

METHODS FOR SENSORY EVALUATION OF FISH

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Sensory analysis is the most direct method for evaluating the freshness and therefore, the quality of fish. Sensory evaluation is defined as 'a scientific discipline used to evoke, measure, analyze and interpret reactions to characteristics of food as perceived through the senses of sight, smell, taste, touch and hearing' (Stone and Sidel, 1993). In sensory analysis, the scientific means of quantifying and interpreting the variations in the sensory characteristics of food such as appearance, odour, flavour and texture are evaluated through the human senses of sight, smell, taste, touch and hearing. Most sensory characteristics can only be measured meaningfully by humans. However, advances are being made in the development of instruments that can measure individual quality changes. With some practice, the pattern of changes in sensory characteristic between very fresh and very spoiled food can be easily and quickly by sensory means and the degree of freshness can be accurately determined.

Sensory analysis constitutes a reliable, rapid, reproducible and relative easy way to evaluate freshness. Moreover, it can be applied to all fish species being in most cases non-destructive. However, like any other methodology, it has to be applied in a systematically and standardized way to give reliable information that can be used as an evaluation method. Without appropriate sensory analysis, there is a high risk of market failure. Sensory analysis is too frequently often overlooked as a requirement before product launch, and is often carried out to a poor standard.

Seven quality factors are the most important and reliable in the Organoleptic examination of fish factors,

1. General appearance
2. Appearance of flesh
3. Texture of raw fish
4. Odour of raw fish
5. Odour of cooked fish

6. Flavour of cooked fish

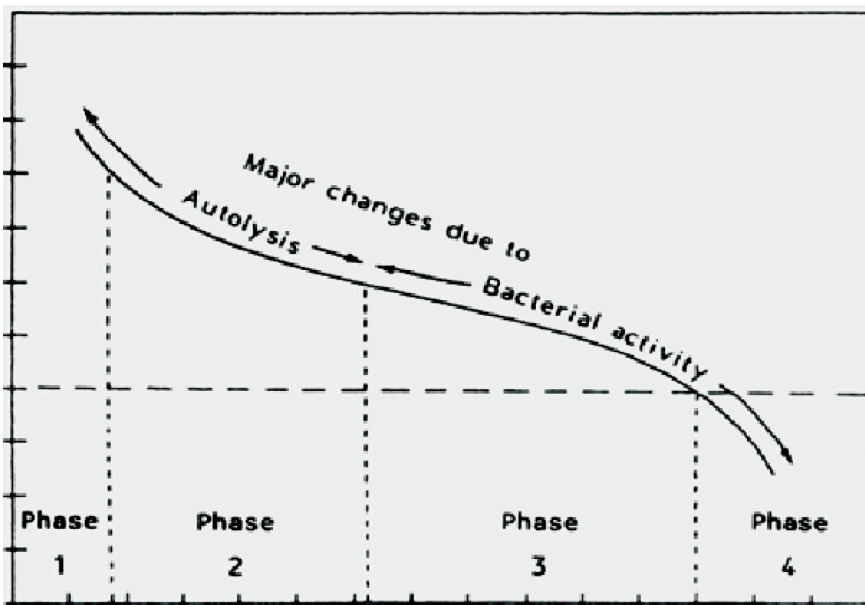
7. Texture of cooked fish

Application of sensory analysis includes quality control of raw materials and finished products, storage tests, development of new products, and off-flavour, aroma research, consumer test and hedonic test. There are two kinds of assessment generally followed,

- a) Organoleptic testing (Subjective method) and
- b) Sensory testing (Objective method)

A characteristic pattern of the deterioration of fish stored in ice can be found and divided into the following four phases:

- ▶ **Phase 1** The fish is very fresh and has a sweet, sea-weedy and delicate taste. The taste can be very slightly metallic. In cod, haddock, whiting and flounder, the sweet taste is maximized 2-3 days after catching.
- ▶ **Phase 2** There is a loss of the characteristic odour and taste. The flesh becomes neutral but has no off-flavours. The texture is still pleasant.



Scoring and grading for fish freshness

- ▶ **Phase 3** There is sign of spoilage and a range of volatile, unpleasant-smelling substances is produced depending on the fish species and type of spoilage (aerobic, anaerobic). One of the volatile compounds may be trimethylamine (TMA) derived from the bacterial reduction of trimethyl-aminoxide (TMAO). TMA has a very characteristic “fishy” smell. At the beginning of the phase the off-flavour may be slightly sour, fruity and slightly bitter, especially in fatty fish. During the later stages sickly sweet, cabbage-like, ammoniacal, sulphurous and rancid smells develop. The texture becomes either soft and watery or tough and dry.
- ▶ **Phase 4** The fish can be characterized as spoiled and putrid.

Quantification of sensory data requires the use of a scale, where the person can assess the deterioration that occurs continuously through varying degrees of intensity. Separate descriptive scales are used for each attribute and the range 10 to 0. The scale of ten is absolutely fresh and zero is completely putrid; anything below four is unacceptable.

Grading is the process of applying a categorical value to a lot or group of fish and fishery products. Grading has the advantage that it offers the possibility of selecting products for different qualities. Grading is simpler and less finely subdivided. In the EEC scheme of grading fish (chilled fish) four grades are given. In this, four grades, four grades (E, A, B and C) of freshness are laid down corresponding to the various stages of spoilage. E is the freshest and C is unfit for human consumption. There are several grading methods used to assess freshness in fish and fish products such as:

1. The torry scoring system
2. The European Union schemes
3. The quality index method

The Torry Scoring System:

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 a 10-point scale originally developed to assess the eating qualities of cooked fish. Scores are given from 10 (for very fresh in taste and odour) to 3 (for spoiled fish) (Table 1). Scores below a 3 are considered unnecessary, as the fish is then not fit for human consumption.

The average score of 5.5 may be used as the limit for consumption. The Torry scale has been developed for lean, medium fat, and fatty fish species.

Table 1. Sensory score sheet for Cod (cooked) from gutted fish stored in melting ice

Score	Odour	Flavour	Texture, mouth feel and appearance	Score
10	initially weak odour of sweet, boiled milk, starchy, followed by strengthening of these odours	watery, metallic, starchy; initially no sweetness but meaty flavours with slight sweetness may develop	dry, crumbly with short tough fibres	10
9	shellfish, seaweed, boiled meat, raw green plant	sweet, meaty, creamy, green plant, characteristic		9
8	loss of odour, neutral odour	Sweet and characteristic flavours but reduced in intensity	succulent, fibrous; initially firm going softer with storage; appearance originally white and opaque going yellowish and waxy on storage.	8
7	wood shavings, woodsap, vanillin	neutral		7
6	condensed milk, caramel, toffee-like	insipid		6
5	milk jug odours, boiled potato, boiled clothes-like	slight sourness, trace of 'off' flavours		5

4	lactic acid, sour milk, 'byre-like'	slight bitterness, sour, 'off' flavours	4
3	lower fatty acids (eg acetic or butyric acids), composted grass, soapy, turnipy, tallowy	strong bitter, rubber, slight sulphide	3

European Union Schemes:

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; A is acceptable quality; while below B is the level where fish is considered unfit for human consumption (Table 2). This method gives rather limited information about the condition of the fish, as it is not species-related and does not take into account the differences between species. The EU-scheme is commonly accepted at auction levels however its use has been disputed.

Table 2.Criteria of EU schemes

	CRITERIA			
	Freshness Category			Not Admitted
	Extra	A	B	
Skin	Bright, iridescent pigment or opalescent, no discolouration	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
Gills	Bright colour, no mucus	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.

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 (Table 3). 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, therefore, the linear relationship between the quality index (QI) and storage time on ice, makes it easy to calculate the remaining shelf-life of fish.

Table 3. Quality Index Method (QIM) schemes

Quality Parameters	Description	Points
Whole fish Skin colour/ appearance	Pearls-shiny, iridescent pigmentation	0
	Less pearl-shiny, yellowish, strips still distinct	1
Odour	Neutral, pond, fresh fish, seaweed	0
	Melon, cucumber, green grass	1
	Cardboards, fishy, putid, rotten	2
Texture	In rigor	0
	Firm, resilient, finger mark disappears immediately	1
	Soft, finger mark still persists after 3 seconds	2

Eyes	Pupil	Black, clear, bright, iridescent	0
		Dark gray, meat, dull	1
		Milky, cloudy, hazy, light, gray	2
	Shape	Convex, bulging	0
		Flat	1
		Concave, sunken	2
Gills	Mucus	Transparent, clear, none	0
		Milky, clotted	1
	Colour/ appearance	Bright red, red, burgundy	0
		Pale red, pink, light brown	1
		Brown, dull	2
	Odour	Pond, fresh fish, fresh rain	0
Melon, cucumber, metallic		1	
Musty, fishy, putrid, rotten		2	
Quality index (total score)			0-14

Suggested readings

1. Stone, H and Sidel, JL. 1993. Sensory Evaluation Practices. 2nd ed. Academic Press: San Diego.
2. Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall