Training manual on

"Preparation of Enrobed and Marinated Fish and Shellfish Products"

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1. Seafood Value Addition

The popularity of fish and fishery products in the domestic, as well as the international markets, is increasing day by day at a greater pace. Fish is considered as a superfood for humans because of its high-quality protein content, n-3 polyunsaturated fatty acids (PUFAs), minerals, vitamins, and other trace elements. Apart from the nutritional and health benefits it offers, it plays an important role in building the economy as it is one of the most traded commodities and a regular food item in the diet of a large population. To reach customers around the world, product diversification and adoption of international flavours preferably ethnic are of great importance. Better utilization of the available fishery resources especially underutilized catches can be attained by adding value in an improved way as demanded by the consumers.

Value addition is the enhancement added to a product before it is offered to the customers. It can be defined as "any additional activity that changes the nature of the product which leads to an increase in price at the time of sale". The category of value-added products includes 'Ready to Eat', 'Ready to Cook', 'Ready to Fry', 'Thaw and Eat', 'Heat and Serve', retail raw branded products, fishery pharmaceutical, and cosmetic products of high unit value in the export market. These products are gaining wide acceptance as modern customers prefer convenience products mostly ready-to-cook foods, and of course due to the increasing trend of fast food gastronomy. Adding value to a product can be achieved through improving the existing market forms of the products, processing convenience food, and developing functional foods. Innovative products with multiple formats or shapes or dimensions, flavours, texture profiles, and new packages will attract customers without any difficulty. The process of value addition is of greater use because it increases the production and productivity, enhances the shelf life of the products, improves the safety of the food, reduces wastage and discards of the fishery resources, increases the utilization of all kinds of available fishery resources, satisfying the changing customer needs and demands, increases the market forms of the product and helps to earn better income.

2. Technology of Enrobing

The present-day consumers' particularly urban consumers are showing more and more interest in food products which are available in ready to eat or ready to cook form. These food items are called convenient products and the global demand for such products is increasing rapidly. This has led to the development of several fishery products varied in taste, texture and appearance. One group among them getting high consumer appeal is enrobed products popularly known as battered and breaded products or coated products. Battering and breading techniques have contributed significantly to value addition of fish and fishery products.

In essence, an enrobed food product is one that is coated with another foodstuff. Coating by battering and breading enhances a food product's characteristics such as appearance, flavour and texture. Coating acts as a moisture barrier, minimizing moisture losses during frozen storage, microwave re-heating and retains the natural juices of foods, thereby ensuring a final product that is tender and juicy on the inside and at the same time crisp on the outside.

There are several ingredients used in the formulation of coatings. Each ingredient performs its functions to contribute to the unique characteristics and functionality of coatings. The commonly used ingredients fall under five categories. They are polysaccharides, proteins, fats, seasonings and water. Besides small quantities of leavening agents, gums, spices, colour etc. may be added to provide specific functional effects. The major ingredients used for the production of batter mix and breadcrumbs are more or less same but the manufacturing techniques employed are different.

2.1 Batter

A batter is defined as "a liquid mixture comprised of water, flour, starch and seasonings into which food products are dipped prior to cooking". Batters are broadly classified as adhesive batter, cohesive batter, and tempura batter.

2.1.1 Adhesive batters are conventional batters and are also termed as traditional batters. The adhesive batter is a fluid, basically consisting of flour and water, into which the product is dipped before it is cooked or fried. It acts as an adhesive layer between the food substrate and the subsequent breading. The primary purpose of this batter is to increase crumb adhesion to the product. The proportion of batter and water is generally in the ratio of 1:2. The desired viscosity and pick up decide the ratio of components in the batter mix.

2.1.2 Tempura batters are also known as leavened batters or puff batters. Wheat and corn flour play an important role in this system. This batter forms a crisp, continuous, uniform layer over the food, constituting its final coating. Tempura batters provide crust coatings of exceptionally high volume, which are also light in texture. The main difference between an adhesive batter and a tempura batter is that the tempura batters always contain leavening agents to generate leavening gas (carbon dioxide) and hence they are applied using special tempura batter applicators to retain the leavening action.

Typical formulation of a batter system is given below. The ingredients are classified as critical and optional based on the functions.

Formulation of batter

Ingredients	Addition range (%)
Critical	
Wheat flour	30-50
Corn flour	30-50
Sodium bicarbonate	Up to 3
Acid phosphate	Adjust based on neutralizing value
Optional	
Flours from rice, soy, barley	0-5
Shortening oil	0-10
Dairy powders	0-3
Starches	0-5
Gums, emulsifiers, colours	Less than 1
Salt	Up to 5
Sugars, dextrins	0-3
Flavourings, seasonings etc.	As required

CIFT Batter Formulation: Refined wheat flour (1Kg), Corn starch (100g), Bengal gram flour (100g), Salt (15g), Turmeric powder (5g), Guar gum (5g), STPP (5g)

2.2 Breading

The term 'breadings' is a general or descriptive term that covers a wide range of cereal based food coating. A breading is defined as "a dry mixture of flours, starch and seasonings, coarse in nature and applied to moistened or battered food products prior to cooking". Most breadings are developed using certain variations of established baking techniques. Wide varieties of breading materials manufactured by different techniques in different sizes, shapes, and colours are commercially available. They can be used alone or in combination with other types of crumbs. Different types of breading are as follows.

2.2.1 Flour type: This type of crumb is available in powder forms that are more economical compared to other types. These are used when the products are intended for deep frying. In this case, the coating matrix will be very dense and a low browning rate on the surface is expected. The pick-up and weight gain in the final product will be relatively less.

2.2.2 Traditional/ cracker type: This type of bread crumbs are usually white or coloured crumbs having a flat-like flake structure with minimal or no crust on the surface. This type of crumbs can be made easier with the least expenses. It forms an even surface on the product as it has a fine granulation and the rate of browning achieved during frying is low. This type of crumbs is used for making fully-fried or oven-heated types of products. Cracker meal is usually used as a coating for products which are deep fat fried for long periods and is widely used on fish products. Moreover, they can be used in pre-dust in combination with different flours. The much denser flakes give a crunchy texture to the final product after frying.

2.2.3 Home-style or American type: This type of crumb has a distinct crust that gives a nice highlighting during the frying that resembles the crumbs usually consumers prepare at home. A medium to high browning rate can be achieved using these crumbs. Compared to the other types, American-style bread crumbs give a more crispy texture to the product as they have an open structure. To get more pickup, medium to large quantities may require while coating. The price of American-style crumbs is much higher than flour and cracker type but they are cheaper compared to Japanese crumbs. Home-style crumbs are more porous than cracker meal and tend to absorb more oil and moisture. They cannot tolerate long frying times and tend to darken more quickly.

2.2.4 Japanese-style or Oriental style or Panko crumb: These types of crumbs are having an elongated spindle shape**.** It is the most expensive type of crumb usually used in full-fat fried or oven-heated high-value products. They are produced by electrical induction heating rather than the conventional baking process to have a

fairly open/porous texture which imparts a light tender crispness. The process helps to form a very light-density crumb without having a crust and also it is possible to produce large- sized crumbs without having a hard texture. Japanese-style crumbs are produced as white or coloured crumbs. Pickup of the product can be controlled from medium to high and the degree of browning to medium light to dark during frying. These crumbs provide excellent visual appeal and a unique surface texture when fried.

2.2.5 Extruded crumbs: In this process, the flour is continuously mixed under highly turbulent and intensive conditions, steam is injected and the resulting slurry of cooked flour is pumped through an orifice. The slurry will be extruded in the form of a cooked 'rope', which is further shredded, dried and screened to achieve the desired particle size. Extruded crumbs are light and fragile and tend to float in oil, may turn black, and deteriorate the oil quality.

2.3 Stages in production of coated fishery products

The production of battered and breaded fish products involves several stages. The method varies with the type of products and pickup desired. In most cases it involves seven steps. They are portioning/forming, pre-dusting, battering, breading, pre-frying, freezing, packaging, and cold storage. The process starts with the stage of tempering frozen fish block or fillet. The tempering is the process of taking produce from frozen to a temperature just below freezing. It raises the temperature of frozen blocks of fish products to just below the freezing point to facilitate cutting and further product handling.

2.3.1 Portioning/forming

Portioning is the first and important stage in the production of coated fishery products. The objective of this step is to cut or shape the substrate in the most economical way so that minimum loss occurs during portioning and subsequent processing steps. The shape of the substrate plays an important role in process

efficiency. The surface area to volume and surface area to weight ratio can play an important role in the application of coating. Cutting loss during portioning is another factor which determines the economics of coated products. Cutting loss is negligible when manually done with a band saw, whereas with automatic block cutting machines it is in the range of 5-10 %.

A recent innovation for the catering sector is forming of skinless and boneless fish fillets into a predetermined shape and size using specially designed forming machines. The shapes vary from conventional fillet shapes to several other imaginative ones. Different types of forming machines of varying capacities for variety products such as balls, cutlets, burgers and other shapes are available for large scale commercial production.

Substrate quality plays an important role in coating adhesion. Water content and the presence of phosphates in fish blocks can have a direct effect on batter adhesion and cook times. An abnormally high amount of water in the fish block becomes a problem when it passes through the band saws and chopper. A thin layer of water is formed on the cut surface, which subsequently freeze and form a frozen film called "ice glaze". This results in poor batter adhesion to fish portions. This can also cause "blow off" of the batter from the fish portion surface during frying.

Presence of phosphates in fish portions can result in prolonged cook time during frying. This can result in darkened and overcooked batters in the final product which lose its consumer appeal. Highly sophisticated portioning and forming machines for different types of products are available for commercial operations.

2.3.2 Pre-dusting

Pre-dust refers to fine, dry material that is dusted onto a food substrate first. Pre- dusts can be unprocessed flours or blends of starch, egg whites and gums of particle sizes similar to those of flour. A more sophisticated and expensive pre-dust may contain salt, spices, seasonings and flavourings for functional and flavouring purposes. Before a fish

portion is battered it usually undergoes a pre-dusting step. The purpose of pre-dusting is to prepare the surface of the portion so that batter can adhere uniformly. Pre-dusting also improves the adhesion of batters to frozen or greasy food surfaces. Salt in the pre-dust can slightly melt the ice glaze covering the surface of fish portion. Excess pre-dust on the fish portion is removed by the use of air blowers. Pre-dusting machines of varying capacities for different types of products are commercially available.

2.3.3 Application of batter

Many types of batter are commercially available and the major processing factors important to their proper operating functions are: viscosity, temperature, set-up rate film thickness, solids content and symmetry of application.

The pre-dusted product is conveyed to the batter applicator and transferred to the next conveyor, which will draw it through the batter. The application of batter to a food substrate is a complex process and the selection of an appropriate applicator depends on many factors such as the type of batter and its process parameters, nature of the substrate and its physical parameters and also the requirements of the final coated product. There are two basic types of batter applicators designed to meet the properties of two generally used types of batter namely, conventional batter and tempura batter. They are overflow applicator and top-submerge device applicator.

Conventional batters are of low to medium viscosity and hence can be applied with total submersion or overflow batter applicators. Low viscosity batters are normally applied in an overflow configuration. Medium viscosity batters may require a total submersion system depending on the product requirements. In the battering process pre-dusted fish portion is conveyed to the batter applicator and drawn through the batter. The fish portion is totally submersed in the batter as it is drawn through it.

Tempura batters require special handling for proper application. Tempuras are high viscosity batters, which contain raising agents. The control of temperature and

viscosity are crucial to product quality and production cost. Tempura batter should not be prepared in advance of use as gas begins to be lost as soon as the batter mix is hydrated. The batter mixer should have a gentle mixing action to avoid the loss of leavening gas. Tempura batters are usually run at a higher temperature than the conventional batters. A cold tempura batter will give less puff. A tempura applicator consists of a deep well pan, a product conveyor and a top submerged conveyor. The top submerged holds the products under the batter and also helps maintain orientation on the belt.

Line speed is a very critical factor affecting batter pickup. An excessively fast line speed will reduce the batter pickup. Too low a line speed also can result in excessive batter adherence. Excess batter, if carried over to the breading section, will cause formation of lumps and this can cause blockages in the breading machine. This will also cause formation of shoulders and tails on the edges of the product and contaminate subsequent breading application. Therefore, to overcome the problems the excess batter is removed by blowing air over the product. The position of the air blower should be as close to the product as possible to control the airflow across the product. Carry over from the pre-dusting operation also is critical. Where pre-dust is carried over, the viscosity of subsequent batter will increase leading to an increase in pickup.

2.3.4 Breading

Breading is applied to the battered products using breading applicators. Specially designed breading machines are used to ensure uniform particle size distribution or granulation on both top and bottom of the product with minimum crumb breakdown.

In the application of breading several important factors are to be considered which may affect the quality of the breading process. They are granulation, bulk density, reducing sugar content, absorption, integrity and porosity.

Granulation is the most important factor which determines the quality of the breading process. Particle size of the breading determines the crispness. Larger (coarse) particles give better crispness to the product than the fine particles. However, larger (coarse) particles are unable to pack closely on the surface of the coating which results in poor pick up and coverage. Optimum crispness, adequate coverage and maximized weight can be achieved by selecting the right particle size of breadings.

Bulk density of the breading affects the pick-up potential as well as the feel in the mouth property of the coated product. The lower density breadcrumbs provide a very light crispy bite to food.

Reducing sugar content in breading determines the fried colour of the coated product. Depending on the intended usage, the sugar content should be adjusted to obtain uniform and consistent colour in the final product. Added colour also plays an important role in the fried colour of the product.

Absorption of a breading is its ability to take up water. High absorption breading's can decrease batter set up rate, reduce tailings and fall off.

Integrity of breading is a measure of its ability to remain an intact particle when hydrated. Lack of integrity will cause loss of texture in the coated product and contributes to a soft surface.

Porosity describes the open cellular network in breaded products. A porous structure of the breading will allow the hot oil to enter and vapourize the moisture from crumb during frying which will impart crispness to the product. Cracker meal breading does not have porosity.

The selection of applicators for breading depends on the type of breading used. They are classified accordingly and a brief description is given below.

Free flowing breadings

Free flowing breadings are used in products from poultry, fish, and vegetables.

Generally these breadings are fine and uniform in granulation. They flow easily in machinery. The applicator for this type of breading encapsulates the product by re-circulating the breading material, thus providing a bottom bed as well as top flow. After the coating is applied, excess material is removed either by air or by "flipping" the product. In the former, the breading falls through a belt opening and an engineered stream of air blows off particles those have not absorbed batter. In the latter the product is flipped from one level to another so that the breading fall off as the product makes a half circle turn.

There are many types of breading applicators available and the appropriate machine depends on the ingredients used. The speed of the breading machine is so adjusted to closely match the belt speed of the batter applicator. For soft products the crumb depth should be maintained as thin as possible to avoid product damage when leaving the breading machine; however, frozen or hard products should have a deep bed of crumbs. Pressure rollers are used to apply sufficient force to press crumbs onto the battered product.

Non Free-flowing Breading or Flour Type Breading

This type of breading poses significant problems for the processor. The movement of particles through a machine is very difficult. This type of material causes machine failures since the material bridges in hoppers or packs around augers. Other problems encountered are slow batter absorption, low pick up usually below 20%, and uneven coverage. Uneven coverage in the finished product is caused by the tendency of the breading to come off during frying in the fryer. To move the non-free flowing breading through the machines a driving mechanism like augers or vibrators that force the coating to flow evenly is incorporated. These units are also suitable for pre-dusting.

Japanese style crumbs with their low bulk density and larger granule sizes make the crumb pickup difficult by the normal batter systems. Special batter formulations, sometimes containing raising agents, may have to be used at medium viscosity for a

desired level of pickup of crumbs. Specially designed breading machines are used to apply uniform particle size distribution or granulation to both top and bottom of the product with minimum crumb breakdown. Air blowers are used to remove excess crumb from the product after breading. Excess crumb carried into the fryer can cause unsightly black specks on the product. Filters are used to remove small particles from the oil to prevent this phenomenon.

2.3.5 Pre-frying/flash frying

After coating with batter/bread crumbs many products are often flash fried in refined vegetable oil prior to freezing. The purpose of pre-frying is primarily to set the batter/bread coating on the fish portion so that it can remain intact during further processing. It also inhibits freeze denaturation and contributes to taste. Besides, pre- frying develops a characteristic crust and gives the product a characteristic fried (oily) appearance and taste. Therefore, the temperature of frying oil and the time of frying are critical. The normal frying temperature is between 180–200°C and the frying time 20-30 seconds. The term pre-frying is used because the final product frying is completed by the consumer for duration of 4-6 minutes depending on the portion size and thickness. The battered/breaded fish portions enter the frying medium through a conveyor system, the speed of which is adjusted so as to keep the fish portion in the hot oil for the required time.

In the process of enrobing, the frying operation plays a vital role on the quality of the finished product. The frying operation is comprised of three basic components. First is the fryer and associated equipment (filters, conveyers etc.). Second is the fish being fried (including the batter and breading) and the third component is the frying fat. Frying fats serve dual purposes in a frying operation. They function first as a heat transfer medium and then as a food ingredient. To choose the proper frying fat for a specific operation many things must be considered. Some frying fats are noted as having a specific flavour which is carried over to the finished product. Some flavours contributed by the frying fat will improve the fried item, whereas others will degrade

the quality of the item. A frying fat that is liquid at room temperature will provide a shiny wet appearance to the product. Moreover, a liquid fat is easier to handle (pumping, metering, pouring etc.) compared to a solid fat. Usually refined, bleached and deodorized vegetable oils are used for frying purpose.

During frying, the fat is exposed to extreme conditions such as high heat, high moisture, turbulence and the introduction of contaminants such as food particles and bread crumbs. These conditions promote the degradation of the frying fat. The prominent forms of frying fat degradation are hydrolysis, oxidation and polymerization.

2.3.6 Freezing

The first step in preparing the fried fish portion for freezing is air-cooling. This is usually accomplished with the use of a fan or a series of fans. This allows the coating temperature to drop, while at the same time allowing the batter coating to recover from the frying shock and also to stabilize itself. The coated fish portions are then fed to the freezer through conveyor belts. Since the fried portions are fragile, care should be taken to avoid contact between the portions while loading in the freezer. Freezing is usually carried out in spiral freezers. Other types of IQF freezers can also be used depending on the product and convenience. Freezing is completed when the internal and external temperature of the fish portion drop to about – 40°C.

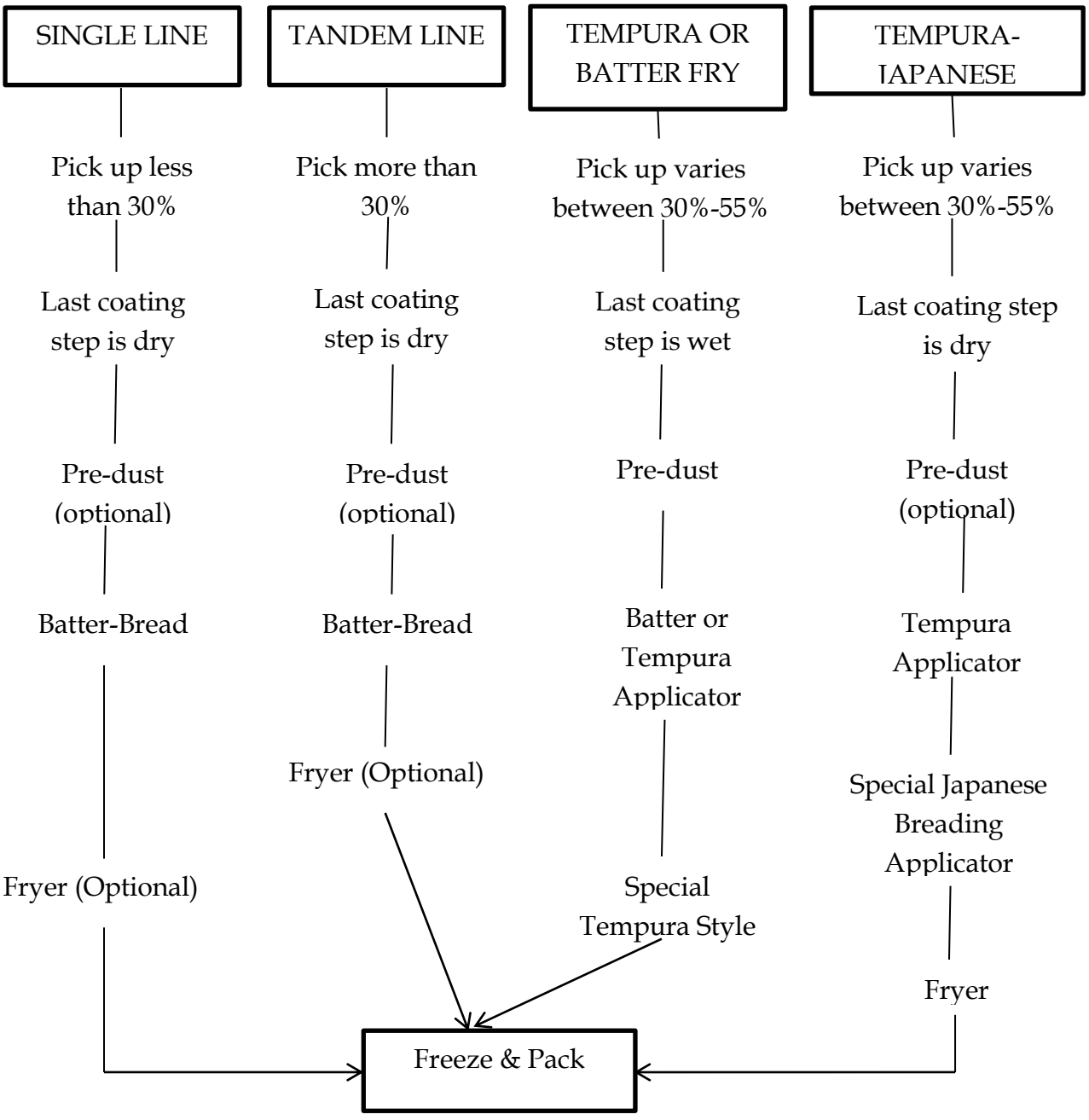
2.3.7 Packaging and storage

The common deteriorative changes taking place during frozen storage of battered and breaded fish products are desiccation, discolouration, development of rancidity etc. Application of proper packaging prevents/retards these changes to a great extent. Conventional packaging materials like flexible plastic films are not suitable for these products as they provide little mechanical protection to the products and as a result the product gets damaged or broken during handling and transportation. Hence thermoformed containers are commonly used for this purpose. The packed coated products are usually stored at –20°C.

2.4 Coating systems

In the production of coated foods, different types of coating systems are involved, although the basic steps are the same. There are four basic coating systems which are employed in commercial coating operations. They are the single line, tandem line, tempura or batter fry line and the tempura-Japanese lines.

These coating systems are as shown in the Figure below.



2.4.1 Single Line: Single line breading system duplicates the manual operation that involves coating the substrate first with a batter and then covering it with breading material with or without a pre-dusting step. This process is mainly used for meat products and premium seafood items. Fryer is an option and not a necessity in the line since the last coating step is dry. The coating pick up is below 30%.

2.4.2 Tandem Line: This consists of two batter- breading machines and an optional pre-dust unit. Sometimes three coating steps are given to thoroughly encapsulate the product. Sometimes fryer is also added in the line as an optional unit as per processor's requirement for the final product. Sometimes a batter-bread-bread line is given where the product is breaded twice to maximize the crust on the surface. Common items produced in this line are coated onion rings, shrimp, fish sticks etc. The coating pick up is above 30%.

2.4.3 Tempura or Batter –fry Line: This system line consists of a pre-dust machine, followed by a tempura batter applicator that transfers product immediately into the hot oil of the special tempura style fryer. Here the product is fried on a special conveyor with a non-stick surface in order to avoid peeling off of the coating. The fryer is an essential unit since the last coating step is wet. The coating pick up varies between 30 - 55%.

2.4.4 Tempura-Japanese: In tempura –Japanese line, a heavily tempura battered product is coated with Japanese style or porous bread crumbs and then flash fried. Pre-dusting is optional. The last coating step is dry. The coating pick up varies between 30 - 55%.

2.5 Equipments in battering and breading process

Development in coating technology has been synonymous with development in machinery and equipment. Prior to the introduction of machines breading lines in food processing plants consisted of a conveyor surrounded by personnel who battered and breaded by hand. The process was slow, tedious, low production rates and difficult to

maintain the hygienic standards. Today a large number of automatic and highly sophisticated processing equipment of varying capacities are available. Commonly used equipment in the production of coated products are grading equipment, peeling and de-veining equipment, cooking equipment, meat bone separator, fish meat strainer, automatic band saw, forming machine, kneading machine, pre-duster, battering and breading machine, fryer, freezing equipments such as blast freezer, cryogenic thermal freezer, modular spiral belt freezer, fill and seal machine, vacuum packing machine with gas flushing capability etc. The introduction of modern machines results in the growth of productivity and reduction of employment; it shortens the duration of technological processes, and makes it easier to prepare more laborious but, at the same time, more attractive products for the consumer.

2.6 Quality evaluation of coated products

Food quality is an important concept because the food people choose depends largely on quality. Food quality must be monitored on a regular day-to-day basis to ensure that a uniform product is produced and that it meets the required quality control standards. Both sensory and objective tests are important in evaluating a coated product, and ideally, they should correlate with or complement each other.

2.6.1 Fish flesh content

One of the chief quality parameters of a coated fish product is the amount of fish flesh content in the product. Fish flesh content in frozen coated fish product is determined by AOAC Official Method 996.15(1997). Method uses (1) combination of heat and water to breakdown adhesive properties of coating (batter and/or breading) and (2) hands to assist in determining when coating's ability to adhere to flesh's frozen surfaces is diminished and can be easily removed. Fish flesh content is calculated using the formula.

$$\% \text{ Flesh} = (W_d / W_b) \times 100$$

Where W_d = weight of debattered and/or debreaded test sample; W_b = weight of battered and/or breaded test sample.

Different countries are following different standards for flesh content. In USA, the department of commerce has specified a minimum flesh content of 75% for raw breaded fish portions and 65% for precooked portions. The Food advisory committee of the UK government has recommended a minimum fish content of 55% for battered, and 60% for the fingers coated with bread crumbs.

Although instrumental methods have been used to evaluate texture of fried, coated products, parameters such as crispness or crunchiness, fragility, tenderness etc. are hard to quantify using empirical mechanical methods. Other parameters such as greasiness, juiciness, oiliness etc. have been assessed with trained panellists.

The possibilities of contamination of coated fish products with microorganisms of public health significance are similar to any other fish products and hence they are evaluated by the conventional methods followed for other frozen fishery products. In spite of tremendous advances in food technology, processing safe food and storing food safe are still matters of worldwide concern.

2.6.2 Pick up

Pick up refers to the amount of coating material adhering to (or picked up by) the product and it is calculated based on the finished weight as follows.

$$\text{Pick up (\%)} = \frac{\text{(Final weight of the product – Initial weight of the product)}}{\text{Final weight of the product}} \times 100$$

According to USDA, the recommended percentage of pick up is 30% for coated products and product with a value more than that should be labelled as fritter.

2.7 Common quality problems encountered during the coating

2.7.1 Voids

Presence of voids is a common quality problem that occurs during the application of batter to fish portion. Voids are bare areas on a fish portion that do not accept the batter. This is caused by many factors such as excessive line speed, shape of the fish portion, absence of pre-dusting material, a non-adhesive surface, ice glaze, and air pockets formed during the application. Once the void is formed, it is difficult to remove it from the fish portion due to the thick consistency of the batter. Hence the portion has to be removed from the line.

2.7.2 Blow off

Blow off can be observed when some or all of the batter is blown off or removed during frying. This problem is accelerated if the portions contained voids. The lingering portions of batter will be fried excessively and give the product a dark unacceptable appearance.

2.7.3 Pillowing

Pillowing will appear as an elevated dome of batter on the product with a large air pocket beneath it. It is caused by the formation of steam pocket due to water vapourization which is trapped under the batter during the frying process. Once the product is cooled, the puffed dome collapses and create an undesirable wrinkled appearance. Pillowing is mainly caused due to the improper blending of the batter mix and also in some cases, due to the very high leavening levels of batter mix.

2.7.4 Tailings

Batter extends beyond the product like a tail or stringer. This is caused due to the excessive thick batter which results in inadequate blow off during the production. The batter will accumulate behind the product as the name suggests.

2.8 Innovative processes in the production of coated products

Cooking the coated product in a microwave oven as an alternative to the final frying step is desirable since this step reduces the oil uptake of the final product as well as saves time spent for the preparation of the product. However, retention of crispiness is the major problem encountered since the microwave cooked product will be soft and soggy. To retain the crispiness of the coated product, different types of batter mixes can be formulated. A dry mix that contains 60–70% of high amylase corn flour provides overall acceptable pre-fried foodstuffs with crispy coatings after microwave cooking.

An innovative process for the manufacture of frozen, battered food products completely eliminates the pre-frying step in the production of coated products. This is achieved by incorporating a cellulose derivative (methylcellulose) in the batter formulation, which makes it possible for coagulation of the batter by immersion of the enrobed product in a hot water bath (approx. 70^0C) instead of an oil bath. The water used and the batter must be at a temperature between 10 and 15^0C. After this step the coagulated, battered product must be subjected to a heating process, which can be performed in a conventional oven, a microwave or by infrared radiation. After the heating, the product is cooled, frozen and packaged for storage at temperatures of -18^0C or below. The product obtained using this method has texture, flavour and colour properties very similar to those of a product manufactured using a traditional process that includes pre-frying in oil, with the advantage of being free of the fat incorporated during pre-frying. The final product, after frying for consumption has a significantly lower fat content because the cellulose incorporated leads to a lower absorption of frying oil. After final frying the commercial product has about 35% oil, whereas a product prepared with this novel method contains about 16% oil.

The production and marketing of the enrobed products offer greater scope for the utilization of low value fishes having white flesh. Besides, many of the cultured freshwater species can be potential raw material sources for the production of enrobed items which can significantly improve the prospects for value addition and income

generation in the fast growing freshwater aquaculture sector. The coating process can also modify the flavour and enhance the acceptability of freshwater species. The process of enrobing is the best option for value addition in fisheries which can ensure the total utilization of resources.

3. Enrobed Fish Products

The coating technology has resulted in the development of an array of high value ready to eat fish products possessing excellent taste characteristics as well as health benefits.

3.1 Fish Balls

There are several varieties of fish which do not command a ready market as fresh fish, but are comparable to many table fish in nutritive value and other attributes. One of the ways of ensuring effective utilisation of such fish is to process ready-to-serve or ready-to-cook value added 'convenience' products, for which there already exists great demand from within the country as also from abroad. Fish ball is one such product prepared using fish mince and starch that can be processed as a coated product or as a heat-processed product in a suitable fluid medium.

3.1.1 Ingredients required

Ingredients	Quantity
Fish mince	1 kg
Corn starch	50 g
Ginger paste	20 g
Garlic paste	20 g
Pepper powder	10 g
Parsely/ Carrom seed (optional)	10g
Salt	10 g
Bread crumbs	200 g
Batter mix	100 g

3.1.2 Method of preparation

Mix mince prepared from fish using a mechanical meat bone separator after heading, gutting, and washing thoroughly with corn starch, ginger paste, garlic paste, salt, pepper and parsley/ajwain. Prepare balls, 2-3 cm in diameter, from the resultant mass and cook in boiling 1% brine for 5-10 minutes. Cool the cooked balls after which they are pre-dusted, battered and breaded.

3.1.3 Packing and storage

Pack the balls preferably in thermoformed trays as such or after flash frying it in vegetable oil. Preserve by freezing and store at -20°C. Deep fry the balls in oil before consumption.

3.2 Fish Fingers

Fish fingers or portions or sticks are regular-sized portions cut from rectangular frozen blocks of fish flesh. It was the first commercially successful coated fish product. Unlike other coated products, the fish finger is a product having 100% fish meat. The fish finger can be made from fillet and fish mince. Fish meat free of bones, skin, and adipose fat is used for this purpose. Generally, after coating, it is flash-fried and stored under frozen conditions. They are usually 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.

3.2.1 Method of preparation

Finger from fish mince

Mix the meat with sufficient quantity of water (containing 0.1% sodium tripolyphosphate and 0.6% common salt, by weight of the total fish meat) to form a pasty mass of hard consistency. Spread to a thickness of ¾ cm in an aluminium tray.

Freeze the material at -40°C for 2 hours. Cut the frozen material into sizes of 7.5 x 2 .0 x 1.5 cm, properly pack and keep at -20°C till further processing. Each finger should weigh approximately 15g.

Finger from fish fillet

Instead of fish mince, if fish meat is used then cut the meat into small pieces and cold blanch in 3% salt solution for 15 minutes. Drain off the pieces for preparing the fingers**.** It can be freezed before battering to improve texture. Pre-dusted, battered and breaded pieces can be stored in the thermoformed trays as such or it can be stored after flash frying in hot oil and further stored at -20°C. When required, deep fry the fingers for consumption. Prepare the batter powder by mixing the batter mix in the ratio of 1:2 (Batter mix: water).

3.3 Fish Cutlet

Fish cutlet has become a popular snack at celebrations, household functions, tea times etc. The basic raw material required for preparation of this product is cooked fish meat generally from less costly fish or cooked meat from skeletal frame obtained after filleting of fish. Fish cutlets are prepared by mixing cooked meat with vegetables, salt and spices followed by shaping the mix, battering and breading. The cutlets are available in different shapes like round, oval, heart shape, triangle etc. It can be stored in the freezer after coating or after flash frying.

3.3.1 Ingredients required

Ingredients	Quantity
Cooked fish meat	1 kg
Cooked potato	500 g
Onion	250 g
Green chilli	20-40 g (As per the spiciness)
Ginger	50 g
Curry leaves	10 g
Mint leaves	10 g
Turmeric powder	3 g
Salt	To taste (Approx.15-20 g)
Pepper powder	To taste (Approx.10 g)
Clove powder	To taste (Approx.2 g)
Cinnamon powder	To taste (Approx.4 g)
Batter mix	100 g
Bread crumbs	200 g
Refined vegetable oil	725 ml

3.3.2 Method of preparation

Clean the fish by removing head, scale, and intestine and wash thoroughly. Cook/steam the dressed fish in 3% brine for 10 minutes. Remove skin, bones, and separate the meat. Cook the potatoes, peel off the skin and coarsely smash them. Chop ginger, green chilli, onion, curry leaves, and mint leaves. Fry chopped ginger, green chilli, onions, curry leaves in oil, and then add mint leaves. Mix these with the cooked meat, smashed potato, turmeric powder, pepper powder, clove powder, cinnamon powder and mix well. Adjust salt content as per taste. Shape 25-30 g each of the mix in round or oval form to a thickness of 2 cm. This is followed by coating of the moulded cutlets, pre-frying, freezing at -40^{o}Cand its frozen storage at -20^{o}C.

3.4 Fish Fillets

Fried coated fish fillet is a prominent food item in the European markets. Along with fried potato chips it forms a substitute for lunch for majority of the floating population in Europe. Coated fish fillet is an important ready to fry/eat commercial product prepared from whole fish. Being a convenient product, it has become a prominent food item in the global markets. The diverse popular coated fish fillets are prepared from lean fishes having white meat like cod, haddock, pollock, perch, halibut, plaice, sole, cat fishes etc. In India, several fishes belonging to perches, sciaenids, as well as fresh water fishes are ideal candidates for coated fillet production. Fillets from large, medium as well as small fishes are used for this purpose. The fillets are trimmed and cut into pieces of uniform size before subjecting to coating process.

3.4.1 Method of preparation

Various stages in the production of coated fish fillet are:

- Filleting
- Cold blanching
- Pre-dusting
- Coating with batter
- Coating with bread crumbs
- Pre-frying
- Freezing
- Packaging
- Storage

Filleting: A fish fillet is a skinless, boneless fish loin cut along the central bone frame and trimmed free of loose or hanging meat. Skinless and boneless fish fillets can be prepared manually as well as using filleting machines. While fillet yield is 30 to 40% with machine filleting, manual filleting gives better yield.

To fillet, keep the fish on the chopping board and cut from behind the pectoral fin down to the main bone and move the knife along the bone frame with minimum loss of meat. Remove the skin along with scales by passing the knife along the skin layer. Also remove the belly flaps. Trim off any hanging meat from the fillet and make it regular and uniform. Wash the fillets in chilled water and drain.

Cold Blanching: Dip the fillets in 3% brine solution for 15 minutes depending upon the size grade and then drain off.

Pre-dusting: The fillets are then pre-dusted with a suitable pre-dust or dry batter mix itself. The excess pre-dust adhered to the substrate is then removed either by shaking or using an air blower.

Battering: An adhesive type quick setting batter is usually used. A typical adhesive batter formulated can be used for this purpose. The ingredients of batter should be mixed evenly and one part of batter powder is mixed with two parts of water to get the required consistency. The pre-dusted fillets are then coated with this batter.

Breading: The batter coated fillets are further coated with bread crumbs. Generally medium size porous crumbs having a relatively large granulation are used even though the selection of the crumbs depends upon the requirement of the finished coated product. The bread crumbs are uniformly applied on the product and the excess crumbs are then removed using an air blower. The coating pick up depends on the viscosity of the batter and the type of crumbs and 30-35% is generally obtained.

Pre-frying: After the application of bread crumbs the fillets are flash fried in hot vegetable oil for 20-30 seconds depending on the size grade of the fillets. The temperature of frying is maintained at 180-200°C.

Freezing: Immediately after flash frying the fillets are cooled using a fan and then frozen in an IQF freezer preferably a spiral freezer for the required time depending on the size of the fillets. The time is adjusted by regulating the conveyer speed of the freezer

Packaging: The frozen coated fillets are immediately packed in thermoformed containers or pouches made of 12µm plain polyester laminated with 118µm LDPE. A

specified number of such consumer packs are then packed in master cartons.

Storage: The packed cartons of frozen coated fillets are stored in a cold storage maintained at -20°C.

3.5 Enrobed Shrimp Products

Enrobed shrimps can be prepared from wild as well as from farmed shrimp in different styles and forms. The most common among them include butterfly form, fantail round, nobashi (stretched shrimp) etc. Based on the concentration of shrimp meat, raw breaded shrimps are categorized as: lightly breaded (65% minimum shrimp meat), breaded (50% minimum shrimp meat) and imitation products.

During the process, the shrimp is headed and washed in potable water. The telson is removed by gently raising it upwards. The shrimp is then peeled leaving the shell intact on the last segment and the tail fans. It is then dressed as per the style intended eg. In butterfly style viz., deveined and the tail fans are trimmed. The deveined, peeled shrimp is cut through the dorsal side length-wise using a sharp scalpel or knife to partially separate the lateral muscle block. The cut surface is gently opened to reveal the butterfly shape. The butterfly shrimp is then coated with a thin layer of pre-dust battered either with a conventional (adhesive) batter or a tempura batter. The battered butterfly shrimp is then breaded either with Japanese style light coloured coarse crumbs or with darker coloured crumbs. It is then arranged in PVC/polystyrene trays, preferably in "well" trays and vacuum packed in laminated pouches. The product is then frozen by blast freezing at -40°C and stored at a temperature below -18°C in master cartons. Generally, the products from farmed shrimp have indicated longer shelf life of 16-18 months compared to those from wild variety which had a shelf life of 12-14 months at -20 °C.

3.6 Enrobed Cephalopod Products

3.6.1 Coated Squid Rings

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 (1-2 cm), steamed for 2-3 minutes after marinating it with 5% salt, further cooled, battered and breaded. The coated rings are flash fried, cooled, frozen, packed and stored. The squid rings can also be subjected to hot blanching in 5% brine for less than 5 minutes depending upon the size before coating process.

3.6.2 Coated Octopus Tentacles

Demand for octopus is on the rise in many countries. It is exported to foreign countries from India as it finds generally less consumers in domestic market. Steamed or marinated octopus tentacles can be coated and fried as it is a favorite cuisine in overseas. Octopus tentacles are separated and cut to required size followed by tenderization (steaming/hot blanching/salt-vinegar treatment/pressure cooking) of the meat and further coated, flash fried, frozen, packed and stored.

4. Shrimp Specialty Products

Products with unique features or functions have inordinate demand in the international markets and it usually fetches three to four times' higher value than the raw material. As shrimp is the most important fishery commodity traded globally and single most consumed seafood in the world, the specialty products from shrimp have greater scope to increases export earnings.

4.1 Centre-peel shrimp

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water. Peel at the centre retaining the head, the last segment and the tail fans. De-vein by inserting a pointed needle or pointed bamboo stick between the segments dorsally and lifting off the vein. Remove the telson by gently raising upwards. Trim off the head and tail fans to reduce the sharpness to avoid damage of the package.

Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40^{o}C & storage below -18°C in master carton

4.2 Cooked centre peel shrimp

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water. De-vein by inserting a pointed needle or pointed bamboo stick between the segments dorsally and lifting off the vein. Remove the telson by gently raising up wards. Cook the shrimp in 1% boiling brine for 2-3 minutes depending on the size grades. Cool in chilled water. Peel at the centre retaining the head, the last segment and the tail fans. Trim off the head and tail fans to reduce the sharpness to avoid the damage of the package.

Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C & storage below -18°C in master carton

4.3 Easy-peel shrimp

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. De-vein by inserting a pointed needle or pointed bamboo stick between the segments dorsally and lifting off the vein. Remove the telson by gently raising up wards. Cut the cuticle up to end of the last segment dorsally or laterally leaving it intact, just to make the cooked shrimp easy to peel.

Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C and storage below -18°C in master carton

4.4 Cooked easy-peel shrimp

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. De-vein by inserting a pointed needle or pointed bamboo stick between the segments dorsally and lifting off the vein. Remove the telson by gently raising up wards. Cook the shrimp in 1% boiling brine for 2-3 minutes depending on the size grades. Cool in chilled water. Cut the cuticle, up to the end of the last segment dorsally or laterally leaving it intact.

Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C and storage below -18° C in master carton

4.5 Shrimp skewer

Raw Material: Freshwater prawn (*M. rosenbergii*)/ Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. Remove the telson by gently raising upwards. Peel the shrimp completely, including the tail fans and de-vein. Arrange 4-5 pieces in a skewer in an inverted "U" shape.

Packaging: Arrange the skewered shrimp in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C and storage below -18°C in master carton

4.6 Fantail round

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. Remove the telson by gently raising up wards. Peel the shrimp leaving the shell intact on the last segment and the tail fans. De-vein the shrimp and trim the tail fans using a pair of scissors

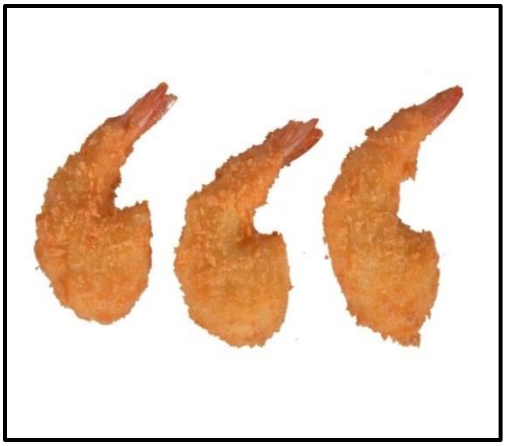
Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C and storage below -18°C in master carton

4.7 Coated fantail round

Raw Material: Fantail round shrimp pre-dust, batter and bread crumbs

Process: Coat the Fantail round shrimp with a thin layer of pre-dust either manually or using a pre-dusting machine. Coat the pre-dusted shrimp either with a conventional (adhesive) batter or a tempura type batter, depending upon the market. Coat the battered shrimp with breading (Japanese style light coloured coarse crumbs for Japan Markets and darker coloured crumbs (yellow-orange) for European and US Markets.



Packaging: Arrange in PVC/polystyrene trays, preferably in "well" trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40^{o}C and storage below -18°C in master carton

4.8 Butterfly shrimp

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. Remove the telson by gently raising up wards. Peel the shrimp leaving the shell intact on the last segment and the tail fans. De-vein the shrimp and trim the tail fans using a pair of scissors. Cut through the dorsal side length-wise using a sharp scalpel or knife (Butterfly cut) to

partially separate the lateral muscle block. Gently open up the cut surface to reveal the butterfly shape.

Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C and storage below -18°C in master carton

4.9 Coated butterfly shrimp

Raw Material: Butterfly shrimp pre-dust, batter and bread crumbs

Process: Coat the butterfly shrimp with a thin layer of pre-dust either manually or using a pre-dusting machine. Coat the pre-dusted shrimp either with a conventional (adhesive) batter or a tempura type batter, depending upon the market. Coat the battered shrimp with breading (Japanese style light coloured coarse crumbs for Japan Markets and darker coloured crumbs (yellow-orange) for European and US Markets.

Packaging: Arrange in PVC/polystyrene trays, preferably in "well" trays and vacuum pack in laminated pouches.

Freezing & Storage: Blast freezing at –40°C and storage below -18°C in master carton

4.10 Butterfly "Sushi" shrimp

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. Remove the telson by gently raising upwards and de-vein. Insert bamboo skewer along the dorsal side length-wise up to the last segment so as the

stretch the shrimp completely. Blanch/lightly cook in 1% boiling brine for 1-2 minutes depending on the size grades. Cool in chilled water. Peel the cooked shrimp completely, including the tail fans. Cut the gently down the ventral side length-wise up to the last segment using a sharp scalpel or knife without damaging the lateral muscle blocks on either side. Gently open up the cut surface to form the butterfly shape.

Packaging: Arrange in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40^{o}C and storage below -18°C in master carton

4.11 Stretched shrimp (Nobashi)

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. Remove the telson and trim the tail fans. Peel the shrimp, leaving the shell intact on the last segment and the tail fans. Make three or four parallel cuts, across or diagonally on the ventral side using a sharp razor. Stretch the shrimp to the desired length by gently pressing it using a stainless steel mould.

Packaging: Arrange in PVC/polystyrene trays, preferably in "well" trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40^{o}C and storage below -18°C in master carton

4.12 Breaded "Nobashi"

Raw Material: Stretched shrimp (Nobashi), pre-dust, batter and bread crumbs

Process: Coat the stretched shrimp with a thin layer of pre-dust either manually or using a pre-dusting machine. Coat the pre-dusted shrimp either with a conventional (adhesive) batter or a tempura type batter, depending upon the market. Coat the battered shrimp with breading (Japanese style light coloured coarse crumbs for Japan Markets and darker coloured crumbs (yellow-orange) for European and US Markets.

Packaging: Arrange in PVC/polystyrene trays, preferably in "well" trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C and storage below -18°C in master carton

4.13 Shrimp single kebab (Barbecue)

Raw Material: Freshwater prawn (*M. rosenbergii*) / Vannamei shrimp 26/30 to 31/40 counts/kg

Process: Wash the whole shrimp in potable water and remove the head. Peel the shrimp completely and devein. Insert a bamboo skewer along the dorsal side length-wise up to the last segment so as to stretch the shrimp completely.

Packaging: Arrange the skewered shrimp in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40°C below -18°C in master carton

4.14 Shrimp vegetable kebab

Raw Material: Shrimp (any species), carrots, onion and capsicum

Process: Wash the whole shrimp in potable water, remove the head, Peel and de-vein. Blanch in 1% boiling brine for 15-30 seconds and cool in chilled water. Wash the vegetables in potable water and dice to approximately 2 cm cubes or cut into square pieces and blanch in 1% boiling brine for 30-60 seconds and cool in chilled water. Arrange in skewer, shrimp alternating with diced vegetables

Packaging: Arrange the skewered shrimp vegetables in PVC/polystyrene trays and vacuum pack in laminated pouches

Freezing & Storage: Blast freezing at –40^{o}C and storage below -18°C in master carton

5. Marination of Fish

Value of fresh, frozen, salted, and dried fishes can be increased by the process of marinating it with spices, sugar solutions, oil, plant extracts, acids like vinegar, fruit juice, and wine to enhance the flavour, tenderness, juiciness, and also to extend the shelf life. Seafood such as squid, mussel, shrimp, sea snail, cuttlefish, and octopus etc. are also used for marination. These products are attracting customers because of their typical flavour, and textural properties. Tenderizing agents like acetic acid is added for texture modification and for better absorption of masala into the fish. The masala used can be theme based, for example mint based, fruit and vegetable based etc. After marinating with the masala, garnishing agents like dry mango, onion etc. can be used to make the product appealing. Selected extracts can be further used for augmenting the taste.

Marinated fish products serve as a good additive in the diet as these products are rich in essential nutrients required. Marinated products are rich source of essential amino acids which are also responsible for flavour and taste. They also contain significant amount of n-3 long chain polyunsaturated fatty acids such as eicosapentaenoic acid and docosahexaenoic acid.

Traditionally, marinades are products with typical flavour prepared from fish by treating it with edible acid and salt and these can be put in a medium such as brine, sauce or oil. The process of marination involves an increase in ionic strength and a decrease in pH which brings desirable change in taste, texture, flavour of marinades. Along with preservative effect acid gives characteristics succulence and tenderness to the marinated fish. Addition of salt aids in extraction of salt out from the fish tissues, helps in coagulation of protein and proteolysis happens in a desired level.

As most of the marinated products contain acid, it should be done in a glass, ceramic or stainless steel container. Aluminium containers should be avoided. Further, the products should be properly covered and refrigerated.

5.1 Flavour enhancers used in marination

Other than acid and salt, different flavour enhancers are used in these semi preserves to augment the palatability and shelf life. Different kinds of sauces are among the major flavour enhancers used in the marinated products. Tomato sauce, pomegranate sauce and olive lemon juice sauce are suitable for the marinated products. Sauces with spices, salt, condiments and sugar further increases the quality of the marinated products. As discussed, additives such as spice, sauce, cream, oil, mayonnaise, parsley and dill is found to have essential effects on quality of marinades. Other than this, different vegetables and sauces like garlic, pasteurized hot pepper etc. are also suitable for the purpose. Commercial lemon pepper and eugenol extract are also used as flavour enhancers. Another category of additives are oils. Oils such as sunflower oil, corn oil, essential oil, and vegetable oil are also suitable for the marinated products. Use of plant extracts like myrtle, rosemary, and nettle extracts with brine have preservative effects when added in the marinated products.

Marination of fish has greater scope as these products have huge demand in the market due to its typical taste, texture, and flavour properties. New flavours can be added to attract the modern customers in domestic and overseas markets.

6. Marinated Fish Products

6.1 Hariyali Fish Skewer

It is a popular appetizer made with green masala 'Hariyali'. The masala is made from a blend of spinach, coriander leaves and spiced with popular spices. The masala mix can be used to marinate fish cubes and fillets. Other varieties such as shrimps can also be used for marination.

6.1.1 Ingredients required

Ingredients	Quantity
Fish cubes/fillet	1 kg
Cashew nut	50 g
Spinach	240 g
Carom seeds	3 g
Black pepper	10 g
Salt	20 g
Black salt	12 g
Garlic	35 g
Ginger	35 g
Green chilli	45 g
Celery	90 g
Pudina	20 g
Coriander leaf	45 g
Lemon juice	60 g
Curd	320 g
Sugar	3 g
Gram flour	5 g

6.1.2 Method of preparation

Dress the fish and fillet it. Cut the fillet into cubes or can be used as such. Initially, marinate it with curd and salt. Keep it for 30 minutes at rest in chilled conditions for tenderization. For marination, boil cashew nut and blanch spinach separately. Drain excess water and keep aside. Grind the carom seed, black pepper, and black salt in a mixer grinder in dry condition. Add the boiled cashew nut to it and grind it well. To this, add ginger, garlic, and grind it again. Add spinach, green chilli, celery, pudina, coriander leaf, and lemon juice to the mix. Grind the marinating mix well and add sugar and gram flour. Apply the mix on the fish and keep for 30 minutes in chilled conditions. For final consumption, the marinated product can be subjected to tawa frying or grilling till properly cooked.

6.2 Fish Karachi

Crispy and spicy marinated fish can be prepared with Karachi masala mix made with gram flour, and spice mix. Fish as cubes and fillets can be used for the purpose of marination.

6.2.1 Ingredients required

Ingredients	Quantity
Fish cubes/fillet	1 kg
Vinegar	30 g
Gram flour	200 g
Chilli flakes	45 g
Coriander	45 g
Jeera powder	45 g
Coriander powder	45 g
Salt	20 g
Garlic paste	25 g

6.2.2 Method of preparation

Dress the fish and fillet it. Cut the fillet into cubes and marinate it with vinegar and salt. Keep it for 30 minutes at rest in chilled conditions for tenderization. Meanwhile grind the marinating mix well and apply the mix on the fish and keep for 30 minutes in chilled conditions. For final consumption, the marinated product can be subjected to tawa frying or grilling till properly cooked.

6.3 Fish Amritsari

Fish Amritsari is a popular appetizer of Punjab. This is a simple dish as this style of marination uses a very light coating of different ingredients including gram flour, carrom seed (Ajwain), chilli powder, and garam masala.

6.3.1 Ingredients required

Ingredients	Quantity
Fish cubes/fillet	1 Kg
Gram flour	80 g
Kashmiri chilli powder	20 g
Carrom seed	4 g
Curd	80g
Black salt	1.5 g
Garam masala	4g
Coriander leaves	20 g
Vinegar	20 g
Salt	4 g
Sugar	6 g

6.3.2 Method of preparation

Dress the fish and fillet it. Cut the fillet into cubes and marinate it with vinegar and salt. Keep for half an hour at rest in chilled conditions. Grind the marinating mix well and marinate the fish under chilled conditions for 30 minutes. Fry in a tawa or grill till all sides are properly cooked.

7. Quality Issues in Battered and Breaded Fishery Products

Enrobed fishery products include fish portions, fillets or mince coated with batter and/or breading (FSSAI, 2011).

7.1 Quality requirements

Product category: Quick frozen fish sticks (fish finger)**,** fish portions and fish fillets – Breaded or Battered **(**Food Safety and Standards (Food Products Standards and Food Additives), Regulations, 2011.

- Quick frozen breaded or battered fish sticks (fish fingers), breaded or battered fish portions and breaded or battered fillets shall be prepared from **fish fillets or minced fish flesh, or mixtures** thereof, of edible species which are of a quality such as to be sold fresh for human consumption.

Fish stick

- The average percent of fish flesh must not be less than 50% of total weight.
- Each stick shall be not less than 10 mm thick
- Fish sticks or portions may be prepared from a single species of fish or from a mixture of species with similar sensory properties

Fish portion

- A fish portion including the coating may be of any shape, weight or size
- Fish portions may be prepared from a single species of fish or from a mixture of species with similar sensory properties

Fillets

- Slices of fish of irregular size and shape, which are removed from the carcass by cuts made parallel to the back bone and pieces of such fillets, with or without the skin

Histamine

- The products shall not contain more than **10 mg/100 g of histamine** in the species mentioned in the list of histamine formers

Defects

- **Foreign matter** (cooked state), not been derived from fish (excluding packing material) – Indication of non-compliance with good manufacturing and sanitation practices
- **Bones** (cooked state) (in packs designated as boneless) - One bone per kg greater or equal to 10 mm in length, or greater or equal to 1 mm in diameter; a bone less than or equal to 5 mm in length, is not considered a defect if its diameter is not more than 2 mm. The foot of a bone shall be disregarded, if its width is less than or equal to 2 mm, or if it can easily be stripped off with a fingernail.
- **Odour and flavour** - Persistent and distinct objectionable odour and flavour indicative of decomposition, or rancidity or of feed.
- **Flesh abnormalities** - Objectionable textural characteristics such as gelatinous conditions of the fish core together with greater than 86 % moisture found in any individual fillet or sample unit with pasty texture resulting from parasites affecting more than 5 % of the sample unit by weight.
- **Storage temperature**: The product shall be stored at -18 °C or lower and shall be declared on the label.

GENERAL QUALITY PARAMETERS

SrNo.	Parameter	FSSR Limit	Test Method
1	Moisture content	Less than 86% of total weight	FSSAI-MoMAF-F&FP
2	Presence of parasites	Less than 5% of the sample unit by weight	Visual observation
3	Presence of bones ((in packs designated as boneless)	a. One bone per kg greater or equal to 10 mm in length, or greater or equal to 1 mm in diameter b. a bone less than or equal to 5 mm in length, is not considered a defect if its diameter is not more than 2 mm. The foot of a bone (where it has been attached to the vertebra) shall be disregarded if its width is less than or equal to 2 mm, or if it can easily be stripped off with a fingernail)	Visual observation
4	Odour and flavor	Absence of objectionable odour and flavours indicative of decomposition, or rancidity	Sensory analysis
5	Flesh abnormalities	Absence of gelatinous conditions of the fish core together	Sensory analysis
6	Average percent of fish flesh	Not less than 50% of total weight	FSSAI-MoMAF-F&FP
7	Thickness of fish finger	Not less than 10mm	FSSAI-MoMAF-F&FP
8	Foreign Mater	Nil	Visual observation

(FSSAI, "food-'o'-copeia")

7.2 Identification of hazards and defects

Processing of quick-frozen coated fish products

(FAO and WHO, 2020. Code of Practice for Fish and Fishery Products)

(*Refer Annexure 1 for details*)

Processing step	Potential hazards
Reception-Fish	Chemical, biochemical and microbiological contamination, scombrotoxin
Reception-Other ingredients	Chemical, biochemical and microbiological contamination
Reception-Packaging materials	Foreign matter
Production of fish core- Sawing	Foreign material (metal or plastic parts of saws)
Production of fish core- Application of additives and ingredients	Foreign material, microbiological contamination, scombrotoxin
Production of fish core- Forming	Foreign material (metal or plastic from machine) and/or Microbiological contamination/scombrotoxin (fish mixture only)
Coating- Wet/Dry coating	Microbiological contamination
Re-freezing – final freezing	Foreign material
Packaging and labelling	Microbiological contamination

1. Reception of raw materials

a. Fish

- Potential hazards: Chemical, biochemical and microbiological contamination, scombrotoxin
- Potential defects: Tainting, block irregularities, water and air pockets, packaging material, foreign matter, parasites, dehydration, decomposition

Technical guidance

- Temperature of all incoming lots should be recorded
- Packaging material of frozen products should be examined for dirt, tearing and evidence of thawing
- Cleanliness and suitability of the transport vehicle to carry frozen fish products should be examined

- Use of temperature recording devices with the shipment is recommended
- Representative samples should be taken for further examination for possible hazards and defects

b. Other ingredients

- Potential hazards: Chemical, biochemical and microbiological contamination
- Potential defects: Mould, color deviations, filth, sand

Technical guidance

- Breading and batter should be inspected for broken packaging material, signs of rodent and insect infestations and other damage such as dirt on packaging materials and wetness
- Cleanliness and suitability of the transport vehicle to carry food products should be examined
- Representative samples of the ingredients should be taken and examined to ensure that the product is not contaminated and meets specifications for use in the end product
- Ingredients should be shipped on transportation vehicles that are suitable for handling food products and ingredients. Vehicles that have previously hauled potentially unsafe or hazardous material should not be used for hauling food products or ingredients

c. Packaging materials

- Potential hazards: Foreign matter
- Potential defects: Tainting of products

Technical guidance

- Packaging material used should be clean, sound, durable, sufficient for its intended use and of food-grade material
- For pre-fried products, it should be impermeable for fat and oil
- Cleanliness and suitability of the transport vehicle to carry food packaging material should be examined
- Pre-printed labelling and packaging material should be examined for accuracy

2. Storage of raw material, other ingredients and packaging materials

a. Fish - Frozen storage

- Potential hazards: Microbiological contamination, toxins, viable parasites
- Potential defects: Dehydration, rancidity, loss of nutritional quality

Technical guidance

- The facility should be capable of maintaining the temperature of the fish at or colder than –18 °C, and with minimal temperature fluctuations
- The store should be equipped with a calibrated indicating thermometer
- Fitting of a recording thermometer is strongly recommended
- A systematic stock rotation plan should be developed and maintained
- Product should be glazed and/or wrapped to protect it from dehydration
- Fish should be rejected if known to contain defects that subsequently cannot be reduced or eliminated to an acceptable level by re-working
- An appropriate assessment should be carried out to determine the reason(s) for loss of control and modify the DAP plan where necessary
- For killing parasites harmful to human health, the freezing temperature and monitoring of the duration of freezing should be combined with good inventory control to ensure sufficient cold treatment

b. Fish - Chilled storage

- Potential hazards: Microbiological contamination, biotoxins, scombrotoxin
- Potential defects: Decomposition, physical damage

Technical guidance

- Fish should be moved to the chilled storage facility without undue delay
- The facility should be capable of maintaining the temperature of fish between 0 °C and 4 °C.
- The chill room should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended
- Stock rotation plans should ensure proper utilization of the fish

- Fish should be stored in shallow layers and surrounded by sufficient finely divided ice or with a mixture of ice and water before processing
- Fish should be stored in such a way as to prevent damage from over-stacking or overfilling of boxes
- Where appropriate, replenish ice supply on the fish or alter temperature of the room

c. Other ingredients and packaging materials

- Potential hazards: Biological, physical and chemical contamination
- Potential defects: Loss of quality and characteristics of ingredients, rancidity

Technical guidance

- All other ingredients and packaging material should be stored in a dry and clean place under hygienic conditions
- All other ingredients and packaging material should be stored appropriately in terms of temperature and humidity
- A systematic stock rotation plan should be developed and maintained to avoid out-of-date materials
- Ingredients should be protected from insects, rodents and other pests
- Defective ingredients and packaging material should not be used

3. Frozen fish block/fillet tempering

- Potential hazards: Unlikely
- Potential defects: Incorrect dimension owing to sawing of over-softened fish flesh (applies to fish sticks)

Technical guidance

- Depending on the use of the fish, the tempering of frozen fish blocks/fillets should be carried out in a manner that will allow the temperature of the fish to rise without thawing
- Tempering block/fillets of frozen fish in chilled storage is a slow process that usually requires at least 12 hours or more

- Over-softening of the outer layers is undesirable (poor performance during sawing) and should be avoided
- It can be avoided if facilities used for tempering are maintained at a temperature of 0–4 °C and if fish blocks/fillets are stacked in layers
- Microwave tempering is an alternative method but should also be controlled to prevent softening of outer layers

4. Unwrapping, unpacking

- Potential hazards: Microbiological contamination
- Potential defects: Remaining undetected packaging material, contamination by filth

Technical guidance

- During unwrapping and unpacking of fish blocks, care should be taken not to contaminate the fish
- Special attention has to be given to cardboard and/or plastic material partly or fully embedded in the blocks
- All packaging material should be disposed of properly and promptly
- Protect wrapped, unwrapped and unpacked fish blocks when cleaning and sanitizing processing lines during breaks and between shifts if the production process is interrupted

5. Production of fish core

a. Sawing

- Potential hazards: Foreign material (metal or plastic parts of saws)
- Potential defects: Irregularly shaped pieces or portions

Technical guidance

- Sawing instruments should be kept in clean and hygienic conditions
- Saw-blades must be inspected regularly in order to avoid tearing of the product and breakage
- Sawdust must not collect on the saw-table and must be collected in special containers if used for further processing

- Sawn shims used to form irregularly shaped fish cores by mechanical pressure should be kept in clean, hygienic conditions until further manufacturing

b. Application of additives and ingredients

- Potential hazards: Foreign material, microbiological contamination, scombrotoxin
- Potential defects: Incorrect addition of additives, decomposition

Technical guidance

- The temperature of the product in the mixing process should be adequately controlled to avoid the growth of pathogenic bacteria, and scombrotoxin formation

c. Forming

- Potential hazards: Foreign material (metal or plastic from machine) and/or microbiological contamination/scombrotoxin (fish mixture only)
- Potential defects: Poorly formed fish cores, cores subjected to too much pressure (mushy, rancid), decomposition

Technical guidance

- Forming of fish cores is a highly mechanized method of producing fish cores for battering and breading
- It utilizes either hydraulic pressure to force shims (sawn portions of fish blocks) into moulds that are ejected onto the conveyor belt or mechanical forming of fish mixtures
- Forming machines should be kept in hygienic conditions
- Formed fish cores should be examined closely for proper shape, weight and texture

6. Separation of pieces

- Potential hazards: Unlikely
- Potential defects: Adhering pieces or portions

Technical guidance

- The fish flesh cores cut from the blocks or fish fillets or other irregular-shaped quick frozen fish material must be well separated from one another and should not adhere to one another
- Fish cores that are touching one another going through the wet-coating step should be removed and placed back on the conveyor in order to obtain a uniform batter coat and a uniform breading pick-up
- Cored fish should be monitored for foreign material and other hazards and defects before coating
- Remove from production any broken, misshapen or out-of-specification pieces

7. Coating

- In industrial practice, the order and the number of coating steps may differ and, therefore, may deviate considerably from this scheme

Pre-dusting: Pre-dusting involves the use of a soft and dry substance that is applied to the wet surface of the food before further coating, and it reduces the gaps between the coating and the food surface and it can be used as a good flavor carrier by adding spices to it.

Role of additives in coated products (*Refer Annexure* 2)

Additives play several essential roles in coated products, especially those coated with batter and bread crumbs. These additives are used in small quantities and serve various purposes to enhance the quality, appearance, and shelf life of the coated food. Some common additives used in coated products include:

- Stabilizers and Emulsifiers: These additives help to maintain the stability of the batter and prevent it from separating or becoming too thin. They also assist in forming a smooth and consistent batter, ensuring even coating on the food.
- Thickeners: Thickeners are used to increase the viscosity of the batter, which helps it adhere better to the food surface. This results in a more even and uniform coating.

- Leavening Agents: Leavening agents, such as baking powder or yeast, are used to create air bubbles in the batter. When the coated food is fried, these air bubbles expand, giving the coating a light and crispy texture.
- Flavor Enhancers: Additives like monosodium glutamate (MSG) or yeast extract are sometimes used to enhance the overall flavor of the coated product, making it more appealing to consumers.
- Colorants: Additives like annatto, turmeric, or paprika are used to give the coating a desirable color. This helps make the food more visually attractive and appealing.
- Anti-Caking Agents: Anti-caking agents prevent the bread crumbs from clumping together, ensuring a uniform and even coating on the food.
- Antioxidants: Antioxidants are used to prevent the fats and oils in the coating from becoming rancid during storage, thus extending the shelf life of the coated product.
- Salt and Seasonings: Salt and various seasonings are often added to the coating to enhance the taste of the final product.
- Egg Wash: While not a traditional additive, an egg wash is often used as a coating before applying breadcrumbs. The egg wash helps the breadcrumbs adhere better to the food and gives the coating a golden brown color when fried.

Technical guidelines

- Pat Dry the Food**:** Before coating, make sure the fish is patted dry with paper towels. Excess moisture can create steam during frying, leading to air pockets in the coating.
- Preheat the Oil: Ensure that the frying oil is preheated to the right temperature (usually between 350°F to 375°F or (175°C to 190°C). A proper temperature helps to seal the coating quickly, reducing the chances of air pockets forming.
- Use a Double-Dip Method: After coating the food in batter, let it sit for a minute or two before applying the bread crumbs. The double-dip method helps to create a sturdier coating, reducing the likelihood of air pockets.

- Press the Coating Firmly: Gently press the bread crumbs onto the food after applying them. This helps to secure the coating and eliminates air pockets.
- Shake off Excess Coating: Before frying, shake off any excess batter or bread crumbs from the food. Too much coating can lead to irregularities and air pockets during frying.
- Fry in Batches: Avoid overcrowding the frying pan or deep fryer. Frying in batches ensures that the food cooks evenly and allows you to maintain the oil temperature consistently.
- Maintain Oil Temperature: Keep an eye on the oil temperature throughout the frying process. Fluctuating temperatures can cause the coating to separate from the food and create air pockets.
- Avoid Overcooking: Overcooking the coated food can cause the moisture inside to turn into steam, leading to air pockets. Cook the food until it reaches the desired level of crispiness without becoming overly dry.
- Drain on a Rack: After frying, place the coated food on a wire rack instead of paper towels. This prevents steam from getting trapped under the food, helping to maintain the crispness of the coating.

There are certain additives that can help to avoid air pockets in coated food products with batter and bread crumbs. One such additive is the use of a foam stabilizer. Foam stabilizers work by enhancing the stability of the batter and reducing the formation of large air bubbles during the frying process. This can result in a smoother, more even coating on the food, reducing the likelihood of air pockets.

One common foam stabilizer used in the food industry is methylcellulose. Methylcellulose is a hydrocolloid derived from cellulose, and it has the ability to create stable foams when incorporated into the batter. It helps to trap air bubbles, preventing them from expanding too much during frying and reducing the risk of air pockets forming in the coating.

When using a foam stabilizer like methylcellulose, it's essential to follow the manufacturer's guidelines regarding the appropriate usage levels and mixing

procedures. Additionally, it's crucial to conduct some trials to determine the optimal amount of stabilizer needed for your specific coated food product.

Remember that while additives like foam stabilizers can be helpful in achieving a smoother coating, it's also essential to consider other factors mentioned in the earlier response, such as proper drying of the food, preheating the oil, and ensuring a uniform coating process. A combination of good practices and appropriate additives can lead to high-quality coated food products with minimal air pockets.

a. Wet coating

- Potential hazards: Microbiological contamination
- Potential defects: Insufficient cover or excessive cover of coating

Technical guidance

- Fish pieces must be well coated from all sides
- Surplus liquid, which should be reused, must be re-transported under clean and hygienic conditions
- Surplus liquid on fish pieces should be removed by clean air
- Viscosity and temperature of hydrated batter mixes should be monitored and controlled within certain parameters to effect the proper amount of breading pick-up
- To avoid microbiological contamination of the hydrated batter, appropriate means should be adopted to ensure that significant growth does not take place, such as temperature control, dumping liquid contents and regular or scheduled clean-ups and/or sanitation during the manufacturing shift

b. Dry coating

- Potential hazards: Microbiological contamination
- Potential defects: Insufficient cover or excessive coating

Technical guidance

- Dry coating must cover the whole product and should stick well on the wet coating

- Surplus coating is removed by blowing away with clean air and/or by the vibration of conveyors and must be removed in a clean and hygienic way if further use is intended
- Flow of breading from the application hopper should be free, even, and continuous.
- Coating defects should be monitored and be in accordance with the standard
- The proportion of breading and fish core should be in accordance with the standard

8. Pre-frying

There are some variations in industrial production for the frying process in so far that quick frozen coated products are completely fried including fish core and re-frozen later. For this case, alternative hazards and defects have to be described and not all statements in this section apply. In some regions, it is common practice to manufacture raw (not pre-fried) coated fish products.

- Potential hazards: Unlikely
- Potential defects: Over-oxidized oil, insufficient frying, loosely adhering coating, burnt pieces and portions

Technical guidance

- Frying oil should have a temperature between approximately 160 °C and 195 °C.
- Coated fish pieces should remain in frying oil for sufficient time depending on the frying temperature in order to achieve a satisfying colour, flavour and structure to adhere firmly to the fish core, but core should be kept frozen throughout the whole time.
- Frying oil has to be changed when its colour becomes too dark or when the concentration of fat degradation products exceeds certain limits.
- Remains from coating that concentrate at the bottom of the frying bath have to be removed regularly to avoid partial dark coloration on coated products caused by the upwelling of oil.

- Excessive oil should be removed from coated products after pre-frying by a suitable device.

9. Re-freezing – final freezing

- Potential hazards: Foreign material
- Potential defects: Insufficient freezing leads to sticking of units to one another or to walls of freezing equipment and facilitates mechanical removal of breading/batter

Technical guidance

- The whole product should be re-frozen to –18 °C or below immediately after pre-frying.
- Products should be allowed to stay sufficient time in freezer cabinet to ensure core temperature of products of –18 °C or lower.
- Cryogenic freezers should have sufficient compressed gas flow to effect proper freezing of the product.
- Processors that utilize blast freezers may package the product in the consumer containers before freezing.

10. Packaging and labelling

a. Weighing

- Potential hazards: Unlikely
- Potential defects: Incorrect net weight

Technical guidance

- Weigh scales should be periodically calibrated with a standard mass to ensure accuracy

b. Labelling

- Potential hazards: Unlikely
- Potential defects: incorrect labelling

Technical guidance

- Prior to their application, labels should be verified
- In many cases, it will be possible to re-label incorrectly labelled products

- An appropriate assessment should be carried out to determine the reason(s) for incorrect labelling and the DAP plan should be modified where necessary

c. Wrapping and packaging

- Potential hazards: Microbiological contamination, scombrotoxin
- Potential defects: Subsequent dehydration, decomposition

Technical guidance

- Packaging material should be clean, sound, durable, sufficient for its intended use and of food-grade material
- The packaging operation should be conducted to minimize the risk of contamination and decomposition
- Products should meet appropriate standards for labelling and weights

d. Metal detection

- Potential hazards: Metal contamination
- Potential defects: Unlikely

Technical guidance

- It is important that line speeds are adjusted to allow for the proper functioning of a metal detector
- Routine procedures should be initiated to ensure product rejected by the detector is investigated as to the cause of the rejection
- Metal detectors, if used, should be periodically calibrated with a known standard to ensure proper operation
- Products in their final packaging should undergo metal detection using equipment set to the highest sensitivity possible
- Since larger packs will be detected at a lower sensitivity than smaller packs, consideration should be given to testing the product prior to packaging. However, unless potential re-contamination prior to packaging can be eliminated, it remains more prudent to perform metal detection once packaged.

11. Storage of end products

- Potential hazards: Unlikely

- Potential defects: Texture and flavour deviations owing to fluctuations in temperature, deep freezer burn, cold store flavour, cardboard flavour

Technical guidance

- All end products should be stored at frozen temperature in a clean, sound and hygienic environment
- Severe fluctuations in storage temperature (more than 3 °C) have to be avoided
- Too long storage time (depending on fat content of species used and type of coating) should be avoided
- Products should be properly protected from dehydration, dirt and other forms of contamination
- All end products should be stored in the freezer to allow proper air circulation

12. Transportation of end product

- Potential hazards: Unlikely
- Potential defects: Thawing of frozen product

Technical guidance

- Vehicles should be designed and constructed such that walls, floors and ceilings, where appropriate, are made of a suitable corrosion-resistant material with smooth, non-absorbent surfaces. Floors of the vehicle should be easily drainable
- Cleanliness and suitability of the transport vehicle to carry frozen food products should be examined
- Equipments in the transportation vehicle viz. chiller (for storing chilled fish/ shellfish) and freezer (for storing frozen fish/ shellfish) should be maintained at 0 °C and –18 °C (maximum fluctuation ±3 °C), respectively until final destination of product is reached except for brine frozen fish intended for canning, which may be transported at –9 °C or colder.
- Live fish and shellfish are to be transported at temperatures tolerable for the species
- Use of temperature-recording devices with the shipment is recommended

7.3 Microbiological Requirements for Battered and Breaded Fishery Products (FSSAI, 2011)

Parameter	Sampling Plan		Limits (cfu/g)	
	n	c	m	M
Aerobic Plate Count	5	2	$1x10^5$	$1x10^7$
Coagulase positive Staphylococci	5	1	$1x10^2$	$1x10^3$
Yeast & mould count	5	0	100	
Escherichia coli	5	2	11	500
Salmonella	5	0	Absent/25 g	
Vibrio cholerae (O1 and O139)	5	0	Absent/25 g	
Listeria monocytogenes	5	5	Absent/25 g	

Sampling Plan: n = Number of units comprising a sample. c = Maximum allowable number of units having microbiological counts above m. m = Microbiological limit that may be exceeded number of units c. M = Microbiological limit that no sample unit may exceed.

8. Packaging of battered and breaded fishery products

Packaging is the method used to preserve food products during distribution, sales, and storage. Packaging plays a crucial role in protecting and ensuring the quality and safety of food products till it reaches the consumer. It involves safeguarding the product from factors like moisture, temperature, shock, vibration, compression, heat, oxygen, dust, and bacteria. It also helps to maintain the sensory properties and keeping quality of the product and thus shelf-life of the product is improved with the help of proper packaging.

8.1 Functions/Objectives of Packaging

The primary objectives of packaging are:

- To contain and protect the food
- To facilitate the convenience of handling and food preparation
- To provide protection from contamination, physical damage, moisture, and temperature
- To ensure proper hygiene for food
- To provide information about the food product to the end consumer
- To make the product more appealing and attractive to the end consumer
- To facilitate attractive display/presentation of the product to the end consumer in supermarkets and shops, making it help to stand out from similar products: Marketing tool/Silent salesman
- Provide information on the history of the preservation of the product to the end consumer

8.2 Type of Packaging Materials

- Paper - Paper and paperboard products
- Cellulose products - Cellophane
- Metals - Tin plates, Aluminum

- Glass
- Wood
- Rubber
- Plant fibres
- Ceramics
- Bioplastics

Synthetic materials/plastics

- Polyethylene (LDPE, HDPE, LLDPE)
- Polypropylene
- Polystyrene
- Polyvinyl chloride (PVC)
- Polyester
- Polycarbonates

8.3 Packaging Types

- Flexible Packaging: Includes materials like paper, flexible laminates, and plastic films.
- Semi-rigid Packaging: Includes materials like aluminum foil, laminates, paperboard, and thermoformed plastic.
- Rigid Packaging: Includes materials like wood, glass, metals, and hard plastics.

8.4 Packaging Levels

In the context of packaging, there are different levels of packaging, each serving a specific purpose in the protection and distribution of products. Here are the main packaging levels:

- *Primary Packaging*: This is the innermost layer of packaging that directly comes in contact with the product. It is designed to provide a barrier and protection to the product and is often in direct contact with food. For example, the primary

packaging of a food product can be a bottle, a can, a bag/pouch, or a blister pack for medicine.

- *Secondary Packaging*: This level of packaging surrounds the primary packages and is used to group them together for easier handling and distribution. It may also provide additional protection to the individual primary packages during transportation and retail display. Secondary packaging can include items like cardboard boxes, cartons, or shrink wrap, which are used to bundle individual items together.
- *Tertiary Packaging*: Tertiary packaging is the outermost layer designed for bulk handling and transportation of products. It is used to protect multiple secondary packages during distribution and warehousing. Tertiary packaging is typically larger and more robust, suitable for palletizing and shipping large quantities of products. Examples of tertiary packaging include wooden crates, pallets, and stretch-wrapped bundles.
- *Ancillary Packaging Materials*: These are additional materials used in packaging that may not fall into the primary, secondary, or tertiary categories but play a supporting role. These materials can include items like labels, stickers, inserts, fillers, cushioning materials, strapping, and tapes. Ancillary packaging materials aid in the presentation, protection, and proper handling of the products.

8.5 Fresh/Chilled Fish Packaging

Packaging for fresh or chilled fish requires specific properties to ensure the product's quality and safety. The following considerations should be present in the packaging:

- Insulation Properties: The packaging should have good insulation properties to maintain the desired temperature of the fish.
- Fresh/chilled fish packaging should include materials that reduce the rate of ice melting.

- Reducing Dehydration and Oxidation: Proper packaging should reduce moisture loss (dehydration) and exposure to air (oxidation), both of which can lead to spoilage and deterioration of the fish.
- Chemical Contamination: The packaging material should be food-grade and free from harmful chemicals that could contaminate the fish.
- Preventing Bacterial Growth: The packaging should be designed to inhibit bacterial growth, reducing the risk of foodborne illnesses.
- Preventing Dripping and Odour: The packaging should be leak-proof to prevent any dripping of fish liquids.

Bulk Fish Packaging

- Containers should be strong
- The weight of the container should be minimal
- It should have good insulation properties
- It should have good barrier properties

o Insulated moulded plastic containers made using HDPE or PP - Polyurethane insulation sandwiched between the inside and outside layers.
  - They are durable and lightweight.
  - They have a lifespan of more than 5 years.
  - They are easy to clean and provide good insulation.

o Moulded containers made from Expanded Polystyrene.
  - Such boxes have minimal weight and provide good insulation. They are easily stackable and easy to handle.

Fresh Fish: Retail Packaging

- Shallow trays made of molded pulp, foam polystyrene, or clear polystyrene
- It can be wrapped in plastic film or from above with a pressed sensitive label.
- Generally, food-grade polyvinyl chloride (PVC) films are used as overwraps.

8.6 Packaging of Frozen Products

Packaging plays a vital role in ensuring the freshness and durability of frozen products. It provides the necessary strength and resistance to preserve the product's quality. For frozen fish packaging, the ideal material should possess the following characteristics:

- Moisture and Aroma Protection: The material should protect the frozen fish from moisture and aroma loss, ensuring the product's quality and freshness are maintained.
- Oxidation and Rancidity Prevention: It should prevent the fish from getting oxidized or rancid, helping to preserve its taste and nutritional value.
- Durable and Tear-resistant: The packaging material should not become brittle or torn easily during freezing, storage, and transportation.
- Low Water Vapor Permeability: The material should have low water vapor permeability to prevent moisture from entering the package and causing freezer burn.
- Low Oxygen Permeability: It should have low oxygen permeability rates to minimize the risk of oxidation and spoilage.
- Odour Retention: The material should retain the fish's odour inside the package, preventing cross-contamination with other foods and ensuring the product's quality and taste remain intact.

Packaging of frozen products

- Primary packaging
- Secondary packaging
- Tertiary packaging

Raw Frozen Fish Products:

a. Block Frozen Products

- Fish is frozen in blocks.

- Low-Density Polyethylene (LDPE) lined duplex board cartons are used to pack the fish.
- Subsequently, these cartons are packed into 5 or 7-ply corrugated fibreboard boxes, known as master cartons.

In the primary packaging of frozen fish and fishery products, low-density polyethylene (LDPE) is commonly used. Some exporters opt for using an LDPE pouch or bag as an alternative to a wrapper. The LDPE used for wrapping is typically 100 gauge, while a thicker 200-gauge LDPE is used for the bag. In certain cases, High Molecular High-Density Polyethylene (HM-HDPE) film, available in 60 and 120-gauge thicknesses, is also used as a cost-effective option. However, this material is not transparent like LDPE film. These packaging materials are chosen for their protective properties and ability to maintain the quality and freshness of frozen seafood products during transportation and storage.

b. **IQF (Individually Quick Frozen) Products**

In the primary packaging of individually quick frozen (IQF) frozen fish, shrimp, and cuttlefish, a plastic unit pouch or wrapper is commonly used. These pouches come in various capacities, ranging from 200 grams to 10 kilograms, depending on the quantity of the frozen seafood product.

- Mono film, co-extruded film, or laminated pouches.
- Unit pouches can be packed into unit/intermediate cartons or packed directly into master cartons.
- 10-micron Biaxially Oriented Polypropylene (BOPP): The most effective film.
- Unit/intermediate cartons made of duplex or 3-ply corrugated fibreboard.

The materials used for constructing the unit pouches include:

- Monolayered LDPE or LLDPE (Linear low-density polyethylene) film
- Co-extruded LLDPE - LDPE, which is a two-layered film
- Co-extruded LLDPE - B - polyamide - B - LLDPE, a multi-layered film

- Five-layered film is likely to contain different combinations of polymers to enhance strength and barrier properties.
- Polyester / LDPE laminate, which combines the properties of both materials.
  - Additionally, some processors use plastic trays made of Expanded Polystyrene (EPS) or Polyethylene Terephthalate (PET) for specific seafood products like head-on shrimps, lobsters, and butterfly shrimps. These trays are either placed in a plastic pouch, which is heat-sealed or in printed paperboard cartons with see-through windows.
  - For butterfly shrimps, after the product is placed on the EPS tray and frozen, they are skin packed with a high-barrier plastic film to provide enhanced protection and preservation during storage and transportation.

8.7 Packaging for Battered and Breaded Products

During storage, the packaging of value-added products may experience changes, such as dehydration, colour variation, rancidity, and other alterations.

- Thermoformed trays made from food-grade materials
- Trays made using PVC, HIPS (High Impact Polystyrene), and HDPE (High-Density Polyethylene) remain unaffected by lower temperatures during frozen storage while effectively preserving the product content.

8.8 Food Safety and Standards (Packaging) Regulations, 2018

As per FSSAI regulations for packaging, the following are the general requirements:

1. Every food business operator shall ensure that the packaging material used complies with these regulations. If Indian Standards are not available, relevant International Standards may be followed.
2. Packaging materials in direct contact with food or likely to come in contact with food must be of food-grade quality.

3. Packaging materials should be suitable for the specific product, storage conditions, and equipment used for filling, sealing, and packaging, as well as transportation.
4. Packaging materials should be able to withstand mechanical, chemical, or thermal stresses during normal transportation. Flexible or semi-rigid containers may require additional overwrap packaging.
5. Food products should be packed in clean, hygienic, and tamper-proof packages or containers.
6. Sealing materials should be compatible with the product, containers, and closure systems used.
7. Tin containers should not be reused for packaging food.
8. Plastic containers of 5 L and above, as well as reusable glass bottles for food packaging, should be durable and easy to clean or disinfect.
9. Printing inks used on food packages should conform to IS: 15495.
10. The printed surface of packaging material should not directly contact food products.
11. Newspaper or similar materials should not be used for storing and wrapping food.
12. In the case of multilayer packaging, the layer in direct contact with food or layers likely to come in contact with food should meet the requirements specified in Schedule I, II, and III of these regulations.
13. The materials listed in Schedule I, II, and III should be compatible with their intended use as packaging material and should not alter the quality and safety of the food product.
14. Food business operators should obtain a certificate of conformity issued by an NABL-accredited laboratory for packaging materials in direct contact with food or layers likely to come in contact with food before use.

Plastic materials intended to come in contact with food products

Plastic materials intended for use in contact with food products must adhere to the following guidelines:

(a) Plastic materials used for manufacturing containers for packing or storing food products must meet the Indian Standards specifications as provided in Schedule – III.

Migration/Leaching:

(b) All plastic packaging materials should pass the prescribed overall migration limit of 60 mg/kg or 10 mg/dm^2 when tested according to IS 9845, with no visible colour migration.

(c) Plastic materials and articles must not release substances in quantities that exceed the specific migration limits.

(d) Pigments or colorants used in plastics in contact with food products and drinking water should conform to IS: 9833.

(e) Products made of recycled plastics, including carry bags, may be used for packaging, storing, carrying, or dispensing food products when standards and guidelines are established by the Food Authority. Such packaging materials must also comply with any other applicable national standards and regulations.

Schedule - IV: List of recommended packaging materials

Fish and fish products or Seafood

- Glass jars with plastic (PP or High-density polyethylene (HDPE) caps
- Metal Containers with metal lid (lacquered tin containers)
- Polyethylene terephthalate (PET) punnets or containers with plastic caps
- Plastic-based multi-layered flexible laminates heat-sealed pouches
- Plastic tray with an overwrap

General Guidance on Fibreboard Boxes and Requirements

Types of Corrugated Board	Maximum Mass of Contents (kg)	Maximum Combined Internal Dimensions of the Box (L + W + H) (mm)	Minimum Bursting Strength of the Board (kgf/cm²) (kPa)	Minimum Edge Crush Test of the Board (kN/m)
Single wall or 3-ply	5	635	6 (600)	3.0
	8	900	8 (800)	4.0
	10	1125	9 (900)	4.25
Double-wall or 5-ply	15	1275	10 (1000)	4.5
	20	1525	12 (1200)	5.0
	25	1715	13 (1300)	5.3
Triple-wall or 7-ply	30	1905	14 (1400)	5.6
	40	2286	17 (1700)	7.0
	55	2667	24 (2400)	9.6
	75	2921	35 (3448)	12.4

Notes:

- Boxes should be made with no single dimension exceeding 50 percent of the combined internal dimensions.
- For calculating the maximum combined dimensions for any intermediate mass content, for each 10 percent reduction in mass of contents below the maximum

permitted for a box, the calculated combined dimensions from the table may be increased by 5 percent.

- Where the compression strength of the box is specified, the Edge Crush Test (ECT) is not necessary.

Food Safety and Standards (Labelling & Display) Regulations, 2020

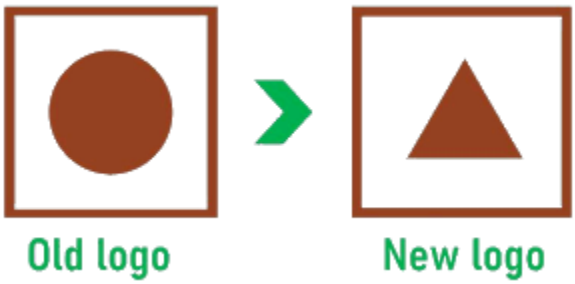
Labelling Requirements:

(1) Name of Food: The name of the food shall be mentioned on each package, indicating the true nature of the food contained in the package.

(2) List of Ingredients

(3) Nutritional Information: Nutritional information per 100 grams or 100 milliliters or per single consumption pack of the product, and the percentage (%) contribution to Recommended Dietary Allowance calculated on the basis of 2000 kcal energy, 67g total fat, 22g saturated fat, 2g trans-fat, 50g added sugar, and 2000mg of sodium (5g salt) requirement for an average adult per day shall be given on the label.

(4) Declaration for Vegetarian or Non-Vegetarian: Non-vegetarian food shall be marked with a symbol inside an equilateral triangle.



(5) Declaration Regarding Food Additives

(6) Name and Complete Address Declaration

(7) FSSAI Logo and License Number

- Logos for Fortified and Organic Foods

Fortified with....
SAMPOORNA POSHAN
SWASTHA JEEVAN

.... से फोर्टिफाइड

सम्पूर्ण पोषण स्वस्थ जीवन

(8) Net Quantity, Retail Sale Price, Consumer Care Details

(9) Lot/Code/Batch Identification

(10) Best Before Date

(11) Labelling of Irradiated Foods

(12) Usage Instructions: For example - "Refrigerate after opening."

(13) Declaration of Food Allergies

Declaration for Crustaceans and their products (Declare if crustacean is present) Fish and Fishery Products (Declare if fish is present)

(14) Labelling on Sale or Offer for Sale of Chilled Foods: All packaged foods intended for sale or offer for sale but not intended for human consumption shall bear this declaration - A black rectangular border around a black cross.

Training Glimpses

Annexure 1

Processing of quick-frozen coated fish products

(FAO and WHO. 2020. Code of Practice for Fish and Fishery Products)

Processing step		Potential hazards	Potential defects
Reception-Fish		Chemical, biochemical and microbiological contamination, scombrotoxin	Tainting, block irregularities, water and air pockets, packaging material, foreign matter, parasites, dehydration, decomposition
Reception-Other ingredients		Chemical, biochemical and microbiological contamination	Mould, colour deviations, filth, sand
Reception-Packaging materials		Foreign matter	Tainting of products
Storage-Raw material	Fish (frozen storage)	Microbiological contamination, toxins, viable parasites	Dehydration, rancidity, loss of nutritional quality
	Fish (chilled storage)	Microbiological contamination, biotoxins, scombrotoxin	Decomposition, physical damage
Storage -Other ingredients and packaging materials		Biological, physical and chemical contamination	Loss of quality and characteristics of ingredients, rancidity
Frozen fish block/fillet-Tempering		Unlikely	Incorrect dimension owing to sawing of over-softened fish flesh (applies to fish sticks)
Unwrapping, unpacking		Microbiological contamination	Remaining undetected packaging material, contamination by filth
Production of fish core-Sawing		Foreign material (metal or plastic parts of saws)	Irregularly shaped pieces or portions
Production of fish core-Application of additives and ingredients		Foreign material, microbiological contamination, scombrotoxin	Incorrect addition of additives, decomposition
Production of fish core-Forming		Foreign material (metal or plastic from machine) and/or microbiological contamination/scombrotoxin (fish mixture only)	Poorly formed fish cores, cores subjected to too much pressure (mushy, rancid), decomposition
Separation of pieces		Unlikely	Adhering pieces or portions
Coating- Wet coating		Microbiological	Insufficient cover or

	contamination	excessive cover of coating
Coating- Dry coating	Microbiological contamination	Insufficient coating or excessive coating
Pre-frying	Unlikely	Over-oxidized oil, insufficient frying, loosely adhering coating, burnt pieces and portions
Re-freezing – final freezing	Foreign material	Insufficient freezing leads to sticking of units to one another or to walls of freezing equipment and facilitates mechanical removal of breading/batter
Packaging and labelling	Microbiological contamination	Under- or over-packing, improperly sealed containers, wrong or misleading labelling
Storage of end products	Unlikely	Texture and flavour deviations owing to fluctuations in temperature, deep freezer burn, cold store flavour and cardboard flavour
Transportation of end product	Unlikely	Thawing of frozen product

Annexure 2

Additives permitted in frozen battered seafood (FSSAI, 2011)

Frozen battered fish, fish fillets and fish products, including molluscs, crustaceans, and echinoderms

- Uncooked product prepared from fish or fish portions, with dressing in eggs and bread crumbs or batter. Examples include frozen raw breaded or batter-coated shrimp; and frozen or quick-frozen breaded or batter coated fish fillets, fish portions and fish sticks (fish fingers) etc.

List of additives

Food Category System	Food Category Name	Food Additive	INS No	Recommended Maximum Level	Note
9.2.2	Frozen battered fish, fish fillets and fish products, including molluscs, crustaceans, and echinoderms	Trisodium citrate	331(iii)	GMP	For use in minced fish only
		ASCORBYL ESTERS		1,000 mg/kg	As ascorbyl stearate.
		Ammonium carbonate	503(i)	GMP	For use in breading or batter coatings only
		Ascorbic acid, L-	300	GMP	
		Butylated hydroxyanisole (BHA)	320	200 mg/kg	On the fat or oil basis. Singly or in combination: butylated hydroxyanisole (BHA, INS 320) and butylated hydroxytoluene (BHT, INS 321).
		Butylated hydroxytoluene (BHT)	321	200 mg/kg	On the fat or oil basis. Singly or in combination: butylated hydroxyanisole (BHA, INS 320) and butylated hydroxytoluene (BHT, INS 321).
		Citric acid	330	GMP	For use in

					minced fish only.
		ETHYLENE DIAMINE TETRA ACETATES (EDTA)		75 mg/kg	As anhydrous calcium disodium ethylenediamin etetraacetate.
		Fumaric acid	297	GMP	For use in breading or batter coatings only.
		Malic acid, DL-	296	GMP	For use in breading or batter coatings only.
		PHOSPHATES		2,200 mg/kg	As phosphorus.
		Potassium carbonate	501(i)	GMP	For use in breading or batter coatings only.
		Potassium dihydrogen citrate	332(i)	GMP	For use in minced fish only.
		Potassium hydrogen carbonate	501(ii)	GMP	For use in breading or batter coatings only.
		Sodium carbonate	500(i)	GMP	For use in breading or batter coatings only.
		Sodium dihydrogen citrate	331(i)	GMP	For use in minced fish only.
		Sodium fumarates	365	GMP	For use in breading or batter coatings only.
		Sodium hydrogen carbonate	500(ii)	GMP	For use in breading or batter coatings only.
		Sodium sesquicarbonate	500(iii)	GMP	For use in breading or batter coatings

					only.
		THIODIPROPIONATES		200 mg/kg	On the fat or oil basis. As thiodipropionic acid.
		Acetylated distarch phosphate	1414	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter
		Agar	406	GMP	For non-standardized food only.
		Carob bean gum	410	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter .
		Carrageenan	407	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings

					conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter .
		Dextrins, roasted starch	1400	GMP	For non-standardized food only.
		Gellan gum	418	GMP	For non-standardized food only.
		Guar gum	412	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Gum Arabic (acacia gum)	414	GMP	For non-standardized food only.
		Hydroxypropyl cellulose	463	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and

					fish fillets – breaded or in batter.
		Hydroxypropyl methyl cellulose	464	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Hydroxypropyl starch	1440	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Acetic and fatty acid esters of glycerol	472a	GMP	For non-standardized food only.
		Karaya gum	416	GMP	For non-standardized food only.
		Lactic and fatty acid esters of glycerol	472b	GMP	For non-standardized food only.
		Magnesium chloride	511	GMP	For non-standardized food only.
		Mannitol	421	GMP	For non-

					standardized food only.
		Methyl cellulose	461	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Methyl ethyl cellulose	465	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Oxidized starch	1404	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets –

					breaded or in batter.
		Pectin	440	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Powdered cellulose	460(ii)	GMP	For non-standardized food only.
		Processed Eucheuma seaweed	407a	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Salts of myristic, palmitic and stearic acids with ammonia, calcium, potassium and sodium	470(i)	GMP	Calcium, potassium and sodium salts only.
		Salts of oleic acid with calcium, potassium and sodium	470(ii)	GMP	For non-standardized food only.
		Sodium alginate	401	GMP	For non-

					standardized food and fish filets and minced fish flesh conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Carboxymethyl cellulose	466	GMP	For non-standardized food and minced fish flesh and breaded or batter coatings conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Tara gum	417	GMP	For non-standardized food only. Excluding whole fish.
		Tragacanth gum	413	GMP	
		Xanthan gum	415	GMP	For non-standardized food only
		Acetylated distarch adipate	1422	GMP	For non-standardized food and breaded or batter coatings in food conforming to

					the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Acid-treated starch	1401	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Alkaline treated starch	1402	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Hydroxypropyl distarch phosphate	1442	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for

					quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Lecithins	322(i), (ii)	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Starch acetate	1420	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Monostarch phosphate	1410	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen

					fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.
		Tripotassium citrate	332(ii)	GMP	For use in minced fish only.
		Phosphated distarch phosphate	1413	GMP	For non-standardized food and breaded or batter coatings in food conforming to the standard for quick frozen fish sticks (fish fingers), fish portions and fish fillets – breaded or in batter.