slitting gives the appearance and texture of crab meat. The slitting is done by a machine which is composed of two steel rollers that cut the thin sheets into strands having 1.5 mm wide. These thin strands are pulled, bundled and rolled into a rope. This rope is colored, wrapped, and cut to the appropriate size. It is then steam cooked, forming a product that imitates in texture and tastes very much like the crab meat.

Shrimp and lobster analog

For the preparation of shrimp and lobster style products, the surimi paste is commonly mixed with pre-prepared surimi meat fibers and transferred to a molding machine or coldextruded in a three-dimensional shape. For imparting the color, a color solution is sprayed inside the mold before stuffing. Another way to impart the color is directly using the colored paste (brushed) on the surface of cooked molded products. In the later method an additional, additional heating is needed to set the color.

Scallop analogs

The plant set up for the production of scallop analog is similar to crab analog. For the preparation of scallop analog, a wider and thicker surimi sheet is extruded compared to the surimi sheet extruded in crab analog preparation. After sheet formation, surimi sheet subjected to partial cooking for facilitating the gelation and subsequently subjected to slitting. After slitting, an uncooked layer of surimi paste is added on top of the gelled surimi sheet immediately. This additional layer of surimi paste is to enhance the binding of fibers. The gelled fibers are wrapped and cut into 2-foot lengths and heat processed. The cooked fiber bundles are cut into the desired dimension of scallops shapes using flaking machine.

II. Shrimp products

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. Shrimp is washed in chilled water containing 5-ppm chlorine, beheaded, deveined, using bamboo stick and peeled keeping the last segment and tail intact. The tail is then trimmed and the shrimp is stretched using a metallic stretcher after making 2-3 parallel cuttings at the bottom side. Stretched shrimps are then packed in thermoformed trays under vacuum and frozen at -40°C.

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.

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 (centre 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. 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.

III. Squid products

Squid rings and stuffed squid are the popular coated products processed out of squid. Cleaned squid tubes are cut in the form of rings of uniform size, cooked in boiling brine (3%) for 1-2 minutes followed by cooling, breading and battering. The coated rings are flash-fried, cooled, frozen and packed. Stuffed squid is generally processed out of small size animals. The cleaned tubes are filled with a stuffing mixture prepared using cooked squid tentacles, potato, fried onion, spices etc. It is then battered, breaded and flash-fried.

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. CIFT has worked on the production of extruded products by incorporating fish mince with cereal flours. The product obtained is finally coated with spice mix to provide a delicious snack that has been christened as “Fish Kure.

Ready to serve fish products in retortable pouch

Ready to serve fish products viz. curry products, in retortable pouches are a recent innovation in ready to serve fish products for 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 CIFT and this technology has been transferred successfully to entrepreneurs.
