

GOOD HYGIENIC HANDLING PRACTICES FOR ENSURING THE SEAFOOD QUALITY

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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 take places in retail fish markets which invites many risk factors creating additional sources of bacteria and contamination. Therefore, the 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.

Onboard handling practices

Fish and fish products intended for human consumption should be handled properly to prevent contamination and spoilage till it reaches the end user. Poor onboard handling practices damages the fish and speed up the spoilage process resulting in post-harvest losses. The important points are

- ▶ The fishing vessel and equipment should be thoroughly cleaned using clean water before and after every fishing trip.
- ▶ Fishing vessel must be kept free of pests using pest control devices.
- ▶ Sea water from fishing harbor/landing centre should never be used for cleaning. Only tap water from the public water supply, clean well / borehole water that has been treated with chlorine or clean seawater should be used to clean boats and equipment.
- ▶ All fish contact surfaces should be made of non-toxic, smooth materials to minimize the build-up of slime, blood, scales etc. from the harvested fish to reduce the risk of microbial contamination.
- ▶ Handling areas should not have sharp corners and projections to avoid physical damage to the fish.
- ▶ Fish should be washed well with potable water/ clean sea water to remove dirt and other foreign matter if any, immediately after harvesting.
- ▶ In aquaculture site, the harvested fish should not be dropped on to muddy floor or hardy surfaces to prevent contamination and physical damages, respectively.
- ▶ Fish should be kept away from objectionable substances such as grease, fuel oil, drainage, bilge water, smoke, and other solid or semi-solid to prevent contamination.
- ▶ Bruised, damaged and decomposed fish shall be separated from the catch during sorting.
- ▶ Bleeding of fish if any, should be carried out as early as possible.
- ▶ Mishandling of the fish such as throwing, standing on fish, exposing to sunlight etc. needs to be strictly avoided.
- ▶ Fish should not be exposed to sunlight for a longer duration as it causes dehydration and accelerate spoilage.
- ▶ The condition of the equipment and utensils should be such that it minimizes the build-up of residues and prevents them becoming a source of contamination.

Chilling and Storage

The ambient temperature of tropical countries favours the growth of mesophilic bacteria. A 5°C rise in temperature doubles the rate of spoilage. Hence, the temperature of fish should be immediately brought down to near 0°C after harvesting to delay the microbial growth and spoilage. Time and temperature control during post-harvest stage are the most effective tools to ensure food safety.

- ▶ Store the harvested fish in ice or chilled/refrigerated seawater as early as possible to bring down the core temperature as close to 0°C avoid bacterial spoilage.
- ▶ Fish and ice should be tightly packed in the container in shallow layers (1:1 fish to ice ratio) to avoid free space which otherwise cause faster melting of ice.
- ▶ In refrigerated or chilled sea water systems, care should be taken to control overloading of fish to prevent physical damage.
- ▶ Boxing/shelving storage areas of fishing vessel should apply minimum pressure on the fish.
- ▶ Clean and chemical-free ice made from potable water should be used and it should be protected from contamination.
- ▶ Fish harvested at different times should be stored separately as they are in different stages of spoilage.
- ▶ Use of crushed ice with sharp edges must be avoided as it causes physical damage to the fish.
- ▶ The containers used for storage should be designed to provide adequate drainage and should ensure proper cleaning and disinfection to avoid contamination.
- ▶ The boxes used for storage should not be over filled or stacked too deep as it exerts pressure on the fish.
- ▶ Fish room/hold must be strong, corrosion resistant, insulated, and easy to clean with smooth surfaces and allows adequate drainage for melt water.

Handling at landing centre

A great deal of fish handling occurs at landing centers or harbours. It should be ensured that the fish leaving the fish landing centres is of an assured quality and safe for human consumption. Proper handling practices assure the quality of fish and reduce post harvest loss at landing centres.

- ▶ The ice should never be dragged on the floor and must be stored in clean containers.
- ▶ Never use seawater from landing centre for cleaning the fish.
- ▶ Do not throw the fish on hard surfaces to prevent physical damage and contamination.
- ▶ Sorting the catch on beaches should be avoided.
- ▶ All the containers/contact surfaces used for unloading and weighing shall be cleaned & disinfected immediately.
- ▶ Entry of flies, cats, dogs, rodents etc. in the fish handling premises may be prevented.
- ▶ Adequate supply of clean, potable water should be ensured at the landing centres.
- ▶ Fish wastes and offal shall be separate boxes with tight lids and shall be discarded properly.

Handling at retail markets

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.

- ▶ Location of retail fish market should be away from vegetable market, meat or other food markets.
- ▶ Facilities for potable water, electricity and proper hygienic sewage disposal should be provided.

- ▶ Facilities like toilet and arrangement for washing of hands should be provided near the market premises.
- ▶ Selling / Auction Platform/ tables should be elevated with smooth vitrified tiles with side protection and drain pipe.
- ▶ Cutting and filleting of fish to be separated from selling area to prevent cross contamination.
- ▶ Separate area for crate and utensil washing must be provided.
- ▶ Waste materials should be properly segregated, iced and stored in tight containers.
- ▶ Drain pipe from display tables and cutting platforms should be directly connected to main drain to avoid splashing of water
- ▶ All fish contact surfaces should be smooth, water resistant and non-corrosive.
- ▶ Effective cleaning procedure and regular cleaning schedule should be maintained.
- ▶ All the utensils should be washed within 2 hrs of use apart from daily washing at the start and end of sale.
- ▶ Utensils must be stored upside down so that they can adequately drain.
- ▶ Protection from adulteration with lubricants, fuel, pesticides, cleaning compounds, sanitizing agents, condensate, and other chemical, physical, and biological contaminants.

Hygienic fish handling in processing units

Processing units aims towards value addition of the fish thus improving the market value of the products. Hygiene and sanitation are one among the pre-requisite programmes for implementing HACCP in seafood processing units. The following important measures need to be takes care of in processing units for the supply of safe products.

- ▶ Design and layout comprising sufficient working space under adequate hygienic conditions, area for machinery, equipment & storage, separation

of operations preventing cross-contamination, adequate natural or artificial lighting, ventilation and protection against pests.

- ▶ All food contact surfaces shall be smooth, durable, non-absorbent type, easy to maintain and clean and non-toxic.
- ▶ Availability of uninterrupted supply of potable water throughout for all processing operations.
- ▶ Availability of suitable facilities for temperature, humidity and other controls.
- ▶ All pre-processing and processing activities should be scheduled under HACCP system with proper documentation.
- ▶ Regular monitoring of processing unit for plant sanitation with an in-house laboratory and an in-process product quality check.
- ▶ Effective maintenance and sanitation systems including cleaning and sanitation procedures, pest control systems, waste management and monitoring effectiveness.
- ▶ All fish handlers should follow the recommended hygienic handling practices such as periodic medical examinations, regular cleaning and disinfection procedures prior and post to processing activities.

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. Seawater from coastal areas should not be used for fish handling purpose.

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. Fish should be iced in 1:1 ratio of fish to ice in insulated containers. Melted ice should be replaced with fresh ice during storage.

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 objectionable odour.

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.

Personnel hygiene

There is a possibility that the people who handle the fish can introduce hazards to the products. Hygiene and cleanliness of workers handling fish and fish product at each stage from harvesting is very crucial in determining the safety of fish. Hence, the fishers should adopt few simple hygienic actions to prevent contamination.

- ▶ No person who is suffering from, or who is a carrier of, any communicable disease or has an infected wound or open lesion should be engaged in fish handling or transportation.
- ▶ Adequate and appropriate protective clothing, face mask, head coverings and footwear should be worn during fish handling.
- ▶ Fish handling personnel should strictly avoid the objectionable practices such as smoking, spitting, chewing, sneezing or coughing to prevent contamination.
- ▶ Fish handlers should sanitize their hands regularly in Hand Dips to prevent contamination.
- ▶ The workers must wash their hands 1) Before they start handling fish or go back to handling fish after other work 2) Immediately after using the toilet 3) Immediately after smoking, coughing, sneezing, using a handkerchief or disposable tissue, eating, drinking or using tobacco or similar substances and 4) After touching their hair, scalp or a body opening.

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 needed 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.

1. 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 4°C) 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.

2. 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.

Suggested readings

Text book of Fish Processing Technology (Ed. K. Gopakumar), ICAR, NewDelhi. pp. 38-83.

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Huss, H. H., Dalsgaard, D., Hansen, L., Ladefoged, H. and Pedersen, Z. L., 1974. The influence of hygiene in catch handling on the storage life of iced cod and plaice. *J. Food Sci. Tech.*, 9: 213-221.

QUALITY DEFECTS IN FROZEN FISH PRODUCTS

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Freezing is a method of low temperature preservation of fish that can ensure a very long shelf life and also keeps the product characteristics similar to fresh fish. However, during prolonged storage, some quality problems can arise in frozen products due to the changes in protein, fat etc. The common quality defects found in frozen fish products is detailed below.

1. Dehydration and freezer burn

During cold storage, some amount of moisture escape from the fish . Sublimation of ice takes place from the surface of unpackaged or improperly packaged fish causing what is termed as freezer burn. It is evident as white patches on the frozen fish. Fish develop a chalky white, yellow or brown colour and wrinkled appearance on the surface. When thawed, such fish presents a dry and spongy texture. Temperature fluctuations in the cold store as well as higher velocity of the circulating air causes dehydration of the product. It can be minimised by use of glazes, packaging material with very low vapour permeability, maintenance of high relative humidity in the cold store and avoiding temperature fluctuations etc.

2. Gaping of fillets

On thawing, frozen fish fillet often exhibits a phenomenon in which the connective tissue fails to hold the muscle blocks together exhibiting gaps in the musculature. Weakening of connective tissue result in the muscle segments falling apart as in cooked fish. This phenominan commonly occure in fish which are well fed at the time of capture and frozen before or during rigor. The muscle contraction during freezing tend the muscle to pull apart.

3. Discoloration

Fat oxidation in the fish muscle during storage leads to yellow discoloration. Some fish like tuna exhibit green or brown discoloration after cooking. This occurs due to the oxidation of myoglobin pigment to metmyoglobin when the fish is exposed to oxidative condition during and after cooking. Loss of characteristic

pink color in lobster and shrimp is the direct consequence of the changes in the pigments like beta carotene and astaxanthene. Brown or black discoloration appear at the cut end of lobster tail during storage probably by the reaction of enzymes. The important problem in frozen squid and cuttle fish is the yellow discoloration of tubes and fillets. Treatment with a mixture of salt and citric acid is found to improve the color.

4. Toughness

Freezing and prolonged cold storage result in toughness of the meat as well as dryness on cooking. Increase in toughness is partly due to the protein denaturation and cross-linking reactions of myofibrillar proteins and also due to desiccation. In the case of fillet it is advised to pass the rigor-mortis before freezing in order to minimise the muscle contraction and toughness.

5. Protein denaturation

The most important change associated with freezing and frozen storage is denaturation of protein. The structural changes taking place in the protein molecule makes definite changes in the physical, chemical and biological properties of the protein. Curdling of proteinaceous material observed during repeated freezing and thawing is an important physical observation associated with protein denaturation. The loss in characteristic texture due to decrease in water holding capacity of protein brings about increased drip loss in some species of fish. Deteriorative protein changes can be prevented by employing very low and constant temperature during storage and by inhibiting the oxidation of fat and desiccation of the product.

6. Fat oxidation during frozen storage

Fat oxidation is a serious concern during the frozen storage of fatty fishes. The unsaturated fatty acids of fish lipids are susceptible to oxidation and the end result is the formation of different kind of undesirable compounds such as aldehydes, carbonyls and other secondary oxidation products. These products besides producing off flavours, reduce the nutritional value of the frozen stored products. Oxidised lipids interact with proteins reducing the nutritive value of the proteins considerably. Malonaldehyde is one of the major oxidation products and estimation of this compound by forming the thiobarbituric acid (TBA) complex is

the accepted method for monitoring the extent of lipid oxidation. In lipid oxidation, the first step leads to the formation of hydroperoxides, which are tasteless but can cause brown and yellow discolouration of the fish tissue. The degradation of hydroperoxides gives rise to formation of aldehydes and ketones. These compounds have a strong rancid flavour. Lipid oxidation is primarily non enzymatic in nature, recently the involvement of microsomal enzymes and lipoxygenase has been reported. This lipid oxidation takes place in fishes having more than 2% of the lipids eg. fatty fishes.

7. Cod store flavour

In some kind of frozen fish such as cod, prolonged cold storage lead to the development of unpleasant odour and flavour referred to as cold store flavour. The compound responsible for such flavour is identified as cis-4-heptenal. This compound is believed to be developed during the oxidation of phospholipids in the fish muscle. During storage, if the fish gets dried up, oxygen reaches the susceptible fattyacids readily and enhances the development of cold store flavour.