SEAFISH

Seafood Quality Assessment Training in the Seafood Industry

Introduction to Assessing Fish Quality

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Fish parasites and food poisoning hazards

Nematodes in fish

The commonest types of worm are - roundworm, tapeworm and flatworm.

Roundworms are the most common parasites found in fish. There is a link between roundworms, seals (and other sea mammals) and fish. Fish are hosts to only one life form in the roundworm life cycle, and the sea mammal is host to the roundworm in another part of the cycle. Thus the more sea mammals there are in the fishing grounds the more roundworms will be found in the fish.

To reduce the number of roundworms in fish reaching consumers the fish should be inspected and worms removed.

There are two main types of roundworm:

Roundworm name	Fish species infected	Length	Colour	Where found
Cod worm.	Cod, Haddock.	4cm	Creamy-white to dark brown.	Flesh and belly flaps.
Herring worm.	Herring, Mackerel, Whiting, Blue Whiting.	2cm	Colourless.	Gut, belly flaps, flesh. (Moves from guts to flesh in ungutted fish.)

Most roundworms will be removed by:
- gutting;
- cleaning the gut cavity;
- trimming and throwing away belly flaps; and
- cutting out worms near the surface of the flesh.

Roundworms do not cause health problems in this country because most fish is cooked before eating.

Roundworms **killed** by:	Roundworms **not killed** by:
Cooking for 1 minute at 60˚C. Hot smoking. Freezing for 24 hours at –18˚C.	Cold smoking. Brining. Pickling.

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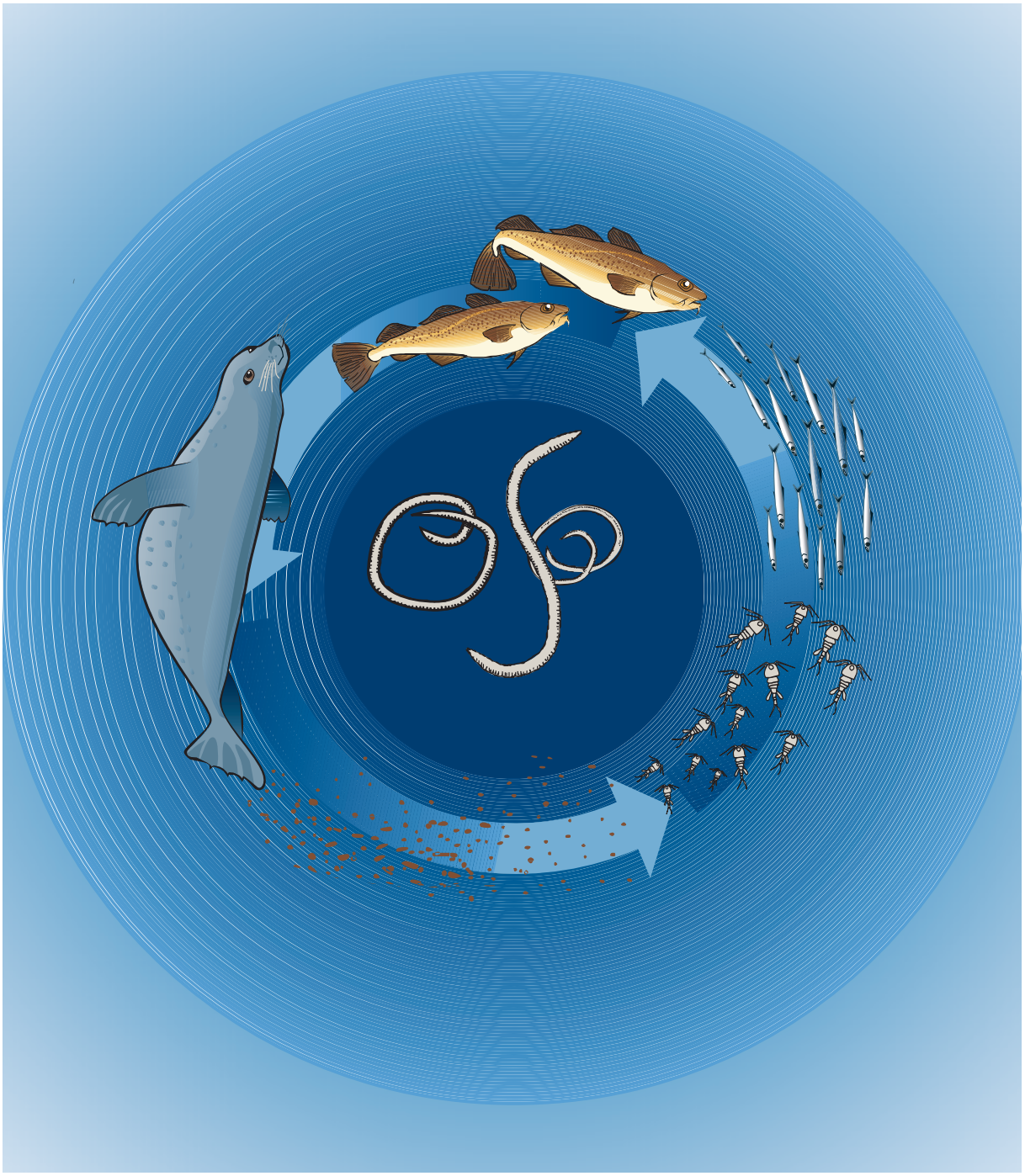
Life cycle of the cod worm



Food poisoning

Paralytic shellfish poisoning
Occurs rarely in the UK but is serious and sometimes fatal. It can occur following the consumption of mussels and other bivalve molluscs that have been feeding on a certain type of plankton that produces a neurotoxin.

Symptoms include a tingling of the tongue and mouth which spreads to the neck, fingers and toes. It can last for up to three days. Occasionally it progresses to paralysis. A large Canadian outbreak occurred in 1968 involving mussels, since then annual monitoring of the toxin levels in mussels has taken place.

Diarrheic shellfish poisoning
This illness is associated with 'red tides' more commonly known as algal blooms. Not all algal blooms are red and their proliferation can be missed as a consequence.

Shellfish feed on this small dinoflagellate plankton which concentrate the constituent toxic chemical known as okadaic acid and additional toxins (DTX - 1, 2, 3; pectenotoxins 1 - 6; yessotoxin).

The symptoms are diarrhea, nausea, vomiting and abdominal pain which can occur between 30 minutes and 12 hours after eating the shellfish and last for three - four days. Where these algal blooms occur any shellfish beds are closed.

Neurotoxic shellfish poisoning
Commonly occurs around the Gulf of Mexico, western coast of Florida, Spain, the eastern Mediterranean and Japan. In all cases of outbreaks the causative agent has been identified as the dinoflagellate Gymnodinium breve; in the Gulf of Mexico blooms of this organism have caused massive fish kills and manatee deaths, while in New Zealand shellfish were the affected species.

The symptoms, which can occur within a few minutes to a few hours, are gastrointestinal and neurological including tingling and numbness of the lips, tongue and throat, muscular aches, dizziness, reversal of the sensations of hot and cold, diarrhoea and vomiting. The duration can be fairly short, from a few hours, but could extend to several days.

Amnesic shellfish poisoning
First recognised as a shellfish poison in 1987 when it was found in toxic mussels harvested from eastern Prince Edward Island in Canada. Since then it has been reported in other parts of the world. A diatom, Pseudo-nitzschia, produces the toxin (domoic acid). In the original incident, mussels were contaminated, but in later incidents on the North American West Coast, anchovies, razor clams and Dungeness crabs were the primary affected species.

The symptoms are vomiting, diarrhoea, abdominal pain, confusion, memory loss, disorientation, seizure and coma.

The onset of gastrointestinal symptoms occurs within 24 hours, neurological symptoms occur within 48 hours.

Scombrotoxin
This illness is caused by toxins that accumulate in the flesh of the fish during un-refrigerated storage. It occurs in species such as mackerel, tuna, sardines and pilchards.

The fish do not always appear to be spoilt but analysis of them reveals a higher level of histamine than would be found in fresh fish.

The presence of high levels of histamine (derived from the amino acid histidine) is not thought to be the cause of symptoms, only an indicator that the fish may be poisonous.

The toxin is not easily destroyed by heat and freshly opened canned fish has caused some of the outbreaks.

Symptoms occur between 15 minutes and three hours after eating the fish and include a burning sensation in the mouth, flushing, headache, vomiting and diarrhoea. They last for up to eight hours.

Vibrio parahaemolyticus
This is a comma-shaped bacterium. It is a common contaminant of fish and shellfish in tropical and subtropical waters. The few outbreaks of this food poisoning which occur in the UK are usually traced to the consumption of imported seafood which has been contaminated after cooked (it is sensitive to heat) and has been left un-refrigerated for some time.

The symptoms, which usually occur between 12 and 18 hours after eating the contaminated food, are abdominal pain and profuse diarrhoea often with vomiting and fever. This is one of the most common causes of food poisoning in Japan.

Hepatitis A (viral food poisoning)
The majority of food-borne outbreaks have been associated with shellfish collected from sewage contaminated waters.

It can also be spread by the faecal-oral route ie a food handler with poor hygiene standards who is a carrier of the virus.

Cross contamination
This is the transfer of bacteria from a contaminated source to an uncontaminated food (usually freshly cooked food). If this food is suitable for bacterial growth and is left un-refrigerated for some time then these bacteria will multiply and when the food is eaten will cause food poisoning. If the contaminated source was raw food, it will not usually be the cause of food poisoning because the bacteria present are later destroyed in cooking.

Seafood quality

Maintenance of fish and shellfish quality

Fish is a very perishable product.

Spoilage occurs as soon as the fish dies and is mainly caused by the action of enzymes and bacteria.

Enzymes are present in the guts of living fish and help to convert the food the fish eats into tissue and energy. When the fish dies these enzymes carry on working and break down the flesh itself.

Bacteria are tiny – one million would fit on the head of a pin. They are found on the skin, in the gills and in the intestine of the living animal. When the fish is alive, its normal defence mechanisms prevent the bacteria from invading the flesh, which is sterile. But in the dead fish, the bacteria multiply rapidly and breakdown the flesh. Eventually the dead fish give off odours and have sour or bitter flavours.

Oil-rich fish, such as herring or mackerel, also spoil when their fat is attacked by oxygen in the air causing the product to go rancid.

Nothing can prevent these natural processes taking place, but they can be **slowed down**.

Temperature control is vital in slowing down the spoilage processes. The warmer the fish is the more quickly the bacteria and enzymes act to produce unpleasant smells and bitter tastes. The following table indicates just how fast fish can go off.

Shelf-life of fish from time of capture

Temperature	Shelf-life
0˚C.	14 days.
+5˚C.	6 days.
+16˚C.	2 day.

0˚C is the temperature of melting ice, +5˚C is a little colder than the average household fridge and +16˚C is around the same temperature as a warm spring or autumn day.

These are shelf lives from the time of capture. The fish may well be several days old before you, the processor, receive it. Therefore, temperature control is vital.

Fish should always be stored and displayed at between 0˚C and +4˚C to avoid unnecessarily rapid loss of quality.

Use of ice in conjunction with refrigeration enables fish to last longer. The ice cools the fish more rapidly than mechanical refrigeration alone and, in melting, the ice keeps the fish moist whilst ‘washing away’ bacteria.

Handling and storage

Seafood should always be iced in transit no matter how short the journey. Recent changes in legislation have also meant that seafood on the auction market must be kept at a chilled temperature.

During processing, the temperature of the seafood can rise significantly when it is removed from chilled storage awaiting processing. These waiting times should be kept to a minimum, and any processing water should be iced.

At the supermarket, it is essential that seafood arriving is rapidly transferred from the reception/loading bay to the chill store.

Seafood in store should be date-coded and used in strict rotation.

Shellfish should not be allowed to dry out or be subject to draughts as such conditions will shorten their shelf-life.

Recent research has shown that physical shock can be harmful to molluscs. Therefore, bags of mussels and oysters should never be dropped as this will lead to a more rapid die-off rate.

Frozen seafood may be transported at temperatures as high as –15˚C but must be stored at or below –18˚C. Incoming frozen produce should be transferred to the cold store immediately. Partial thawing damages product texture and appearance leading to a poor eating experience.

Product that has thawed should be rejected and packaging should be checked for damage, as exposed seafish will readily become freezer-burnt. Product should be dated on receipt and used in rotation. The condition of the store itself should be periodically checked – in particular the door seals and chiller units. Correct storage of products to allow good air circulation is essential.

Fish quality indicators

Indicators of fish quality are the best tools a fish retailer has in judging the delivery that has been received. By applying these you can ensure that the customer buys the quality expected from a reputable fish retailer. Repeat custom depends on the quality of the product.

The reliance on Use by Dates is a crude way of assessing the quality and remaining shelf life of wet fish on a fish counter. So much relies on the conditions chilled seafood has been stored in during transport and display that Use by Dates offer little real indication of quality and remaining shelf life.

Fillets of wet fish (may have been previously frozen)

- The flesh should be translucent.
- The flesh should be firm and not 'ragged' or gaping.
- The flesh should not retain an indentation when pressed lightly with a finger.
- There should be no smell of ammonia or sour odours.
- There should be no bruising or blood clots.
- There should be no areas of discolouration.
- The maximum tolerance for cod worms is three per 3.2kg (7lb).

Frozen fish

- Where frozen fish is packaged, the packaging should be undamaged.
- There should be no evidence of freezerburn.
- There should be no evidence of the fish having partially thawed and then re-frozen.
- The thawed fish should be firm and not ragged or gaping.

Eating quality

At the time of sale, fish must possess the flavours characteristic of the species. Sour, bitter or rancid flavours are not acceptable.

When frozen fish or previously frozen fish is being sold it must be free of the following on cooking:

- objectionable cold storage odours and flavours;
- toughness and dryness resulting from cold storage deterioration; and
- gelatinous texture.

See also TORRY Taste Panel Scheme for cold storage deterioration.

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The assessment of freshness

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Quality Index Method (QIM) Scheme for Cod

Quality Parameter		Description	Score
Appearance	**Skin**	Bright, Iridescent pigmentation	0
		Rather dull, becoming discoloured	1
		Dull	2
	Stiffness	In rigour	0
		Firm, elastic	1
		Soft	2
		Very soft	3
Eyes	**Cornea**	Clear	0
		Opalescent	1
		Milky	2
	Form	Convex	0
		Flat, slightly sunken	1
		Sunken, concave	2
	Pupil	Black	0
		Opaque	1
		Grey	2
Gills	**Colour**	Bright	0
		Less Coloured, becoming discoloured	1
		Discoloured, brown spots	2
		Brown, discoloured	3
	Odour	Fresh, seaweedy, metallic	0
		Neutral, grassy, musty	1
		Yeast, bread, beer, sour milk	2
		Acetic acid, sulphuric, very sour	3
	Mucus	Clear	0
		Milky	1
		Milky, dark, opaque	2
Flesh, fillets	**Colour**	Translucent, bluish	0
		Waxy, milky	1
		Opaque, yellow, brown spots	2
Blood	**Colour**	Red	0
		Dark red	1
		Brown	2
Quality Index			**0-23**

Cod

Quality Index = 1,02 x days in ice + 1,08 (R2 = 0.965)

Quality Index	Storage Time in ice (days)	Remaining shelf life (days)
1	1	14
2	2	13
3	3	12
4	3	12
5	4	11
6	5	10
7	6	9
8	7	8
9	8	7
10	8	7
11	9	6
12	10	5
13	11	4
14	12	3
15	13	2
16	13	2
17	14	1
18	16	0

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Torry freshness scoring system for iced raw cod / haddock

Score	Eyes	Skin	Texture and effect of rigor mortis	Flesh and belly flaps	Kidney and blood	Gills appearance	Gills odour	Score
10	Bulging, convex lens, black pupil, crystal-clear cornea.	Bright well-differentiated colours, glossy, transparent slime.	Flesh firm and elastic. Body pre-rigor or in rigor.	Cut surface stained with blood. Bluish translucency to fillet.	Bright red, blood flows readily.	Glossy, bright red or pink, clear mucus.	Initially very little odour increasing to sharp, iodine, changing to less sharp sea-weedy shellfish odours.	10
9	Convex lens, black pupil with slight loss of initial clarity.		Flesh firm and elastic. Muscle blocks apparent. In or just passing through rigor.	White with bluish translucency, may be corrugated due to rigor mortis effect.	Bright red, blood does not flow.			9
8	Slight flattening or plane, loss of brilliance.	Loss of brilliance of colour.	Firm, elastic to the touch.	White flesh with some loss of bluish translucency. Slight yellowing of cut surface of belly flaps.	Slight loss of brightness, some browning.	Loss of gloss and brightness, slight loss of colour.	Freshly cut grass. Sea-weedy and shellfish odours just detectable.	8
7							Slight mousy, musty, milky or caprylic.	7
6	Slightly sunken, slightly grey pupil, slight opalescence of cornea.	Loss of differentiation and general fading of colours, overall greyness. Opaque and somewhat milky slime.	Softening of the flesh, finger indentations retained, some grittiness near tail.	Waxy appearance of the flesh, reddening around the kidney region. Cut surfaces of the belly flaps brown and discoloured.	Loss of brightness, some browning.	Loss of brightness, some browning.	Bready, malty, beery, yeasty.	6
5							Lactic acid, sour milk or oily.	5
4	Sunken, milky white pupil, opaque cornea.	Further loss of skin colour. Thick yellow knotted slime with bacterial discolouration. Wrinkling of skin on nose.	Softer flesh, definite grittiness.	Some opacity, reddening along the backbone and brown discolouration of belly flaps.	Brownish kidney blood.	Brown or bleached.	Lower fatty acid odours (eg acetic or butyric acids) composed grass, 'old boots', slightly sweet, fruity or chloroform-like.	4
3							Stale cabbage water, stale turnips, 'sour sink', wet matches.	3

Torry taste panel system for cod / haddock - cooked fillet

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 developing.	Dry and crumbly with short tough fibres.	10
9	Shellfish, seaweed, boiled meat, raw green plant.	Sweet, meaty, creamy, green plant, characteristic flavours.	Succulent, fibrous. Initially firm going softer with storage. Appearance white and opaque.	9
8	Loss of odour, neutral odour.	Sweet and characteristic flavours but reduced in intensity.		8
7	Wood shavings, wood sap, vanillin.	Neutral.		7
6	Condensed milk, caramel, toffee-like.	Insipid, tasteless as if chewing cotton wool.		6
5	Milk jug odours, boiled potato, boiled clothes-like.	Slight sourness, trace of 'off' flavours, possibly slight ammonia.	Flesh soft becoming very soft and slimy. Appearance becoming discoloured and yellowish.	5
4	Lactic acid, sour milk, byre-like.	Stronger sourness, slight bitterness, strong 'off' flavours, some ammonia.		4
3	Lower fatty acids (eg acetic or butyric acids), composted grass, soapy, turnipy, tallowy.	Strong bitterness, rubber, sulphide, definite ammonia.		3

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Quality Index Method (QIM) Scheme for Plaice

Quality Parameter		Description	Score
Appearance	**Skin (both dark and white side)**	Fresh, bright, metallic, no discolouration	0
		Bright, but without shine	1
		Matt, rather dull, slight green/blue or purple discolouration	2
		Dull, green/blue, purple discolouration	3
	Mucus	Clear, not clotted	0
		Slightly clotted and milky	1
		Clotted and slightly yellow	2
		Yellow and clotted	3
Eyes	**Form**	Convex	0
		Convex but slightly sunken	1
		Flat or swollen (like a balloon)	2
		Flat, sunken in the middle	3
	Brightness	Clear, black shining pupil	0
		Rather matt, black pupil	1
		Matt, opaque pupil	2
		Milky, grey pupil	3
Gills	**Odour**	Fresh oil, seaweedy, metallic, peppery	0
		Neutral, oily, grassy, slightly musty	1
		Musty, bread, beer, malt, slightly rancid	2
		Rancid, sour, rotten, sulphurous	3
	Colour	Bright, light red	0
		Slightly discoloured, especially at the end of gill filaments	1
		Discoloured	2
		Yellowish, brown, grey	3
	Mucus	No mucus	0
		Clear	1
		Yellowish, slightly clotted	2
		Yellow, brown, clotted	3
Flesh, fillets	**Colour**	Fresh, translucent, bluish	0
		Waxy, milky	1
		Dull, slightly discoloured, yellowish	2
		Opaque, discoloured, yellow, brown	3
Quality Index			**0-24**

Plaice

Quality Index = 1,28 x days in ice + 0 (R2 = 0,89)

Quality Index	Storage Time in ice (days)	Remaining shelf life (days)
1	1	12
2	2	11
3	2	11
4	3	10
5	4	9
6	5	8
7	5	8
8	6	7
9	7	6
10	8	5
11	9	4
12	9	4
13	10	3
14	11	2
15	12	1
16	13	1
17	13	0

Torry freshness scoring system for iced raw flatfish

Score	Odour - (gills and belly cavity)	General appearance	Flesh	Texture	Score
10	Fresh oil, metallic, roses, freshly-cut grass.	Eyes full, bright or very slightly cloudy. Gills bright red or very deep pink with slight clear slime. Slime on body clear to slightly milky.	Translucent with blue or pink tinge. Dark purple in backbone.	Firm and slimy.	10
9	Metallic, oily, earthy, peppery.				9
8	Oily, seaweedy, aromatic.	Eyes slightly sunken, some opacity. Gills pale pink. slightly bleached with thick opaque slime. Slime on body thick and opaque. Edge of gill cover slightly bleached and pinking and pinking on underside of body.	Loss of translucency. Bluish or pinkish white. Slight waxyness. Backbone still purple.	Loss of slime but no grittiness.	8
7	Oily, citric, musty, mousy.				7
6	Oily, bready, biscuity, malty, cut-flower stems.	Eyes sunken and opaque. Gills bleached with thick grey or brown slime. Slime on body yellow and watery. Bleaching on back, particularly in head region and gill cover, pinking on underside.	Waxy, slight yellowing, slight discolouration of body cavity. Backbone still well coloured (red-blue to purple).	Slight grittiness.	6
5	Sour beer, slight rancidity, painty, cod-liver oil.				5
4	Muddy, grassy, meaty, stale vegetables, 'old boots', fruity, sweaty, lower fatty acids.	Eyes completely sunken or bloated and opaque. Gills very bleached with dirty grey or brown-yellow slime. Slime on body watery with yellow bacterial discolouration. Marked bleaching and pinking on body.	Some opacity, yellow or brownish discolouration extending in from fin rays. Reddening in backbone.	Grittiness towards the tail.	4
3	Rotten cabbages, sour sink, wet matches, rotten meat, rancid butter.				3
2	Byre-like, singed hair, ammonia.	Eyes totally collapsed. Gills badly bleached and badly discoloured with bacterial slime. Body slime watery or scarce with marked bacterial discolouration, particularly in head region. Gill covers very bleached; marked pinking on the underside	Marked opacity, yellow or brown discolouration and marked reddening in backbone.	Marked general grittiness.	2
1	H_2S, strong ammonia, sulphides.		Marked discolouration particularly in body cavity. Blood almost completely diffused in backbone.		1
0	Faecal, nauseating, indole.				0

Torry taste panel system for plaice - cooked fillet

Score	Flavour descriptions	Odour descriptions	Texture descriptions	Score
10	Meaty, shellfishy, earthy.	Meaty, oniony, fresh butter or margarine, Worcester sauce, slight caramel.	Firm and dry.	10
9	Sweet and meaty (or oily fresh herring-like).	Oily, slightly aromatic, slight peppery, boiled clothes.		9
8	Sweet and meaty with curry, peppery or spice flavour.	Curry, oily, peppery, damp clothes, baked smell.	Crumbly, short, firm.	8
7	Neutral or bland.	Caramel, boiled potatoes, musty, butterscotch.		7
6	Rancid, slightly sour.	Metallic, slightly sour acrid, slightly sweaty boiled string.	Soft but dry.	6
5	Sour, rancid oil, rancid butter, fish meal.	Sour bread, lower fatty acids, rancid.		5
4	Sour or bitter.	Slight amines, slight ammonia, sour beer, spoiled cheese.	Soft and moist.	4
3	Strong sour and strong bitter, rotten fruit.	Ammonia, very sour, slightly faecal, rotten fruit.		3
2	Very bitter, very sour.	Strong ammonia and amines.	Very soft and sloppy.	2
1	Nauseating.	Very strong ammonia, strong faecal, putrid cheese.		1

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Torry freshness scoring system for raw mackerel

Score	Appearance			Gill odour	Score
	Skin and body	Eyes	Gills		
10	Firm body with silky smooth skin. Lateral line and reticulations on upper surface well defined. Body colours iridescent with strong royal blue and turquoise colours on upper surface. Blue and violet on ventral surface with silvery sheen. Passing into rigor or in rigor.	Bulging convex eye with protruding lens. Shiny jet-black pupil with metallic brown iris. Eye-cap water clear.	Uniformly dark red with free blood and water-clear slime present.	Weak, delicate odours, cloying sweet, sharp, pepper, seaweed, blood.	10
9					9
8	Loss of colour definition. Some blood stains apparent. Passing out, or out of rigor.	Convex eye lens plane with cornea. Pupil less shiny, iris green / blue. Slight clouding of eye cap.	Dark purple / maroon with paler edge. Congealed blood present with opaque slime.	More definite odours as above, also fragrant, fresh grass, fruity, metallic, shellfish.	8
7					7
6	Colours of dorsal surface paler, reticulations grey, ventral surface white with golden tinge. Patchy iridescence.			Dull muddy odours, musty, mousy, malty, cardboard, linseed oil, cod liver oil, biscuits, blood.	6
5	Washed-out colours, definite golden tinge to skin, patchy iridescence. Body soft with red / brown slime oozing from gill covers. Skin wrinkles on flexing.	Flattening of eye but still convex. Pupil wrinkled with slight clouding of lens. Iris silvery and starting to wrinkle. Yellowing of eye cap.	Loss of colour with red / brown slime.	Stale odours as above, also butterscotch, wet cardboard, wet dogs.	5
4	Fish limp and floppy with distinct ice marks. Washed-out colours with mottling or golden tinge.	Eyeball plane with eye socket. Cloudy lens with silvery iris showing black specks.	Browning of gills, patchy bleaching, increased slime and red/brown slime oozing from gill cover.	Mixture of odours from above and below.	4
3	Little distinction between upper and lower surfaces. Body very soft. Skin very wrinkled with distinct ice marks.	Concave or flattening eye with cloudy pupil.	Marked bleaching and browning of gills covered in black slime.	Sweet-rotten odours, oil sweet-rotten fruit (grapefruit), old grass cuttings, sickly sour.	3

Torry taste panel system for mackerel - cooked fillet

Score	Flavour and odour descriptions (white and red flesh)	Score
9	**White meat:** sweet, starch, astringent, metallic, blood, meaty (cold lean beef), green plant, spicy, lemons, muddy, strong sweet oil. **Red meat:** strong meaty, sweet.	9
8	**White meat:** sweet, oily chicken (white meat), dull blood, herbs (eg parsley), roast meat (cold lamb, pork), starch, astringent, insipid, earthy, mushrooms, oranges / lemons. **Red meat:** rich strong meat, apples.	8
7	**White meat:** sweet, earthy, cardboard, slight curry, bland sweet oil, oranges / lemons. **Red meat:** rich strong meat, apples.	7
6	**White meat:** slightly sweet, weak meaty, just detectable rancidity, musty, wet paper, cardboard, neutral bland oil, new leather. **Red meat:** strong, slightly rancid	6
5	**White meat:** neutral bland oil, greasy cold chicken, slight rancidity, sweet/sour caramel, acidic, after-taste. **Red meat:** strong meat, rancid, sulphury.	5
4	**White meat:** slightly sour, rancid, stale roast meat, cold mutton stew, yeast burning sensation on sides of tongue, 'coin-in-mouth' sensation, acrid. **Red meat:** strong rancidity, sulphury.	4
3	**White meat:** sour, rancid, rotten (sweet sensation), chicken skins, charred paper, sulphides. **Red meat:** strong rancidity, sultry, tasted with difficulty.	3
2	**White meat:** strong rancidity, bitter, burnt/acrid, strong sulphides, rotten cabbages, rotten fruit. **Red meat:** nauseating rancidity and sulphury.	2
1	Nauseating, ammoniacal, very strong sulphides, tasted with difficulty.	1

Quality Index Method (QIM) Scheme for Herring

Quality Parameter		Description	Score
Appearance	**Skin**	Very Shiny	0
		Shiny	1
		Matt	2
	Blood on Gillcover	None	0
		Very little (10-30%)	1
		Some (30-50%)	2
		Much (50-100%)	3
	Consistency	Hard	0
		Firm	1
		Yielding	2
		Soft	3
	Belly	Firm	0
		Soft	1
		Burst	2
	Odour	Fresh sea odour	0
		Neutral	1
		Slightly secondary odour	2
		Strong secondary odour	3
Eyes	**Brightness**	Bright	0
		Somewhat lustreless	1
	Shape	Convex	0
		Flat	1
		Sunken	2
Gills	**Colour**	Characteristic red	0
		Somewhat pale, non-glossy, opaque	1
	Odour	Fresh, seaweedy, metallic	0
		Neutral	1
		Some secondary odour	2
		Strong secondary odour	3
Quality Index			**0-20**

Herring

Quality Index = 2,3 x days in ice + 0,97 (R2 = 0,740)

Quality Index	Storage Time in ice (days)	Remaining shelf life (days)
1	0	8
2	0	8
3	0	8
4	1	7
5	1	7
6	2	6
7	2	6
8	3	5
9	3	5
10	3	5
11	4	4
12	4	4
13	5	3
14	5	3
15	6	2
16	6	2
17	6	2
18	7	1
20	8	0

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Torry freshness scoring system for raw herring

Score	Appearance					Odour	Texture	Score
	Eyes	Gills	Skin	Flesh	Belly walls			
10	Slightly convex. Pupil clear and black.	Dark red, purple. Clear slime.	Bright colours, iridescent. Few loose scales.	Glossy, rosy hue. Fresh bright blood on fillet.	No belly burst.	Oily, marine, fresh blood, sulphide, weak odour.	Firm, stiff, smooth.	10
9	Flat, slightly convex. Pupil clear and black.	Dark red, pink. Slightly faded.	Bright, slight iridescence. Few loose scales.	Slight translucency, rosy hue. Bright blood on fillet..		Oily, marine, fresh fruit sulphide.	Loss of stiffness but still firm and smooth.	9
8	Flat, slightly convex. Slightly cloudy.	Dark red, pink, slightly brown. Slight reddening of gill covers.	Loss of brightness, slight bronzing. Some loose scales.	Slightly opaque. Slight discolouration of belly flaps.	No or very slight belly burst.	Oily, musty, slight sulphide.	Loss of stiffness, slight softening, smooth.	8
7		Red, pink. Slight bleaching and reddening of gill of covers.		Slightly opaque. Slightly brown. Slight discolouration of belly flaps.	Slight belly burst.	Oily, musty, sulphide, slightly sour.	Limp, slightly soft, slightly gritty.	7
6	Flat. Slightly cloudy.	Red, pink, brown and reddening of gill covers.	Dull, slight bronzing. Some dirty scales.	Opaque, dull brown. Reddening on belly flaps.		Musty, stale fruit, stale grass, malty, sour.		6
5	Flat, slightly sunken. Pupil cloudy, grey.	Pink, brown slime, reddening of gill covers.	Dull, bronzing. Dirty scales.		Definite belly burst.	Stale fruit, stale grass, malty, sour.	Limp, soft, gritty.	5
4	Flat, slightly sunken. Pupil cloudy, bloodshot, discoloured.		Dull, bleached. Brown slime.	Opaque brown. Discoloured belly flaps and tail.	Severe belly burst.	Sweaty, sour sink stale meat.		4

Torry taste panel system for herring - cooked fillet

Score	Flavour and odour descriptions (brown and white flesh)	Score
10	Fresh, sweet, seaweedy flavour.	10
8	Less sweet, seaweedy flavour plus slightly oily flavour.	8
6	Stronger oily flavour; some stale seaweedy flavour and some 'blown oil' flavour.	6
5	Definite 'blown oil' flavour plus stale, seaweedy flavour.	5
3	Strong unpleasant 'blown oil', sweaty or rancid flavour, definitely stale.	3
1	Repulsive flavour.	1

Quality Index Method (QIM) Scheme for Farmed Salmon

Quality Parameter		Description	Score
Skin	**Colour/ appearance**	Pearl-shiny all over the skin	0
		The skin is less pearl-shiny	1
		The fish is yellowish, mainly near the abdomen	2
	Mucus	Clear, not clotted	0
		Milky, clotted	1
		Yellow and clotted	2
	Odour	Fresh, seaweedy, neutral	0
		Cucumber, metal, hay	1
		Sour, dish cloth	2
		Rotten	3
	Texture	In rigor	0
		Finger mark disappears rapidly	1
		Finger leaves mark over 3 seconds	2
Eyes	**Pupils**	Clear and black, metal shiny	0
		Dark grey	1
		Matt, grey	2
	Form	Convex	0
		Flat	1
		Sunken	2
Gills	**Colour**	Red/dark brown	0
		Pale red, pink/light brown	1
		Grey-brown, brown, grey, green	2
	Mucus	Transparent	0
		Milky, clotted	1
		Brown, clotted	2
	Odour	Fresh, seaweed	0
		Metal, cucumber	1
		Sour, mouldy	2
		Rotten	3
Abdomen	**Blood in Abdomen**	Blood red/not present	0
		Blood more brown, yellowish	1
	Odour	Neutral	0
		Cucumber, melon	1
		Sour, fermenting	2
		Rotten/rotten cabbage	3
Quality Index			**0-24**

Farmed Salmon

Quality Index = 0,692 x days in ice + 1,57 (R2 = 0.953)

Quality Index	Storage Time in ice (days)	Remaining shelf life (days)
1	0	20
2	1	19
3	3	17
4	4	16
5	6	14
6	7	13
7	9	11
8	10	10
9	11	9
10	13	7
11	14	6
12	16	4
13	17	3
14	19	1
15	20	0

Torry taste panel system for cold storage deterioration

Score	Cold store flavour	Firmness	Dryness
0	Absent	Very soft	Sloppy, watery
1	Very slight	Softer than normal	Juicy (equivalent to 3 day old iced unfrozen fish).
2	Slight	Firm (equivalent to normal 3 day old iced unfrozen fish)	Slightly dry
3	Moderate	Slightly firmer than normal	Dry
4	Strong	Slightly tough	Extremely dry
5	Very strong	Tough	
6		Extremely tough	

Ideal Score = 0 2 1

Simple scoring system for smoked fish

Freshness	Characteristics of Chilled Fish	Characteristics of Frozen Fish	Cooked Eating Qualities
Good: (Desirable)	**Appearance:** no gaping or discolouration, cold smoked fillets glossy. Maybe less on smoked defrosted fish **Texture:** Cold smoked fish firm and elastic **Odour:** 'fresh', smoky	**Frozen Appearance:** No freezer burn or ice crystals on surface **Thawed Appearance:** Similar to chilled fish **Thawed Texture and Odour:** Similar to chilled fish **Drip:** Negligible release of drip on thawing	**Chilled Fish Flavour:** Mild, fresh smoky flavours Sweet flavours Flavours characteristic of species Not strongly salty **Frozen Fish Flavour:** As above No cold storage flavour
Medium (Acceptable)	**Appearance:** Cold smoked fillets less glossy. Maybe even less on smoked defrosted fish **Texture:** Cold smoked fillets less firm and elastic **Odour:** Slightly stale	**Frozen Appearance:** Could have some freezer burn and a few ice crystals on surface **Thawed Appearance:** Similar to chilled fish **Thawed Texture and Odour:** Similar to chilled fish **Drip:** Noticeable release of drip on thawing	**Chilled Fish Flavour:** Mild, smoky flavour Slightly stale flavour Not strongly salty **Frozen Fish Flavour:** As above Cold storage flavour just detectable
Poor (Unacceptable)	**Appearance:** Cold smoked fillets with no gloss. Gaping of fillets. Discolouration especially along lateral line and on belly flaps. Possible pink colouration of fillet **Texture:** Cold smoked fillets soft and inelastic **Odour:** Stale, rancid or putrid	**Frozen Appearance:** Obvious freezer burn with large quantities of ice crystals on surface **Thawed Appearance:** Similar to chilled fish **Thawed Texture and Odour:** Similar to chilled fish **Drip:** Copious quantities of drip released on thawing	**Chilled Fish Flavour:** Sour, bitter, rancid, acrid, resinous, musty or strong salty flavours Strong 'off' odours, ammoniacal **Frozen Fish Flavour:** As above Well developed cold storage flavour and texture tough and dry from cold storage

SEAFISH

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