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TRAINING MANUAL ON HYGIENIC HANDLING AND PREPARATION OF READY TO COOK FISH & SHRIMP PRODUCTS

Under MoA with Shri Bokka Venkata Sunilraja
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Training Manual

on

Hygienic handling and preparation of Ready-to-Cook Fish & Shrimp products

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Hygienic handling of fish in the retail markets

Seafood is recognized as superior protein source to terrestrial meat because of possessing easily digestible protein with all EAAs, highest amount of omega 3 PUFAs such as EPA and DHA, rich macro and micro mineral content and a low caloric density and red meat. However, seafood is highly perishable on account of its higher moisture content and soft texture and the maintenance of fish quality is difficult than in the case of meat products. Hygienic handling is one among the important extrinsic factors that influence the quality of fish. The fish and fishery products intended for sale in the retail market must be safe. They should not cause any illness or injury to the consumer. For the production of safe fish, not only the quality of the raw material (such as fish, shrimp) but also the quality of water, ice, ingredients (such as salt) and the cleanliness of food contact surfaces (such as tables, utensils) and personal hygiene of the workers is very important. Using fresh raw material and good quality ingredients helps in producing fishery products that meets the regulatory requirements of Food Safety Standards Authority of India (FSSAI).

Various handling activities including fish landing, washing, dressing, packing, distribution, distribution and selling takes places in retail fish markets which invites many risk factors creating additional sources of bacteria and contamination. Therefore, implementation of hygienic measures is recommended to prevent contamination of fish at retail markets. Good handling always results in economic benefit to the farmers, processors and retailers because the consumers are willing to pay more for a premium quality product. Implementing hygienic handling practices helps to reduce microbial growth and delay spoilage. Hygienic handling practices ensure the supply of safe and quality fish to consumers while meeting the standards of national and international food safety regulatory bodies. Post-harvest handling refers to the activities carried out after the fish is captured from cage or pond or other

production site unit till the product reaches the consumers. Whereas hygiene measures involve not only the activities that deal with operations but also those focusing on the facilities/equipment, operational measures which are aimed to ensure safety of the final product.

Good manufacturing process (GMPs):GMPs are all those practices that are required to manufacture a fish product that meets the recommended national and international regulatory requirements. Keeping the fish processing facility in good condition, keeping the equipment in good running condition and employing a reliable and reproducible production process are some examples of GMPs. The equipment (such as freezers, cookers) should not have sharp edges, crevices or angles that accumulate dirt and food particles. The layout of all the equipment in the processing unit i.e., their location in relation to the flow of men and material is an important GMP. The layout must ensure a seamless, unidirectional flow of material i.e., raw material receiving, pre-processing, processing, storage and transport.

1. **Quality of water:**Water is needed for ice production, fish processing, and washing purposes. The water used for processing of fish must be of potable quality. The water used in fish processing plants must meet the regulatory standards (IS 4251 for non-EU plants and 98/83/EC for EU plants (IS :4251). An overhead water tank (cement tank inside lined with tiles or plastic tank) is necessary to store the water. The capacity of the water tank depends on the quantity of fish processed (as a rough estimate 10 litres of water is necessary for processing 1 kg of fish/shrimp). Proper plumbing is necessary and prevent backflow of post-process or wastewater. Chlorination of water is needed to destroy harmful microorganisms. The residual chlorine content of water used for processing fish must be less than 2 ppm.

Calculation for the amount of chlorine solution to be added to water

$$\text{Chlorine solution required (ml)} = \frac{\text{Required ppm of chlorine} \times \text{Volume of water required in Litres}}{\% \text{ of available chlorine in commercial can} \times 10}$$

Purpose	Recommended level of available chlorine content (ppm)
Process water, glaze water and ice production	<2
Hand dip water	<20
Foot dip water	100-200
Water for sanitation of utensils, processing table, processing machinery etc	100
Water for sanitation of floor and wall	100-200
Water for sanitation of drain	250-500

2. **Quality of Ice:** The ice used for chilling of fish must be prepared from potable water. The block ice should be prepared in rust free containers. Ice blocks should not be dragged on the floor. The ice blocks must be crushed with rust free equipment. Ice should not be put on dirty floor but should be placed in clean crates.

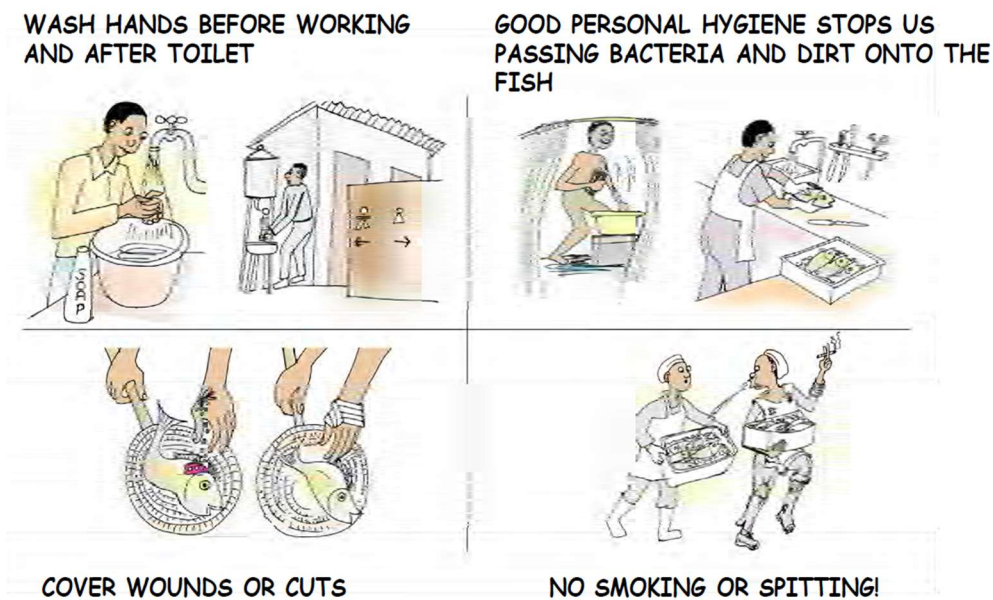
3. **Quality of Salt:** The salt used for salting of fish should be free from foreign matter with no visible signs of dirt, oil, bilge or other extraneous matter and should not have any objectional odour.

4. **Cleanliness of food contact surfaces:** Food Contact Surfaces are those surfaces that contact human food and those surfaces from which drainage onto the food surfaces that contact the food ordinarily occurs during the normal course of operation. Eg. tables, knives, cutting boards, utensils, fish boxes, conveyor belts, ice storage bins, gloves etc. All food contact surfaces should be adequately and routinely cleaned and disinfected. Proper washing of the food contact surfaces should include scrubbing to remove biofilms and solid waste, cleaning with detergent, rinsing with potable water, application of sanitizer followed by final wash with potable water.

5. **Good Hygiene Practices (GHPs) of the workers:** The fish processing unit must restrict the entry of sick employees as food workers can potentially act as carriers or transmitters of pathogenic microorganisms either directly through their bodies or indirectly through their clothing. Workers who are sick or carrying open wounds must be excluded from handling and packaging the fish in the processing plant. Workers suffering from gastrointestinal (diarrhoea, vomiting) and respiratory (coughing, running nose) infections must not handle the food. The workers should remove their jewelry, and footwear. They should change their street clothes with a clean uniform in the specific change room. The workers should wear gum boots, cover the hair with caps/covers, cover their nose and mouth with masks prior to their entry into the processing area from the change room. Workers must not carry allergens in to the processing plant. Workers should not eat in the processing area. The eating should be restricted to designated area (canteens/ lunch room) constructed in non-production areas. Smoking, chewing of tobacco products and spitting must be prohibited in food processing units.

Workers should wash their hand properly as per WHO washing guideline. Hand sanitizers should be prepared with the prescribed concentration (chlorine hand dip of 20 ppm). Hand washing facility to be

provided in the change rooms located near entrances of processing rooms and in rest rooms. Dirty hands are major vehicle for transfer of bacteria. It is of utmost importance from the food safety point of view to train the workers on proper hand washing procedure. A clean hand has a bacterial load of less than 100 viable bacteria per square centimetre. The workers, after washing their hands, should avoid touching potentially dirty items. The workers should know that they should always wash their hands before the start of the work, after using the toilet and before restart of work after lunch break etc.



6. **Control of pests:** Pests such as insects and rodents carry disease causing organisms. Moreover, their droppings contaminate the food. Pests have to be controlled both within the processing plants and around the processing plant. Bait stations or glue traps at different points are need to trap the rodents. The doors and windows should be tightly fit. All entrance and exit points to be fitted with air curtains and plastic strip curtains.
7. **Prevention of cross contamination:** Cross-contamination occurs due to crisscrossing or mixing of cleaned food with raw, unwashed food. This can be prevented by ensuring unidirectional flow of men and material in the fish

processing plant. The raw and cooked products should be kept separate at all times, the unprocessed material must be maintained at a temperature as close of that of melting ice (less than 4⁰C) to avoid multiplication of bacteria. The processed fish and packaging material should be protected from condensate or other dripping liquids and from splashes of water.

8. **Proper labeling, storage and toxic compounds:** It is necessary to ensure protection of food, food packaging materials food contact surfaces from adulteration with lubricants, fuel, pesticides, cleaning compounds, sanitizing agents, other chemical, physical, and biological contaminants. So such items should be labeled properly and stored in separate rooms.

Ready to cook chilled fish/shrimp products

a. Chilling of fish:

Fish is a highly perishable food commodity and it spoils at a rapid rate at room temperature. Chilling is an effective method of maintaining the freshness of fish products. This normally involves keeping the harvested fish in sufficient quantity of ice to maintain the temperature of fish at around 1-4°C, which delays the enzymatic action and retards microbial activity, thereby extending the shelf life of the fish and fish products. The fish processors have to remember that the core temperature i.e., the temperature of fish meat that is close to the central bone, must reach a temperature of less than 4°C. To achieve this core temperature under tropical conditions, one kg of ice is required to chill one kg of fish (1 : 1 ratio). Traditionally, chilling is carried out using flake ice or crushed block ice. Icing is usually done in insulated ice-boxes which are effective. Ice-boxes are made from food grade polyethylene materials in double wall construction, leak proof, rust proof and corrosion free, strong and durable with different storage capacities. Chilling of fish is performed in layers. One layer of ice is laid which is followed by a layer of fish. Weigh the fish and calculate the quantity of ice required for icing. Place one layer of ice at the bottom of the ice box. Place one layer of fish above this ice layer in the box. Cover this fish layer with another layer of ice. Repeat the process till you reach to the top of the ice box. Ensure that the top most layer of fish is covered with ice. Close the lid of the ice-box tightly. The storage life of fish in chilled condition varies with the fish species. For example, shelf life of 12-15 days has been achieved for seer fish and black pomfret. Indian Mackerel and Indian oil sardine have very short shelf life in ice (3-7 days), due to rancidity and belly bursting.

b. Chilled fish products

The modern food habits along with the fast life have created an enormous demand for ready to make food products, especially in urban areas. There are viable opportunities in cities for marketing ready to cook forms of fish products to meet the consumer demands. Improved market forms are one kind of value addition to fish and shell fish, through which the consumers can reduce the time required for further preparation of the product. A brief detail on value added chilled fish styles are given below.

1. Dressed and gutted fish

The purpose of gutting is to remove the viscera, gonads and sometimes the swim bladder. Hygienically gutted fish fetches higher price in the retail as well as export markets. Also, gutting process delays the spoilage in fish. Extreme care has to be taken while gutting to avoid bruises or cut in the fish flesh as it will reduce the market



value. This procedure is performed on a table made of special material which is hard, easy to wash and does not absorb fluids. Yield of gutted fish ranges from 75-80%. Dressed and washed fish can be distributed in consumer packs in ice. Vacuum packaging and active packaging further improves the shelf life of the products.

2. Fish steaks

Steaks are the most convenient ready to cook form preferred by consumers. Steak is a section of fish removed by cutting approximately at right angles to the back bone of fish. Slicing of beheaded whole fish into steaks of 2.5-3.5 cm with a cut perpendicular to the animal's backbone is a very common fish processing method.



Larger fish, particularly cyprinids, which have a massive and more solid backbone, need slicing mechanically. Most of the mechanical slicer utilize multiple rotating circular saws attached to the drive. The distance between the saws as well as the elements moving the fish along the line can be adjusted. A mechanized cutter can process 20-40 fishes/minute, depending on the fish size. The steaks are packed in consumer packets and kept in chilled condition. The shelf life of steaks can be improved by vacuum packaging, modified atmosphere and active packaging techniques.

3. Fish fillet

Fish fillet is a skinless, boneless fish loin cut parallel to the central bone frame and trimmed free of loose or hanging meat. Filleting can be done manually or mechanically. Filleting efficiency depends upon fish species, its sex, size, freshness and nutritional condition. Manual filleting is very labour-intensive and largely depends on the skills of the workers. A sharp knife and flat board made up of metal or plastics are required for manual filleting. The fillet is placed on the board skin down, the meat is grasped in the left hand and the knife is drawn between the skin and meat. Manual filleting is time consuming; however,



it gives better yield than mechanical filleting. Fillets with low fat and minimum fat content are preferred by the consumers. Average yield of skinless fillet is 40-45%. Skinless fillet can be used as a raw material for the production of a variety of valueadded products.

4. Marinated fish

Fish steaks or fillet pieces can be marinated with salt and spices and packed in thermoformed trays. The fish is coated with a paste consisting of spices, salt, seasonings and allowed to remain for 6-12 hours or preferably overnight at chilled condition. This fish can be fried in oil or roasted before consumption. Ready to fry marinated fish/shell fish shrimp,



mussel, oyster, squid, cuttle fish etc. can be stored upto 2 weeks at 4⁰C. Cured product like mackerel is suitable for marinating with spices.

c. Ready-to-Cook shrimp products

1. Centre-peel shrimp

Centre peel shrimp is a convenient shrimp product. Freshwater prawn (*Macrobrachium rosenbergii*) / *Penaeus vannamei* shrimp 26/30 to 31/40 counts/kg are suitable for this style. The shrimp is peeled at the centre retaining the head, the last segment and the tail fans and is deveined. The head and tail fans are trimmed off to reduce the sharpness to avoid damage of the package. The product can be packed in PVC/polystyrene trays. Vacuum packing in laminated pouches can also be done to improve the shelf life.

2. Easy-peel shrimp

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. Cut the shell, up to end of the last segment dorsally or laterally leaving it intact, just to make the shrimp easy to peel.

3. Butterfly shrimp

Wash the whole shrimp in potable water and remove the head. Remove the telson by gently raising upwards. 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.

4. Stretched shrimp (Nobashi)

Freshwater prawn (*M.rosenbergii*) / *P. vannamei* shrimp 26/30 to 31/40 counts/kg are suitable for this product. 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 or food grade plastic mould. CIFT shrimp stretching mould developed by ICAR-CIFT has six grooves that can accommodate all the commonly available sizes of vannamei



shrimp. Stretched shrimp remain straight even after cooking. Battered and breaded stretched shrimp can be a potential value added product for the domestic urban market.

5. Peeled and deveined shrimp

Wash the whole shrimp in potable water and remove the head and shell. De-vein by inserting a pointed needle or pointed bamboo stick between the segments dorsally and lifting off the vein. The product can be packed in PVC/polystyrene trays. Vacuum packing in laminated pouches can also be done to improve the shelf life.

d. Packaging of chilled fish and fish products

Fresh fish is the most perishable among the foods. Proper packaging is an important requirement for maintaining hygiene and safety of fish products. Packaging also aims to reduce the post harvest losses in fisheries. In whole sale and local markets, fish is mostly sold without any packaging, but for retailing and on line marketing, packaging is of utmost importance.

1. Air packaging

Packaging materials for fresh fish should provide a barrier against oxygen to reduce fat oxidation, prevent dehydration, retard chemical and bacterial spoilage and permeation of external odours. The packaging material should be food grade, non-toxic and do not impart any undesirable odour to the packed fish. Plastic trays of Expanded Polystyrene (EPS) or Polyethylene Terephthalate (PET) are suitable for packing ready-to-cook products from shrimp and fish. Polyethylene films that meet the specifications of FSSAI can be used as the primary packaging for retail purpose. For bulk transportation, the container should be sturdy enough to withstand the rigors of transit and travel by different modes, should be of light weight, hygienic and easily cleanable and possess good insulation properties. High density polypropylene containers are commonly used for transportation of fish in the landing centres and fish markets.

2. Vacuum packaging

Vacuum packaging involves the removal of air from the package and the application of a hermetic seal. The air removal creates a vacuum inside the packs and lack of O₂ in packages may minimise the oxidative deteriorative reactions and aerobic bacterial growth. Vacuum packaging can considerably extend the viable shelf life of many cooked foods. The use of vacuum

packaging, in gas impermeable and heat stable materials, has many advantages, which include; no or low risks of post pasteurization contamination, ease of handling, Inhibition of growth of aerobic spoilage organisms and inhibition or slowing of deleterious oxidative reactions in the food during storage due to oxygen barrier properties of the packaging material.



There are number of criteria required for the films used for vacuum packaging in large scale production methods. These requirements include: high durability, i.e. ability to withstand considerable mechanical stresses during packaging, handling and transport, retention of flexibility even at low temperatures (-2 to 4°C) to enable satisfactory handling in the packaging and refrigeration rooms,

impermeability to liquids, including oils and fats and macromolecules, impermeability to gases, in particular oxygen, so that



oxidative deterioration of the packaged food stuffs is limited or inhibited, manufactured from non-toxic, food acceptable, odourless materials and must be able to create airtight durable heat seals to close packs. Many of these criteria have been met by a range of materials mostly multi-laminated plastics. Vacuum packed foods maintain their freshness and flavor 3-5 times longer than with conventional storage methods, because they don't come in contact with oxygen. Foods that are high in fats and oils won't become rancid, because there's no oxygen coming in contact with the fats, which causes the rancid taste and smell.

e. CIFT-Insulated Fish Bags

Temperature abuse is the single most important factor in loss of quality in fish and fishery products. Insulated fish bag is a simple intervention for hygienic handling of iced-fish by traditional fishermen, fish vendors and urban fish consumers. ICAR-



Central Institute of Fisheries Technology, Visakhapatnam Research Centre has designed insulated fish bags of different sizes with an objective to preserve the quality of the fish caught by the fishermen. Fish kept along with ice (1:1 ratio) preserves the quality of iced-fish for a period of 6 hours. The insulated fish bags are convenient and find use in the transportation of iced fish.



The back pack model is basically a cylindrical bag with straps for carrying the bag on the back while walking or riding on a motorcycle. The empty weight of the back pack model fish bag is 1.18 Kg. The volume of the bag is 50 litres and can easily hold 10

kg of iced-fish and fishery products. Apart from back pack model, Insulated fish bags of various shapes and sizes were made to suit the needs for different types of users (fishermen, fish retailers, fish consumers). Cylindrical model best suits for fisherwomen for easy transportation.



These bags of 20 kg capacity have a round plastic support (covered with foam sheet and has Velcro sticker on one side is supplied along with the bag so to bear the weight of the material and for easy carrying. This design will be

convenient for the fisherwomen for door step delivery of fish and fishery products. Medium and small sized insulated bags are designed for seafood consumers when they would like buy fish in larger quantities for household purposes.

f. Quality and safety requirements for chilled fish products

Food safety regulations have been laid by the Food Safety Standards Authority of India (FSSAI) for sale of chilled fish and chilled shrimp products in the domestic market.

Microbiological parameters for Chilled Finfish

Sampling Plan		Limits		Action in case of unsatisfactory results	
Hygiene Indicator Organisms				Improvement in hygiene; Time-Temperature Control along value chain	
	n	c	m		M
Aerobic Plate Count	5	3	5x10 ⁵ cfu/g		1x10 ⁷ cfu/g
Safety Indicator Organisms					
<i>Escherichia coli</i>	5	3	11 MPN/g		500 MPN/g
<i>Salmonella</i>	5	0	Absent/25g		
<i>Vibrio cholerae</i> (O1 and O139)	5	0	Absent/25g		

Microbiological parameters for Chilled shrimp (Crustaceans)

Sampling Plan		Limits		Action in case of unsatisfactory results
n	c	m	M	Improvement in hygiene; Time-Temperature Control along value chain
Hygiene Indicator Organisms				
Aerobic Plate Count	5	3	1x10 ⁶ cfu/g	
Safety Indicator Organisms				
<i>Escherichia coli</i> (MPN)	5	3	11 /g	
Salmonella	5	0	Absent/25g	
<i>Vibrio cholerae</i> (O1 and O139)	5	0	Absent/25g	

Where

n : Number of units comprising the sample

c : Maximum allowable number of defective sample units

m : Acceptable level in a sample

M : Specified level when exceeded in one or more samples would cause the lot to be rejected

Hygienic drying of fish

In India, nearly 15-20% of the total catch is preserved by drying. Uses of dried fish include direct human consumption of commercially important fishes and animal feed development from uneconomical or by-catch fishes. However, the quality of traditionally produced dry fish is very poor as it is processed under unhygienic conditions (open sun drying on sand, road, and cement platforms), causing contamination and loss of quality. Adoption of hygienic practices and standard operating procedures helps in attaining high quality products with enhanced shelf life.

a. Selection of raw materials

Selection of fresh quality raw material is a necessary requirement for making high quality dried fish products. Instead of using unsold fish, very fresh fish without any signs of spoilage should be selected for making dried fish intended for human consumption. Fishes which are in the early stages of spoilage can be used for making dried fish intended for animal feed development. Spoiled fishes should not be selected for drying purpose.





Fresh fish suitable as raw material for drying

b. Salting process

Salting is preferred for bigger sized fishes to improve the storage life of dried fish. Salt used to produce salted fish shall be clean, free from foreign matter, show no visible signs of contamination with dirt, oil, bilge or other extraneous materials. Fresh fish is split open by a cut from dorsal side along the vertebral column and eviscerated. For bigger sized fishes, scores are made along the thick flesh portion for better penetration of salt. The dressed fish is washed thoroughly and drained to remove excess water on the surface of fish. Salt is then applied in a salt: fish ratio 1:3 (bigger fish) to 1: 7 (smaller fish) depending upon the size of the fish. Salting is done as layer by layer in a container, preferably a plastic or cement tank. Wooden planks are placed on the top and weighed down. Salting is done for period of 16-18 h, preferably overnight.



Dry salted fish



Fish after salting

c. Drying

Traditionally, very small and flat fishes like anchovies, small ribbon fish, sole fish etc. are dried whole without salting to moisture content less than 25%. Brine salted fish can be dried up to a moisture content of 30-35%. The salted or unsalted fishes are dried by sun drying or mechanical drying.

1. Sun drying

Sun drying is simple and economical, but often ends up with poor quality product. Places having sufficient sunlight exposure and wind circulation is more suitable

for drying yard. Entry of birds and street animals to the drying site should be prevented. It is always advantageous to dry the fish on racks than on the sand or floor. Rack drying allows a hygienic way of drying fish under sun. Better circulation of air is ensured if the fish

is kept 1 m above the ground. Racks designed with slopping top allow easy removal of surplus water oozing out from fish at the beginning of drying. The fish need to be turned occasionally to facilitate quicker and even drying. Solar tent dryers also facilitate faster drying.

Fishes like ribbon fish, Bombay duck and lizard fishes can be hanged from poles using hooks.



b. Mechanical drying

The process is totally controlled and yields better quality product with longer shelf life compared to sun drying. In mechanical dryer, the drying shelves need to be interchanged for attaining uniform drying. Mechanical drying may be done at a temperature of 50-60°C. Temperature above 60°C causes cooking and case hardening, i.e., surface gets over dried and limit the drying of interior parts of fish. Solar dryers of different capacities are developed and

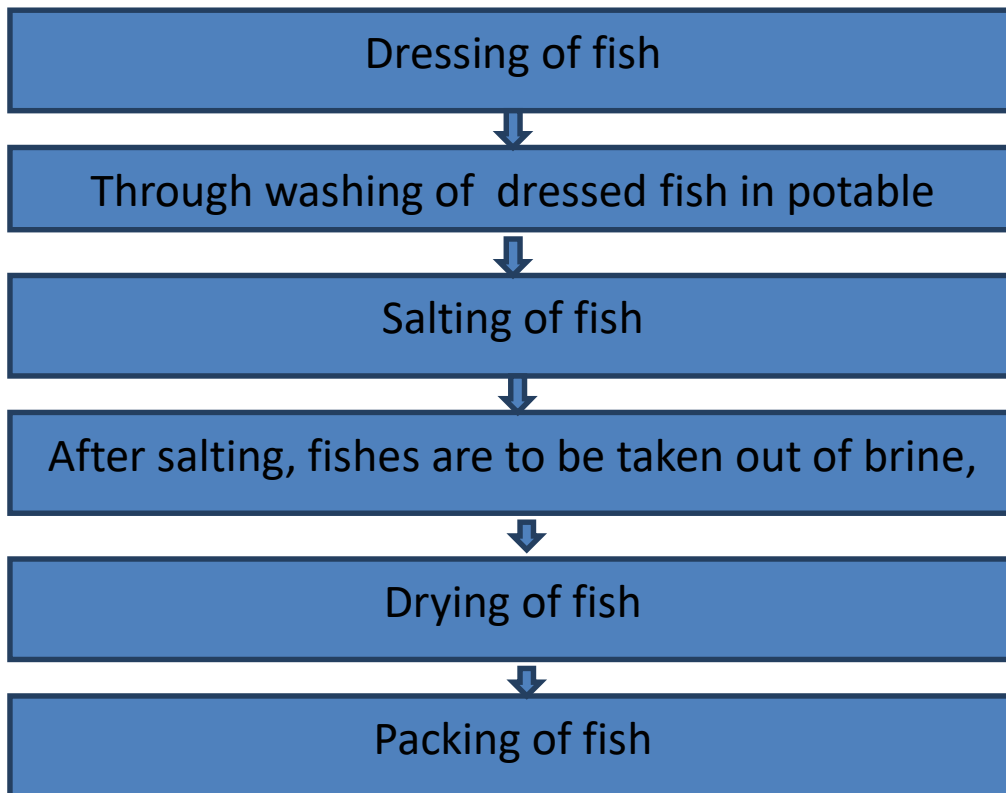
commercialized by ICAR-CIFT including hybrid solar dryer with LPG/ Biogas/ electricity as alternate back up heating source for continuous hygienic drying of fish even under unfavourable weather conditions.



Solar tent dryer



Solar dryer with electrical back-up



Flow chart for producing dried fish

c. Packaging of dried products

Type of packaging and surrounding atmospheric conditions influence the quality of dried fish. Commonly used gunny bags are easy for the entry of insects, rodents and pests to enter and spoil the product. The packaging material should be waterproof to prevent the absorption of moisture from surrounding. Materials like waxed corrugated cartons, deal wood or plywood boxes are suitable for bulk packaging of dried fish. Gusseted bags made of HDPE and LDPE laminates are found more suitable for bulk dry fish packaging. For consumer packs, LDPE or polypropylene are commonly used. However, laminated film of LDPE or polypropylene with polyester gives better water proof property.

d. Safety and quality standards

The quality of packaged dried fish intended for sale in the domestic markets should meet the food safety and quality specifications laid by the Food Safety and Standards Authority of India (FSSAI).

Standards for Dried/ Salted and dried fishery products.

Characteristics	Requirements
Water activity at 25°C	Less than 0.78
Salt content (% sodium chloride) *	Not less than 12%
Histamine content (Max) **	200 mg/kg
Acid insoluble ash (sand) on dry basis	Not more than 1%

*applicable only to salted fishery products.

** applicable for products prepared from fish species associated with histamine poisoning

Microbiological parameters for Dried / Salted and Dried Fishery Products

Sampling Plan		Limits		Action in case of unsatisfactory results
	n	c	m	M
Hygiene Indicator Organisms				
Aerobic Plate Count	5	0	1x10 ⁵ cfu/g	-
Yeast & mould count	5	2	100cfu/g	500cfu/g
Safety Indicator Organisms				
<i>Escherichia coli</i>	5	0	20 MPN/g	
<i>Salmonella</i>	5	0	Absent/25g	

Where

n : Number of units comprising the sample

c : Maximum allowable number of defective sample units

m : Acceptable level in a sample

M : Specified level when exceeded in one or more samples would cause the lot to be rejected

Fish pickle

Pickle is an inevitable commodity in the Indian diet. Like vegetable pickles, fish pickle has also gained popularity in the recent past. Fish/Prawn pickle, when carefully prepared under most hygienic conditions with addition of required quantity of salt, preservatives and spices will have generally an average shelf life of one year. Most of the sea fish like Prawn, Tuna, Pomfret, Mackerel, etc. are ideally suitable for making fish pickles. Fish



pickle is the preserved fish product in a combination of spices, salt and vinegar. The pH of fish pickle should be 4.6 or lower to reduce the microbial activity. Preservative action is given by low pH and presence of salt. Traditionally, spicy, pungent pickle made of vegetables like lime; gooseberry, ginger, garlic etc. were used as an important side dish along with meals and used to be considered an appetizer. Though such pickles made of fish or meat was practically unknown in the past, such products have now become very popular and products under several brand names are now available in the market.

Ingredients

Fish (boneless pieces cut into small chunks)	:1000 g
Mustard	:10 g
Green chilly	:50 g
Garlic	:200 g
Ginger	:150 g
Chilli powder	:50 g
Turmeric powder	: 2g
Gingelly oil	:200 g
Vinegar	:400 ml
Salt	:60 g
Pepper	:2.5 g
Sugar	:10 g
Cardamom, clove, cinnamon	:1.5 g

Procedure

1. Mix the cut fish thoroughly with 3% of its weight of salt and keep for two hours for partial drying.
2. Fry the fish in minimum quantity of oil. Set apart the fried fish.
3. Fry the ingredients like Mustard, Green chilly, Garlic and Ginger separately. Half of the ginger and garlic can be ground and fry.
4. Combine these ingredients and then add chilly powder, pepper and turmeric powder and mix well over low flames for a few minutes.
5. Remove from fire, add fried fish and mix well.
6. Allow to cool and then add vinegar, powdered cardamom, clove, cinnamon, sugar and remaining salt and mix thoroughly.

7. Transfer to clean, sterile glass bottles and seal with acid proof caps.
8. Take care to see that there is a layer of oil over the contents in the bottle.
9. Flexible pouches made of 12 μ polyester laminated with 118 μ LD-HD co-extruded film can also be used for packing pickle.

Requirements for Fish Pickle

Characteristics	Requirements
Fluid portion (% by weight, Max)	40
pH	4.0 - 4.5
Acidity as acetic acid of fluid Portion (% by weight, Max)	2.5 - 3.0
Sodium chloride (% by weight, Max)	12.0

Fish pickle shall possess the characteristic pleasant aroma and flavour and shall be devoid of any objectionable off-taste, smell or odour. The material shall be free from artificial colouring matter and firming agents other than edible common salt and vinegar (4% acetic acid).

Microbiological Quality standards for Fish Pickle (FSSAI)

	Sampling Plan		Limits (cfu/g)		Action in case of Unsatisfactory results
Hygiene Indicator Organisms	n	C	M	M	Improvement in hygiene, Control of pH/acidity, Selection of ingredients
Aerobic Plate Count	5	0	1x10 ³		
Coagulase positive Staphylococci	5	1	1x10 ²	1x10 ³	
Yeast and Mold count	5	0	100		
Safety Indicator Organisms					
Escherichia coli	5	0	20 MPN/g		
Salmonella	5	0	Absent/25g		

Battered and breaded fish/shrimp products

Battered and breaded or enrobed products are the highly demanded product among the group of value added products. An enrobed/coated product is one, where a food material is coated with another food stuff. Coating the food product with a batter and breading before cooking is an established age old domestic practice. However, changing food habits of consumers has created the need for an increased market supply of ready to cook or ready to serve products which include the most prominent coated fishery products. Breading and battering of food products enhance characteristic such as appearance, flavour and texture. Battered and breaded products offer a convenient food valued widely by the consumer. Many products are coated and immediately frozen, or they may be pre-fried, and then frozen for distribution and sales to consumers and food service establishments. They can be quickly reconstituted by conventional heating methods. As far as fish processing industry is concerned, value addition is one of the possible approaches to raise profitability, since this industry is becoming highly competitive and increasingly expensive.

The production of battered and breaded fish products involves several stages; they are portioning/forming, pre-dusting, battering, breading, flash frying, freezing and cold storage.

a. Portioning/forming

In this process, the boneless/skinless fish is cut into desired shape (fingers or nuggets). Frozen block of minced fish can also be used as raw material for making different styles.

b. Pre-dusting

Before dipping into batter, the fish portion is given a pre-dusting in a fine raw flour type material. Batter mix itself can be used for pre dusting. Pre-dusting is given to enable uniform absorption of batter.

c. Coating with batter

A batter can be defined as a liquid mixture composed of water, flour, seasonings into which food products are dipped before cooking. Batter enhances the nutritive value of fish products. Also, it minimizes the moisture loss from the product during storage and increases the bulkiness of the product, thus reducing the cost of product. Composition of a typical adhesive batter is given below.

Batter mix composition

Ingredient	Amount
Maida	1000g
Corn flour	100g
Bengal gram powder	100g
Salt	12g
Sodium tri polyphosphate	5g
Turmeric powder	5g
Hydrocolloids (Guar gum)	5g

d. Breading

The breading is normally a bread based crumb. The batter coated portions are further coated with bread crumbs. Generally medium sized

porous crumbs with relatively large granulations are used. Breading can be done manually or mechanically. The bread crumbs are uniformly applied over the product and excess crumbs are removed using an air blower. In general, a pick up ratio of 30-35 % is advised.

e. Pre- frying

Pre- frying is required if the product is intended for frozen storage. The purpose of pre- frying is primarily to set the coating on the fish portion. The temperature of frying oil and the time of frying are critical. The normal frying temperature is between 180-200°C and the time is 20-30 seconds. The term pre frying is used because the final product frying is completed by the consumer for a duration of 4-6 minutes depending on the portion size and thickness.

Coated fish products

Fish fingers: Fish fingers are regular sized portions cut from rectangular frozen block of fish fillet or fish mince. It is very important to select the raw material for fish fingers. Generally, white colored boneless species like Pangasius, Tilapia etc. are used for making fish fingers. A typical coated fish finger weighs about 28 g of which up to 50% is contributed by batter and bread crumbs. The cut pieces are given a coating of pre-dust, batter and breading as in the case of fish fingers. It



has been observed that sensory quality of fish finger developed from fish fillet is superior to that developed from mince block.

Procedure

1. Cut finger portions from fish fillet
2. Dip in 3% brine at chilled temperature for 15 min
3. Drain and pre dust the finger with dry batter flour
4. Dip in batter and fry

Fish fillet: Fried coated fish fillet can be a delicious fish product for domestic and export marketing. Table sized fishes with a minimum pin bones are suitable for making this product. Fresh water



fishes of table size without any pin bones are suitable for making coated fish fillets. Skinless fillets are given a cold blanching treatment to improve the color and texture of the fillet. The frozen coated fillets are immediately packed in thermoformed containers or pouches. A specified number of such consumer packs are then packed in master cartons and is stored at -20°C.

Procedure

1. Prepare table size skinless fillet: after cutting the fillet, belly flap and hanging meat need to be removed for better appearance.

2. Dip in 3% brine at chilled temperature for 10-15 min: This step removes the blood, slimes if any from the fillet and it impart a firm texture to the fillet.
3. Drain off and pre dust with dry batter
4. Give coating of batter and bread crumbs and fry

Coated shrimp products

Coated shrimp products are delicacy among the seafood lovers and it fetches higher price in the market. Breaded shrimp can be prepared from both wild and farmed shrimp in different styles, viz. peeled and deveined, butterfly, round tail- on, cooked and peeled nobashi etc.

Coated fantail round: prepared the fan tail round shrimp from raw material, wash it thoroughly in potable water and dip it in chilled water containing 3% brine for 15 min. This is to give a firm texture to the product. Coat the Fantail round shrimp with a thin layer of pre-dust followed by coating in 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.

Coated butterfly shrimp: 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.

Breaded “Nobashi”: Prepare stretched shrimp from raw material. 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).

Quality requirements for battered and breaded fishery products:

Batter means liquid preparation from ground cereals, spices, salt, sugar and other ingredients and/or additives for coating. Breading means dry breadcrumbs or other dry preparations mainly from cereals with colourants and other ingredients used for the final coating of fishery products.

Generally, the battered and breaded fishery products are partially cooked by the processor for culinary purposes (e.g., setting the batter or breading, or stabilizing the product shape), and are customarily fully cooked by the consumer or end user. Although the exterior of these products may appear cooked, the interior fish protein is not coagulated, and the products are not ready-to-eat. Quality specifications have been laid by the Food Safety and Standards Authority of India (FSSAI, 2017) for battered and breaded fishery products which covers mainly the microbiological requirements vis-à-vis hygiene indicator organisms and safety indicator organisms.

i) FSSAI Microbiological Requirements for battered and breaded fishery products:

a) Hygiene Indicator Organisms

Aerobic Plate Count				Coagulase positive Staphylococci				Yeast & mold count				Action in case of Unsatisfactory results
Sampling Plan		Limits (cfu/g)		Sampling Plan		Limits (cfu/g)		Sampling Plan		Limits (cfu/g)		
n	c	m	M	n	c	m	M	n	c	m	M	
5	2	1 x 10 ⁵	1 x 10 ⁷	5	1	100	1000	5	0	100		Improvement in hygiene; Time-Temperature Control

b) Safety Indicator Organisms

<i>Escherichia coli</i>				<i>Salmonella</i>				<i>Vibrio cholerae</i> (O1 and O139)				<i>Listeria monocytogenes</i>			
Sampling Plan		Limits (MPN/g)		Sampling Plan		Limits		Sampling Plan		Limits		Sampling Plan		Limits	
n	c	m	M	n	c	m	M	n	c	m	M	n	c	m	M
5	2	11	500	5	0	Absent/25g		5	0	Absent/25g		5	0	Absent/25g	

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.

Factors influencing quality of breaded or battered fishery products:

Raw Material	Fish/shrimp used for preparing the battered and breaded product shall be of a quality equal to that of fish/shrimp sold fresh for human consumption.
Coating material	All the ingredients used for coating shall be of food grade quality and conform to all applicable Codex standards
Frying fat (oil)	Oil used in the cooking operation shall be suitable for human consumption and for the desired final product characteristic.
Food additives	Antioxidants, humectants, acidity regulators, thickeners colours, emulsifiers, flavour enhancers, raising agents, and used in accordance the <i>General Standard for Food Additives</i> (CODEX STAN 192-1995)

The final product shall be free from microorganisms or substances originating from microorganisms in amounts which may present a hazard to health in accordance with standards established by the Codex Alimentarius Commission; shall not contain histamine that exceeds 20 mg/100 g (applies only to species of *Clupeidae*, *Scombridae*, *Scombrosocidae*, *Pomatomidae* and *Coryphaenidae* families); shall not contain any other substance in amounts which may present a hazard to health in accordance with standards established by the Codex Alimentarius Commission.