



Chapter 3

Sensory Evaluation & Hygienic Handling of Fish

Laly S. J.

Quality Assurance and Management Division
ICAR-Central Institute of Fisheries Technology, Cochin
Email: lalyjawahar@gmail.com

Introduction

Fish and other seafood are highly important as they cover a part of protein demand for humans. The nutrient composition of fish is rich in health beneficial polyunsaturated fatty acids, vitamins and minerals. Fresh fish spoilage can be very rapid after it is caught. Freshness makes a major contribution to the quality of fish and fishery products. Nutritional values, color, texture, and edibility of foods are susceptible to spoilage. Improper pre and post-harvest handling conditions can enhance exacerbation of indigenous bacteria that could cause spoilage of fish.

Freshness is the most important attribute when assessing the quality of seafood and is of great concern. The quality of seafood degrades after death due to the chemical reactions [changes in protein and lipid fractions, the formation of biogenic amines and hypoxanthine (Hx)] and microbiological spoilage. This leads to the deterioration of sensory quality of seafood during inadequate storage. The factors contributing to spoilage of fish are

- High fat content
- High protein content
- High moisture content
- Weak muscle tissue
- Extent of bacterial contamination
- Unhygienic handling etc.

Methods for Assessing Freshness Quality

Freshness makes a major contribution to the overall quality of fish and fishery products and is greatly influence by both pre-harvest conditions and post-harvest handling practices. There are different methods for assessing the fish freshness. They are

- Sensory and Non-sensory or instrumental.
- Non-sensory – Chemical, physical and microbiological methods.
- Non-sensory assessment is based mainly on measuring major physical or chemical alterations from the original condition of the fish.



Sensory methods

Sensory evaluation is the most important method in freshness assessments. They are the most convenient method for testing seafood quality in field level. Sensory tests involve using senses to evaluate the quality of seafood. Typical sensory tests include the evaluation of appearance, texture, odor, flavor and other attributes. This method is very subjective since everyone has their own likes and dislikes.

Sensory evaluation of food is defined as the scientific means of quantifying and interpreting the variations in food characteristics (odour, taste, tactile, appearance) by using human senses of sight, smell, taste, touch and hearing. Sensory evaluation provides rapid measurements of the freshness of seafood. Sensory methods are capable of giving objective and/reliable results when assessments are done under controlled conditions. They can be very fast, reliable, non-destructive on raw fish and no expensive instruments are needed. There are several grading methods used to assess freshness in fish and fish products. Vision is very important to see defects such as bloodstains, bones and parasites. The appearance of the fish, including the gills and eyes, gives information about the freshness of the fish. Odour of both raw and cooked fish is also important in sensory evaluation of freshness. People are very sensitive to various compounds produced in fish during storage, and especially spoilage, such as several sulphur and nitrogen compounds. Flavour is the olfactory perception caused by volatile substances released from a product in the mouth as well as the basic tastes caused by soluble substances in the mouth. There are four classical basic tastes: sour, salt, bitter and sweet. In addition to these others are metallic, astringent and umami. In sensory evaluation of fish, the tactile sense is mainly used to evaluate the texture of fish flesh, for example by pressing a fingertip on the fish flesh to observe if the fish is still stiff or soft. The texture of seafood can also be sensed through chewing.

Selection and training of sensory panels

- Selection of participants shall be based on basic sensory acuity and ability to describe perceptions analytically.
- Personal characteristics are very important when selecting people for the sensory group
- Panellists must also be healthy and normally sensitive (taste and odour senses).
- Basic selection tests and training guidelines can be found in Meilgaard *et al.* (2006), ISO 8586-1 (1993), The Codex guidelines for sensory evaluation of fish and shellfish in laboratories (Codex Standards 1999)
- The training of the sensory panel should begin by describing the procedures of the sensory evaluation



- Samples should be coded and randomly presented among the panellists

Procedures for sensory evaluation

COLLECTING AND TRANSPORTING SAMPLES –

- ✓ Acceptance or rejection decision is made on the basis of an examination of a sample drawn from the batch according to guidelines (regulatory or commercial)
- ✓ Samples if not evaluated immediately, should be stored under appropriate conditions.
- ✓ Fresh and chilled products should be examined on the day they are received.
- ✓ Products in either chill or frozen storage should be appropriately wrapped to prevent drying out or desiccation

PREPARATION OF SAMPLES FOR EXAMINATION

- ✓ Procedures for the preparation of samples should be appropriate for the product types - fresh or frozen
- ✓ Frozen products should be first examined in the frozen state
- ✓ then be thawed for sensory evaluation
- ✓ Thawing can be accelerated by immersion of the material in water with wrapping

COOKING

A small portion is sectioned from the sample unit and the odour and flavour or gelatinous condition confirmed by cooking without delay by cooking method. The product must not be overcooked.

Procedures for the assessment of products

Samples should be assessed relative to the characteristics of the species concerned

1. Assessment of Raw Products
2. Assessment of Frozen Products -Frozen fish should be examined in the frozen state.
3. Assessment of Cooked Samples - Cooked samples should be held in a closed container, allowed to cool to a comfortable tasting temperature, and kept warm unless they are assessed immediately. Products which have already been cooked, for example cooked shrimps, should be warmed up slightly.

Training of assessors

- **Objective** - effects of personal influence are minimized, used to distinguish between two or more products, based on certain attribute of raw fish (skin, eyes, gills, texture, etc.)
- **Subjective** – acceptance is freely expressed, often called hedonic, used in product development and market research, what ordinary consumers think

Sensory evaluation of seafood: methods

Training Manual on 'Quality Assurance of Fish and Fishery Products, ICAR-CIFT, Cochin-29 (18-29 Sep., 2023)



In sensory evaluation of seafood, grading, ranking and scaling methods are the most frequently used methods.

❑ **Difference tests**

Difference tests can be used to determine whether a difference exists in a single sensory attribute or in several. They determine whether there exists a perceptible difference in a given attribute, and the specification of the direction of difference.

- ✓ ranking (ISO 8587, 1988) - arrange in order according to the degree, used for preliminary screening
- ✓ triangle test (ISO 4120, 2004) – select one out of three coded samples
- ✓ paired comparison test (ISO 5495, 2005) – select from two set of samples

❑ **Grading schemes**

Grading is the process of applying a categorical value to a lot or group of products. Sensory grading most often involves a process of integration of perceptions by the grader.

Examples : EU quality grading scheme (EU-scheme) and the Torry scheme

European Union Scheme

The EU scheme its main advantage is that the fluctuation between assessors is diminished. In this scheme, three grades of freshness are established: E, A and B, corresponding to various stages of spoilage. E (Extra) is the highest possible quality, while below B is the level where fish is considered unfit for human consumption. The method only uses general parameters to describe freshness quality, it does not take different sensory characteristics of different species into account, nor does it provide useful information about the past or remaining storage time as it is too general.

The EU scheme is criticized for its limitations in that it does not take into account the differences between species (uses only general parameters) and mixes both subjective and objective sensory methods in the assessment scheme.



	CRITERIA			
	Freshness Category			Not Admitted
	Extra	A	B	
Skin	Bright, iridescent pigment or opalescent, no discoloration	Pigmentation bright but not lustrous	Pigmentation in the process of becoming discoloured and dull	Dull pigmentation
Skin mucus	Aqueous, transparent	Slightly cloudy	Milky	Yellowish, grey, Opaque mucus
Eyes	Convex, black, bright pupil, transparent cornea	Convex and slightly sunken, black, dull pupil	Flat, opalescent cornea, opaque pupil	Concave in the centre, grey pupil, milky cornea
Gills	Bright colour, no mucous	Less coloured, transparent mucus	Brown/green becoming discoloured, thick opaque mucus	Yellowish, milky mucus
Peritoneum on gutted fish	Smooth, bright, difficult to detach from flesh	Slightly dull, can be detached from flesh	Speckled, comes away from flesh	Does not stick
Smell of gills and abdominal activity	Seaweed smell	No smell of seaweed, neutral Smell	Fermented, slightly sour	Sour
Flesh	Firm and elastic, smooth surface	Less elastic	Slightly soft, less elastic	Soft, scales easily detached from skin, surface rather wrinkled

Torry scale

- ✓ The Torry scale is the first detailed scheme developed for evaluating the freshness of cod (Shewan *et al.* 1953).
- ✓ The first scoring method for use with fish and fishery products was developed at the Torry Research Station in the UK.
- ✓ The Torry scale is the most frequently used industry scale for evaluating the freshness of cooked fish.
- ✓ It is used both by producers and buyers.
- ✓ It is a descriptive 10-point scale that has been developed for lean, medium fat and fat fish species. Scores are given from 10 (very fresh in taste and odour) to 3 (spoiled). It is considered unnecessary to have descriptions below 3, as the fish is then not fit for human consumption.
- ✓ The average score of 5.5 has been used as the limit for 'fit for consumption'



- ✓ Members of the sensory panel detect evident spoilage characteristics, such as sour taste and hints of ‘off’ flavours.
- ✓ The Torry scale has been developed for lean, medium fat, and fatty fish species.

Quality Index Method

The QIM was developed at the Tasmanian Food Research Unit (TFRU) of the Commonwealth Scientific and Industrial Research Organization (CSIRO) QIM schemes are developed for individual species. Each attribute is scored from 0 to 3 by novice or experienced assessors with low scores indicating the best quality. The sum of all attributes is called demerit points, or QIM index points. This value increases linearly with storage time in ice of a given fish Using the QIM system, the linear relationship between the quality index (QI) and storage time on ice, makes it easy to calculate the remaining shelf-life of fish.

- ✓ QIM is widely accepted as a reference method in research.
- ✓ In quality management it is important to be able to apply a sensory system that reflects the different quality levels in a simple, reliable and documented way.
- ✓ QIM has those advantages, in addition to being rapid, cheap to use, non-destructive and objective compared with other sensory methods.
- ✓ Further, it is easy to work with as it includes instructions. It is a convenient method to teach inexperienced people to evaluate fish, and to train and monitor performance of panellists.
- ✓ In QIM, a demerit score is employed to assess the quality of fish by a panel of experts. The demerit score consists of different quality attributes, whose quality can be assessed by giving demerit score to each attributes/factors
- ✓ As the quality index (the total sum of scores, referred to as the QI) is designed to increase linearly with storage time
- ✓ QIM is based on characteristic changes that occur in seafood with storage time in ice. A score from 0 to 3 points is given for changes of parameters

A demerit score system developed by Branch and Veil (1985) having a total demerit score of 39 is given below

Factor being assessed	Observation	Demerit points
Appearance of surface	Very bright	0
	Bright	1
	Slightly dull	2
	Dull	3
Skin	Firm	0
	Soft	1
Scales	Firm	0
	Slightly loose	1
	Loose	2



Slime	Absent	0
	Slightly slimy	1
	Slimy	2
	Very slimy	3
Stiffness	Pre rigor	0
	Rigor	1
	Post rigor	2
Eyes clarity	Clear	0
	Slightly cloudy	1
	cloudy	2
Shape	Normal	0
	Slightly sunken	1
	Cloudy	2
Iris	Visible	0
	Not visible	1
Blood	No blood	1
	Slightly bloody	1
	Very bloody	2
Gill colour	Characteristic	0
	Slightly dark	1
	Slightly faded	2
	Very dark/very faded	3
Mucus	Absent	0
	Moderate	1
	Excessive	2
Smell	Fresh oily	0
	Seaweedy	1
	Fishy	2
	Stale/Spoiled	3
Belly discolouration	Absent	0
	Detectable	1
	Moderate	2
	Excessive	3
Firmness	Firm	0
	Soft	1
	Burst	2
Vent condition	Normal	0
	Slight break/exudes	1
	Excessive	2
Smell	Fresh	0
	Neutral	1
	Fishy	2
	Spoiled	3
Bell y cavity stains	Opalescent	0
	Greyish	1
	Yellow brown	2
Blood	Red	0
	Dark red	1
	Brown	2



Total demerit point	0-39
---------------------	------

FISHQCheQ App

- ICAR – CIFT has developed a demerit score based fish quality index (FQI) system for assessing/ evaluating quality/ freshness of fresh fish.
- The developed FQI system considered five general quality characteristics viz.
- Appearance of fish outer surface, fish eyes and gills, condition of fish belly and vents.
- This web based system would help the consumer to check/ evaluate the quality of fresh fish instantly.
- This system provides the instructions for evaluating the quality/ freshness of fish.
- After evaluating the fish in terms of quality characteristics description, the consumer or user has to select appropriate score given in the element score sheet.
- After complete selection of demerit score, a final fish quality index (FQI) would be computed automatically along with the quality description of fish.
- Both web and mobile application (Google play store) is available

Hygiene handling of fish

A high level of care is required while handling the harvested fish as the fish is highly perishable compared to any other food commodities. Implementing good post-harvest handling practices is essential to keep the fish safe and in good condition till it reaches the consumers. Bacterial spoilage is the most important factor affecting fish quality. Bacterial growth on fish is slowed by proper cleaning, dressing and chilling. Chemical changes, including oxidation, causes a fish to have a fishy odour. Chemical changes can be slowed if the fish is kept out of sunlight, is kept covered and moist, and is chilled properly. Fish muscle tissue is fragile compared with muscle tissue of other animals. Bruising, gaping, and mushy flesh can all be reduced if fish are handled gently and chilled quickly. Dehydration, or drying out can be avoided if fish are chilled quickly and kept covered with ice or chilled seawater. Contaminants should be kept away from fish and from surfaces that come in contact with fish. Fuel, oil, paint, cleaners, and other such chemicals should never be stored in a fish hold. Only clean ice made from potable water should be used to chill fish.

Onboard handling practices

- A good supply of clean or potable water at adequate pressure should be available.
- Non potable waterlines should be clearly identified and separated.



- Ice prepared from potable water under hygienic conditions should be available to preserve fish.
- Fish receiving deck shall be smooth, clean and free from engine oil, grease, etc. Adequate facilities should be provided for washing and disinfecting equipment, where appropriate.
- Objectionable substances, which could include bilge water, smoke, fuel oil, grease, drainage and other solid or semi-solid wastes, should not contaminate the fish and shellfish.
- Containers for offal and waste material should be clearly identified, covered and made of impervious material.
- Separate and adequate facilities should be provided to prevent the contamination of fish and shellfish by poisonous or harmful substances; offal and waste materials.
- Adequate hand washing and toilet facilities, isolated from the fish and shellfish handling areas, should be available where appropriate.
- The artificial lights provided on the deck and in the hold shall have protective covers. Facilities to prevent the entry of birds, insects or other pests, animals or vermin should be provided, where appropriate.

Fish Landing Site/ Harbour

Location and Surroundings

- The Landing Site / Fishing Harbour shall be located at a site ideal for the purpose and shall be free from undesirable smoke, dust, other pollutants and stagnant water. The premises shall be kept clean.

Design and Construction

- Suitable covering shall be given at the fish landing site/harbour to protect fish and shellfish from environmental hazards such as sun light, rain, wind blown dust etc.
- Adequate working space shall be provided for hygienic handling of fish and shellfish.
- Floor and walls shall be smooth and easy to clean and disinfect. The floor shall have sufficient slope for proper drainage and to avoid stagnation of water.
- Drainage lines of adequate size and slope shall be provided to remove waste water, the outlet of which shall not open to the sea near the landing berth.
- Landing site shall be constructed in such a way to avoid entry of exhaust fumes from vehicles.



- Preferably, separate auction hall(s) may be provided, which is well protected from the entry of pests/insects, for display and sale of fish and shellfish.
- Fish and shellfish shall not be kept directly on floor. Raised platforms shall be constructed for display, which are smooth, easy to clean and disinfect.

Equipments and Containers

- The containers and equipment used to handle fish and shell fish shall be smooth, impervious and made of corrosion free material, which is easy to clean and disinfect and kept in a good state of repair and cleanliness.

Facilities and Utilities

- Provision for adequate quantity of potable water or clean sea water shall be available in the landing sites for cleaning and sanitation. Non potable waterlines should be clearly identified and separated
- Facilities for hygienic handling and storing of sufficient quantity of good quality ice and provision for crushing the ice hygienically shall be provided, as applicable.
- Adequate facilities should be provided for washing and disinfecting equipment, where appropriate.

Marketing

Location

- The facility shall be located in the areas not subjected to regular and frequent flooding, and shall be free from undesirable odour, smoke, dust, pest, and other contaminants.
- The facility shall have adequate drainage and provision for easy cleaning.
- The area should provide ease of transportation of fish towards the market and outwards

Premises Requirements and Construction

- Facility shall be constructed to enable hygienic processing and sale of fish and fish products to ensure food safety
- Sufficient parking facility, loading and unloading facility for fish, cleaning facility for fish transportation vehicle, fish storage crates, chilled fish storage, solid waste disposal facility, effluent treatment plant etc may be provided.
- In wholesale fish markets raised platforms with drainage facility
- A sign board indicating the type of fish and fish products sold shall be displayed prominently.
- The surfaces of walls, partitions and floors of retail area shall be made of impervious materials for easy cleaning and sanitation



- adequate space for the fixtures, fittings and equipment used
- Fish laid down for sale shall not come into direct contact with floors, walls or other fixed structures
- Doors, windows and floors shall be constructed for effective cleaning & sanitation
- provide protection to avoid entry of flies, other pests and stray animals
- There shall be an adequate supply of potable water.
- Fish handlers shall be provided facilities for cleaning their hands and toilet facilities.

Reference

1. Codex guidelines for sensory evaluation of fish and shellfish in laboratories
2. Food Safety Management System (FSMS) Guidance Document for Fish and Fish Products