Shelf life of fish

Shelf life can be defined as the period of time that the fish is fit for consumption. Shelf life of different fishes may be vary depending on several factors.

Shelf life of fish can be determined on the basis of some criteria i.e. sensory, biochemical or microbial criteria. Time and temperature of storage can also be used as criteria to determine the limit of self life.

Factors affecting the shelf life

The shelf life and quality of fish is a function of several factors. These are:

Composition of fish:

- Protein content in fish affects the shelf life. Protein rich fish are more prone to spoil.
- Weak muscle tissue and high red muscle decreases the shelf life of fish.
- Fish with high oil content are good for the health benefits of Omega-3 fatty acids, but the high oil content in fish shortens the shelf life due to fat oxidation.
- Season, spawning, water quality, lack of oxygen, temperature, food quality are the factors influencing composition of fish.

Temperature:

Keeping fish at a cool temperature ensures that to maintain its quality for its maximum shelf life.

- The microorganism responsible for spoilage of fresh fish changes with changes in storage temperature.
- High temperatures increase the rate of fish spoilage and low temperatures slow it down.
- The faster a lower temperature is attained during fish chilling effectively inhibit the spoilage activity.
- Generally, the rate at which fish loses quality when stored in ice (0 °C) is used as the baseline when comparisons are made regarding shelf-life at different storage temperatures.
- At low temperatures (0-5°C), *Shewanella putrefaciens*, *Photobacterium phosphoreum*, *Aeromonas spp.* and *Pseudomonas spp.* cause spoilage.
- At high storage temperatures (15-30°C) different species of *Vibrionaceae*, *Enterobacteriaceae* and Gram-positive organisms are responsible for spoilage

Physical damage

- Fish is soft and tissue get damage easily, therefore rough handling results in contamination of fish flesh with bacteria and allow releases of enzymes, speeding up the rate of spoilage.
• In addition, careless handling can burst the guts and spread the contents into the fish flesh.

**Unhygienic handling**

Hygienic handling of the fish is considered an important factor to maintain good quality. If fish are not properly bled, cleaned and handled, then the shelf life of fish declines.

• Rough handling damages the flesh, causing enzyme breakdown and bacterial spoilage.
• Careless handling of fish, damaged tissue, broken cells release autolytic enzymes, which induce the production of spoilage substances viz. cathepsin, calpain, trypsin, chymotrypsin etc.
• These spoilage substances create a positive environment for microorganisms and favor growth of microorganisms, resulting in the production of nitrogenous compounds. Further decomposition produces ammonia amines, indole, skatole etc. and foul smell.

**Method of catching:**

• Struggling of fish damages the fish tissue and accelerates the rigor mortis and decreases the shelf life.

**Intrinsic factors:**

• Big fish stay fresh longer than small fish, flat fish keep better than round fish, fish caught in warm, tropical seas spoil faster than those caught in cold waters.
• Bony fish are edible longer than cartilaginous fish.
• Lean fish keep longer than fatty fish.
• Thick skin fish keep better than thin.

**Post harvest treatment**

• Handling on board, hygiene, proper bleeding, cleaning and gutting.
• Rate of chilling, especially fatty fish and temperature control.
• Hygiene during processing.
• Packaging, storage and transportation.

**Bacterial contamination**

Large numbers of microorganisms present on the outer surface and inside fish. Bacterial contamination reduces the shelf life of fish by bacterial spoilage:

• Reduction of Trimethylamine oxide into Trimethylamine (TMO)
• Breakdown of urea into ammonia
• Breakdown of amino acid into primary amines. Formation of histamine from histidine and arginine from glutamic acid etc.
• Rancidity-oxidation of fat, Fat oxidized by atmospheric O₂, unpleasant odour and rancid taste.
• Increase temperature and exposure of light increases oxidation rate.

**Assessment of shelf life**

**Sensory method**: Involves the use of human sense organ called sensory test, may be biased but it represent customers view.

Characteristics of food as perceived through the senses of sight and general appearance of skin of fish, eye, color and mucus in gills, presence and absence of indentation, stiffness of fish, condition of belly, smell and texture etc.

**Physicochemical methods**:  
Determination of pH: Knowledge about the pH of fish meat may give valuable information about its condition.

Evaluation of putrefaction/decomposition/determination of end product of spoilage:

**Chemical indicators of Spoilage**: Trimethylamine, Total Volatile Basic Nitrogen, Volatile Reducing Substance (VRS), Indole, Skatole, Hydrogen Sulphide etc.

Lipid as Indicator of Spoilage: Measurements of oxidative rancidity, Peroxide Index, Thio Barbitanic Acid Test.

Determination of Amines: Total Volatile Basic Amines, Ammonia, Trimethylamine (TMA), Dimethylaramine (DMA), Biogenic Amines, Nucleotide Catabolites

**Microbiological methods**: Total counts of bacteria, Spoilage bacteria, Spoilage reactions.
Preservation of Fish

Fish preservation is the method to extend shelf life of fish and other fishery products by applying the different methods of preservation in order to improve the quality of the products.

- Preservation of fishes through different techniques used to prevent spoilage to maintain nutritive value and flavor of fish.
- Fish is a perishable and tends to decompose very quickly. Therefore preservation becomes an essential part of fishing industry.
- Preservation includes different way to control deterioration of fish caused by microorganism, oxidation of chemical agents, proteolytic enzymes, and various non-enzymatic reactions etc.
- Each method of preservation required cleanliness of fish: fish should be washed with cleaned cold water to remove the surface bacteria, slime, blood stain etc.
- The internal organ and gut of fish must be removes as they contain the enzymes and harbour putrefactive bacteria. Large fishes should be gutted to remove internal organs.

Methods of Preservation

Drying

- Sun drying is the most primitive method of fish preservation.
- Hanging fish in sun light, wind or over wood fires.
- This process is slow and takes many days/week and depending on size and thickening of fish and climatic condition of particular area.
- Drying usually implies the removal of water vapour by evaporation.
- This is the simplest and cheapest method and widely used for both fresh and marine fishes.

Salting

Sal is preservative agent used to lengthen the shelf life of fish and fishery product. This is used in almost all methods of preservation except in icing, refrigeration and freezing. There are different kinds of salts, some being better than other for fish curing.

- Salting is also an old age method for fish preservation involves dehydration of fish by osmosis.
- Enzymes of autolysis and bacteria are destroyed/render inactive by the concentration of salt.
- Salting of fish includes, cleaning, washing, icing the fish immediately after caching.
- Fish should be gutted and scars are to be cut out of muscle allow better penetration of salt.
There are two types of salting, dry and wet salting.

**Dry Salting**
- In dry salting, fishes are rubbed by salt powder and then packed in tubs or cemented tanks.
- Dry salt powder is sprinkled between layers of fishes.
- The ratio of salt to fish varies 1:3 to 1:8 depending on the weather and type of the fish.
- Oily fish requires more salt.
- After salting, fishes are removed from the container, washed, and dried in the sun for 2-3 days.

**Wet salting (Brining)**
- This is a cheaper method, requiring a lesser amount of salt.
- The principle is to keep the fish for a long time in brine, where the brine must float the fish.
- Before brining, fish should be cleaned, de-headed, de-scaled, and gutted; small fish can be salted whole.
- Large fish must be cut open, and it is preferable to take out the backbone.
- In places where the fish is thick, slashes must be made so that salted brine can penetrate the flesh.
- Fish should be submerged in the brine for the required time.
- This salted fish can be kept for a longer time in a dark or in a shady place.

**Smoking**
- Smoking is another old method for preserving fish.
- Purpose of smoking is to cook the fish as well as to smoke it.
- Fishes are smoked in order to give a pleasant taste rather than preserve it.
- Smoking adds chemicals for bactericidal and anti-oxidant activities.
- Phenol content of the smoke acts as an antiseptic and imparts a characteristic color and mild flavor due to the presence of resins and tars in the smoke.
- Two types of smoking processes are widely used.
- Cold smoking, where the temperature of the smoke is not raised above 30°C, and hot smoking, where the temperature reaches up to 80°C.

**Chilling and Freezing**
- Microbial activity is arrested at low temperatures below 10°C and it is almost nil at freezing point.
- Keeping in large amounts of ice is an effective method to preserve fish for a long time.
- Fishes after cleaning and gutting are kept in a block of ice.
- Alternate layers of ice and fish must be arranged to get better results.
In large specimens the ice may be inserted in abdomen after removing internal organ.
Side effect of freezing that frozen water crystals pierce the cell wall and make fish mushy in texture.
To limit this type of cell damage quick freezing is required.

Canning

- Caning is the relatively modern and comparatively effective method of fish preservation by heat sterilization in air tight sealed container (tin cans).
- Container should be anti-corrosive and perfectly air tight.
- By heat sterilization, enzymes and bacteria are permanently inactivated without changes in food quality.
- The canned fish can be used safely for a longer period without losing palatability.
- Quality of canned product depends on handling of fish, nature and quality of fish.
- Before canning fishes should be cleaned, de- scaled and gutted.
- Fishes are beheaded and larger fishes are cut into pieces (fillets).
- In case of prawn, appendages, shell and head should be properly removed.
- Removing of head and gut in one operation is called nobbing this can be done by using nobbing machine.
- After dressing, product is washed in chlorinated water to remove blood stain and slime.
- Removal of moisture content can be done in brine, steam, hot air or by drying in oil.
- The fillets are then packed in cans which are again passed in steam chamber for exhausting.
- The object of exhausting is to reduce the amount of air in head space of cans.
- Exhaust chamber is a long tunnel which is heated by steam and the temperature maintained at about 90-95 °C.
- After exhausting, sauce, flavour or oil should be added to the product.
- The lead of cans be seamed, and cans should be washed to remove adhesive solid and liquid using a detergent.
- Finally the canned product should be undergoing final cooking and sterilization by heat.
- This Second cooking will inactive the enzymes and bacteria, if present in the cans.
- Processing time and temperature to sterilize the cans depend on nature and type of pack.
- After processing cans should be cooled in chlorinated water and labeled.

References: Fundamentals of Ichthyology by S.P. Biswas, Freely available materials on internet