Using Fish and Shellfish Quality Assessment Methods

Learner
Workbook

Title	Understand how to use fish/shellfish quality assessment methods
Level	2
Credit value	3

Learning Outcomes	Assessment Criteria
The learner will:	**The learner can:**
1. Know what the factors are that affect the quality of fish/shellfish	1.1 Outline the causes of fish/shellfish spoilage 1.2 State the impact of handling and temperature control on fish/shellfish quality and spoilage.
2. Know how to assess the quality of fish/shellfish	2.1 Describe the methods used to assess the quality of fish/shellfish, and their limitations, including; • manual • chemical • microbiological testing 2.2 State the quality assessment methods that use taste and smell. 2.3 State the quality assessment taste calibration 2.4 Outline the QIM fish quality assessment methods for seafood 2.5 Outline the TORRY fish quality assessment methods for raw and cooked seafood.
3. Know the importance of fish/shellfish quality assessment	3.1 Outline the role of quality assessment in quality assurance 3.2 State how to develop new seafood quality assessment schemes 3.3 Outline the management of quality assessment in the fish/shellfish industry 3.4 State the food safety legislation that controls fish/shellfish quality assessment.

Achieving the Unit

The following information will support you with the knowledge requirements to help you achieve this unit.

Whilst the booklet provides a good source of information, it is not exhaustive. We recommend that you research information yourself via the internet or at your local library. Useful sources of information include the Sea Fish Industry Authority (www.seafish.org) and the Seafood Training Academy (www.seafoodacademy.org).

Seafish have developed a range of training resources in fish processing including:

- A training DVD showing methods of assessing the quality of fish;
- A series of taught courses supported in seafood quality assessment ranging from a half day introductory course to a five day advanced course.

There is more information on resources at the end of this workbook, and various demonstration videos can be accessed via the Library in the Seafood Training Academy website.

……Good Luck!

Lee Cooper
Seafish

UNIT DETAILS

Unit Number: FP.137K

Unit Qualification Number:

Title: Understand how to use fish/shellfish quality assessment methods

Level: 2

Credit Value: 3

UNIT AIMS

This unit supports workforce development for those who understand how to use fish or shellfish quality assessment methods, according to job role, in a fish/shellfish processing or related business.

The unit is designed for use primarily by operatives and others who carry out these workplace activities. The aim of the unit is to assess knowledge and understanding to recognised National Occupational Standards.

CONTENTS

SECTION ONE:

INTRODUCTION

"Quality is key to our business." Ask any manager in any seafood business if quality is important and their answer will be some variation on *Quality is Key.*

But is that really true? And if it is, then why do we spend so little time assessing the quality of the fish and shellfish we handle and process, and so little effort in minimising quality loss?

One possible answer is a lack of understanding of how to objectively assess the quality of fish and shellfish, and a certain complacency that our part of the seafood supply chain is doing all it can to ensure the best possible product is presented for sale to the consumer.

Sadly, the reality is that the UK seafood industry is probably losing millions of pounds every year in unnecessarily lost quality. In this we are little different from seafood industries in other countries.

The aim of this learner workbook is not to show you how to minimise quality loss, but how to assess the quality of the fish and shellfish that you have.

There is a well known manufacturing saying that: "If you can't measure it you cannot control it". This is also true in seafood. Without a means of objectively measuring quality, all you can do is keep your fingers crossed and hope that what you are doing is the right thing.

What is quality?

A simple question which is not that simple to answer.

Product quality is not fixed, but varies depending upon the perceptions of the customer. A quality product is one that completely satisfies the expectations of the person buying it. If the expectation is low then the product need not be that good to qualify as a quality one. This approach may be perfectly valid when deciding on the manufacture of pairs of shoes, but it is of less importance when we consider a product such as fish and shellfish. Why is this?
The quality of fish and shellfish as a raw material cannot be improved, it will slowly degrade as the organic material spoils. We cannot reverse this

spoilage process, the best we can do is to slow it down and try and retain as much ‘quality’ as possible until the final product is consumed by the customer.

In an ideal world fish and shellfish would be harvested, processed and consumed all in the same day, but in reality it can be days or even weeks between the fish being caught and the fish pie being consumed. If that fish pie is to be enjoyable to eat then we need to ensure that quality loss is minimised during that journey from the sea to the plate.

What causes quality loss?

People can cause excessive or unnecessary quality loss. By this we mean that even though spoilage is inevitable once the fish or shellfish have been harvested, good practices can minimise that loss. When people fail to do the simple things that can minimise quality loss then the whole industry can suffer.

Before we can properly understand how to minimise quality loss and how to assess the quality of fish and shellfish we need to understand the process of spoilage.

CAUSES OF FISH AND SHELLFISH SPOILAGE

As fish spoils the appearance, flavour and aroma undergo a gradual change from something that is acceptable to something that is not. These changes are caused by bacteria, enzymes and oxygen.

Enzymes naturally present in the flesh of the fish and shellfish are vital to their well being while alive, but will after death start to break down the cells and flesh they are found in.

Enzymes are found predominantly in the guts of the fish and are used to break down the food that the fish eats so that it can be digested. When the fish dies these enzymes then penetrate the flesh and break down and spoil the flesh of the fish itself. As this is a chemical spoilage it <u>will even continue slowly</u> in the frozen state.

In the frozen fish the spoilage is slightly different and ‘odd’ flavours known as ‘cold storage flavour’ is developed. This has been described as a ‘cardboardy’ or ‘turnipy’ flavour.

The development of these cold storage flavours normally take a period of many months, but can be accelerated by allowing the temperature of the fish to fluctuate in cold storage.

Bacteria present on the tissues of the fish (skin, gills, gut lining) will start to multiply after death and will break down fish flesh:

- Developing unpleasant odours and flavours;
- Breaking down flesh;
- Developing changes in the volume and colour of fish slime;
- Other visual changes.

The main spoilage bacteria are members of the *Pseudomonas* and *Schewanella* families and should not be confused with food poisoning or pathogenic bacteria. That's why food poisoning from seafood is rare unless contaminated with pathogenic bacteria by careless handling or contaminated seawater.

For bacteria to have much of an impact they must multiply their numbers. Multiplication is affected by temperature. Get it too hot and bacteria will slow down, stop multiplying and eventually die. Get it too cold and they lose the urge and eventually stop multiplying, but they don't die. Different bacteria have different temperature preferences.

Oxygen can be a problem, particularly with the long-term storage of frozen fish and shellfish as fats can be oxidised. The oxidised fats have a rather unpleasant (but not dangerous) taste and smell that is described as rancid.

- Rancidity is caused by the oxidation of the fats and oils present in the flesh. Rancidity –
    - Mainly affects pelagic species
    - Creates a much slower type of spoilage
    - Is not stopped by freezing but only by the exclusion of oxygen/air.

Because most white fish have very low fat content in the flesh, normally below 1%, rancidity is not a problem. Rancidity is really only a problem in pelagic, oil rich fish, with between 10% and 25% fat in their flesh (depending on species and season).

The normal way of preventing rancidity is to exclude the oxygen/air by vacuum packing the fish.

Rancidity is a much slower type of spoilage normally occurring over a period of months so it usually only affects preserved (frozen) oil-rich fish. Any fat will continue to oxidise or go rancid even in the frozen state if it is exposed to air.

This effect can also be seen in fatty meats such as bacon or high fat foods such as butter or margarine.

IMPACT OF TEMPERATURE AND HANDLING ON QUALITY

Time and Temperature

As we have explained above, the two main spoilage causes are bacteria and enzymes. Both of these are affected by temperature and take time to have an impact. How fish and shellfish are handled after harvesting will also have a major impact on the quality of the fish throughout its journey to the plate.

During that journey the fish (for example) will be harvested from the sea at a temperature that may reach as high as 15^0C in the summer.

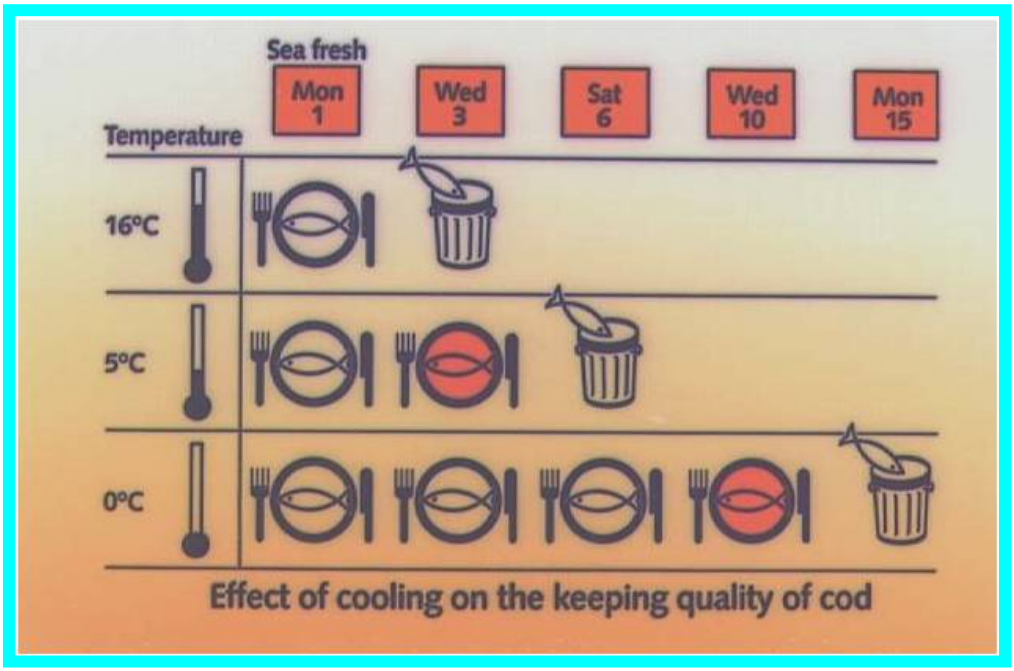
Once onboard the fishing boat it should be gutted and washed and then boxed in ice within as short a time of possible. The fish temperature will slowly drop to around 1-2^0C in the fish hold.

Ideally it will remain at that temperature until the fillet arrives at the fishmongers slab a few days later, but it may briefly warm up while it is at the processor, and if badly displayed by the fishmonger it may well warm up significantly during display.

What impact will this have? Firstly, let's introduce the phrase 'equivalent days on ice'.
Days on ice assumes that the fish is harvested, gutted, cleaned and immediately cooled to around the temperature of melting ice and then kept at that temperature without any variation.

At this temperature the various bacterial and enzyme driven changes happen steadily and there is a slow, steady and gradual loss of quality as the fish degrades from sea fresh, through acceptable but bland, to noxious and inedible. It may take 15 days or more in ice for some species to stop being acceptable.

If the fish suffers temperature abuse[1] then spoilage will be accelerated and even though it may only be five days from harvest, it may look, smell and taste like ’15 day old fish.’



This diagram indicates the importance of temperature control. At 0˚C (the temperature of melting ice) the shelf life of most white fish is about two weeks from the date of capture.

If fish is stored at about 5˚C, the temperature of a domestic refrigerator, the shelf life is halved to about one week.

At about 16˚C (the temperature of a spring day) the shelf life is further reduced to less than 3 days. Remember that these storage times are from the date of capture, and any rise in temperature at any stage after capture will further reduce the shelf life.

From this you will see that after washing and gutting the fish the most important thing is to keep it cold!

Fish caught during the summer months by ‘day’ boats which should be supplying excellent quality fish. But because they generally do not take ice to sea, they can be supplying fish of an inferior quality because it deteriorates very quickly after capture when the sea temperature can be 15 or 16˚C, and the air temperature can be 20 to 30˚C.

[1] Simply meaning it is not kept at the correct temperature.

Rough handling, poor gutting and cleaning can also accelerate the spoilage of fish, but temperature abuse still remains the number one cause of excessive and unacceptable quality loss.

SECTION TWO:

QUALITY ASSESSMENT METHODS

There are various types of quality assessment methods that measure a variety of factors and use them to give some kind of numerical score. The score may be used on its own or related back to the equivalent days on ice.

Some quality assessment methods rely on chemical or microbiological tests, while others will rely on biological changes to indicate the degree of quality loss.

Microbiological analysis

- Expensive
- Time consuming
- Not a good indicator of fish quality (total numbers of bacteria not a reliable measurement of quality)
- Important as indicator of food safety in Ready To Eat (RTE) foods

This type of analysis can take 24-48 hrs to return results.

Bacteria are not an accurate way of determining fish quality, because different fish of similar quality can be found to have widely varying numbers of bacteria present depending on catch areas, or the way in which they have been cleaned and washed.

All that can be said is that as fish ages the number of bacteria present will increase, but if a starting number is not known then it cannot be used as a reliable indicator of quality or spoilage.

If the seafood is ready to eat, then the number of bacteria and their types is important for food safety assessments rather than quality assessments. This is particularly so for live bivalve shellfish, such as oysters, which are eaten uncooked.

Chemical Analysis

Chemical analysis is based on the analysis of breakdown products produced when fish spoil. These are typically:

- TMA (Tri-methylamine);

- TVB (total volatile bases) or TVN (total volatile nitrogen);
- Hypoxanthine;
- ATP/ADP/AMP ratios;
- Peroxide value – measure of fat oxidation.

They are

- Expensive;
- Time consuming;
- Often not a good indicator for higher quality fish and shellfish.

Chemical analysis is more rapid than bacteriological testing (normally results in a few hours) but normally samples would still have to be sent off to a laboratory. The quantities of the different chemicals increase as the fish spoils.

Chemical analysis is a more reliable way of determining fish spoilage, although levels of chemical in many of the methods remain quite low until the fish has become quite spoiled. For this reason these methods tend to be used as a method for determining when fish is no longer acceptable, rather than trying to equate the levels of chemical to a particular quality.

Electrochemical methods

Some of the chemical changes in fish flesh can be measured electrically. These methods rely on equipment that may be expensive to buy, but which usually gives a very quick result.

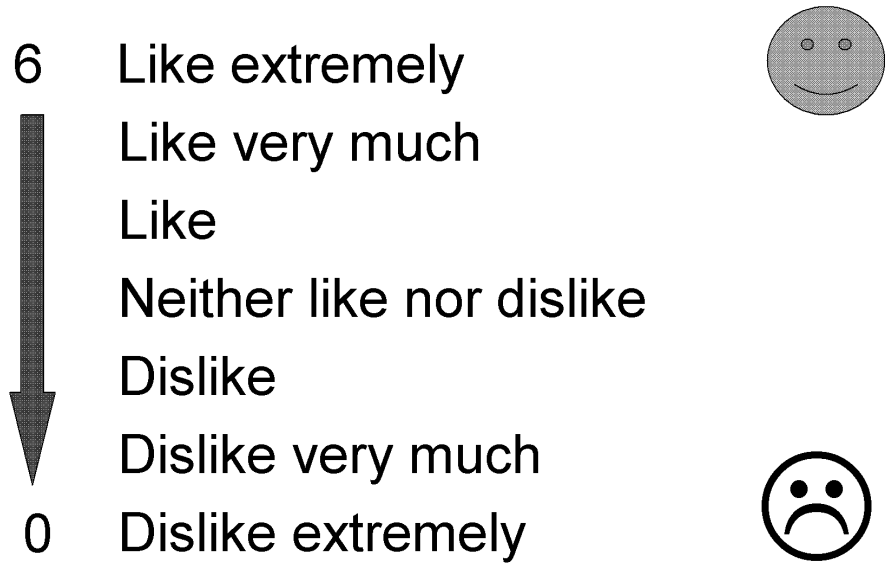
Problems may arise with interpreting the results, particularly if the fish has been frozen prior to testing.

Manual Methods or Organoleptic Testing

Organoleptic testing simply means using your senses to judge the appearance, taste, smell and feel of the fish or shellfish to determine its quality.

These various manual methods fall naturally into two different groups.

One group is based around how the person assessing the quality of the fish or shellfish feels about it. Do they like the smell, taste of look of it? These types of schemes are called *hedonic scoring systems*



They are ideal where personal preference is important, such as assessing a new perfume product but of little use as a technical measure of fish and shellfish quality.

What is needed is an **objective** approach to using our senses to quickly assess quality against a clearly defined set of criteria.

The advantages of such systems (when used by trained operators) are:

- They are often the quickest way of assessing quality;
- They can be surprisingly consistent when used every day;
- They use human senses to detect the sequence of changes during spoilage.

There are three main schemes in use in the UK today.

- EU (EAB) Scheme
- Torry Schemes
- Quality Index Method (QIM)

The EU (EAB) Scheme

This is the EU system used on the port markets for labelling fish. This is usually carried out by the fisheries inspectors or the selling agents and a 'tally' is placed in every box of fish. It is not species specific and because it only has 3 scores it is not really accurate enough for the processors. E is extra quality, A is very good quality, B is acceptable quality, anything below B is reject quality.

It does take into account physical damage e.g. South coast beam trawled plaice suffers from some physical damage from the trawl. The EU scheme will not give an E grade to otherwise excellent quality plaice because of this physical scuffing.

Appendix 1 shows the EU (EAB) Grading Criteria

Torry Schemes

The Torry Schemes were developed in the early 1950s at the Torry Research Station in Aberdeen, which was the Ministry Fisheries Laboratory up to the mid 1990s when it was closed down. The Torry scheme was set up using a limited number of species and concentrated on the types of fish i.e. round fish, flat fish, herring, mackerel, salmon, Nephrops (scampi).

Advantages include:

- Widely used in UK for past 50 years;
- Effective objective system for sensory evaluation of fish (QC and scientific trials);
- Gives detailed evaluation of organoleptic qualities of fish;
- Schemes are available for raw (whole) and cooked fish.

Disadvantages include:

- Needs training;
- Limited number of species covered;
- With the loss of the Torry Research Station, no new recognised[2] schemes have been developed.

Quality Index Method

The QIM scheme was developed in the 1990s modifying an Australian scheme which had been developed in the 1980s. The QIM scheme currently covers about 19 different species of fish found in the North Atlantic.

- Developed through concerted action project harmonising activities of 3 leading fish labs in Europe (Denmark, Iceland & Holland);
- Effective objective system for sensory evaluation of fish (QC and scientific trials);
- Large number of species covered.

Both the Torry and QIM schemes (and the EAB scheme to a lesser extent) rely on the appearance and smell of the fish and shellfish being assessed. Only the Torry schemes have cooked as well as raw schemes. The cooked schemes have important advantages over all other schemes:

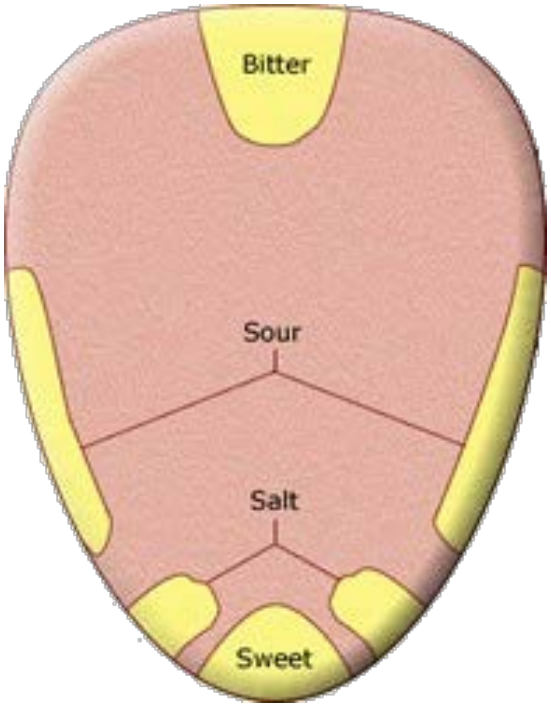
- Cooked scores are most closely related to the actual eating experience of the customer;
- The cooked schemes can assess fish and shellfish products, and part processed materials such as scampi tails or fish fillets;
- Trainees seem to pick up the skills for assessing cooked products more quickly than the raw schemes.

The QIM system recognises these advantages and work is underway to develop a QIM method that can be applied to cooked fish and shellfish.

[2] Some companies have developed Torry-like schemes for their own use.

Because the cooked Torry schemes use taste as a key criteria it is necessary to train staff to distinguish between certain subtle differences in taste.

Taste the Difference



As our sense of taste is based on taste buds on our tongue that can detect sweet, salty, sour and bitter flavours, it is useful to be able to identify how sensitive individuals are to each type of taste. Different parts of the tongue 'specialise' in detecting different types of flavours (see diagram). Sweet flavours are detected at the front of the tongue and bitter flavours at the back.

It is common on seafood quality assessment training programmes to carry out a taste calibration exercise on participants to see who is more or less sensitive to the four key flavours. Individuals also learn to identify where in their mouth these different sensations are detected which can help when experiencing the more complex flavours from real samples.

Taste Calibration Exercise – simple description[3]

Samples of sugar, salt, citric acid (sour) and chloroquin (bitter) are made up.

A series of up to 6 increasingly dilute samples are prepared and tasted by the participants.

Starting with the most dilute sample, the participants taste each until eventually they are able to detect the faintest hint of that flavour. This is their threshold sensitivity.

Assessors do not need to be overly sensitive to these flavours as their job is to evaluate the more complex mixture that is a real sample. But if an assessor has a high threshold for one particular flavour then that can cause problems for assessment.

[3] A more detailed guide to carrying out this exercise is available from Seafish.

The taste calibration exercise is of particular use in screening individuals who want to sit on taste assessment panels.

QUALITY INDEX METHOD

Principles of QIM

- Based on objective evaluation of attributes of raw fish (skin, eyes, gills, flesh blood):
    - indicators are given a score of 0 to 2 or 0 to 3 points (0 = excellent, 2/3 = pPoor);
    - scores added up to give overall quality index (increases linearly on a plot against storage time in ice);
    - storage time on ice and remaining shelf life obtained from a table or graph.
- The lower the score, the fresher the fish.

Both QIM and raw TORRY look at the same indicators of freshness, namely eye, gills, skin, flesh and odour of <u>whole</u> fish and shellfish.

Both schemes use very similar words to describe these indicators.

BUT, the way in which the indicators are scored and the scores added up to give a final result are VERY different.

The Quality Index Method gives more points for each indicator as freshness is lost. The best possible quality fish may have a gill colour that scores 0 while the worst will have a score of 3. So gill colour has 4 possible scores – 0, 1, 2 or 3.

Other indicators may only have 3 possible scores (0,1 or 2), for example flesh colour.

If all of the indicator scores are added up then the freshest possible score is 0 while the worst possible score is around 23 (for most species).

1. For fish there are 10 individual indicators that need to be assessed.
2. Each individual score must be recorded and all the scores added up for each fish assessed.
3. Any missing scores – if for example the gills have been removed – can cause problems:

a. If no score is given, then this is the same as giving a score of 0 – the score for the highest quality fish;
b. To fill in the blank with an average score based on the available indicators, the assessor must first calculate or guess the average score, before then calculating the total score;
c. No valid assessment score can be provided on part processed fish – head and gutted fish for example or prawn tails, as too many indicators are missing.

QIM- adding the scores

Indicator	Good Fish	Poor Fish	Indicator	Good Fish	Poor Fish
Stiffness	0	3	Gill Colour	0	3
Skin	0	2	Odour	0	3
Cornea	0	2	Mucus	0	2
Form	0	2	Flesh Colour	0	2
Pupil	0	2	Blood Colour	0	2

Good Fish Score = 0 Poor Fish Score = 23

Each fish species has its own scheme for determining its freshness.

Each scheme has clearly defined descriptions of the indicators that correspond to each score**.**

Additionally, a relationship has been established between the QIM score for each species and the equivalent days on ice, as well as the remaining shelf life**.**

Storage time and remaining shelf life on ice is determined from the relationship between quality index and days in ice.

Remaining shelf life = shelf life - predicted storage time, where predicted storage time = no. of days that fish has been stored in ice.

So, for a box of fish it’s possible to carry out an assessment, arrive at a QIM score and then translate that score into days on ice and remaining shelf life.

QIM - How it works

Let's use Cod as an example.

A cod with dull skin but firm flesh; eyes that had only just started to cloud over and flatten but which still had a black pupil; gills that are discoloured, grassy, with some milky mucus; white milky flesh and dark red blood would score about 10.

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 rigor	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 that scores 10 on the QIM scale has probably spent around 8 days packed in ice, and with careful processing and handling will still be edible for a further 7 days.

Cod

Quality Index = 1,02 x days in ice + 1,08

(R^2 = 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

Resources: In addition to the resources available from Seafish (see Section 4) the Australian Government published an Australian Quality Index Manual in 2010. Developed with assistance from Sydney Fish Market, the manual is useful for those importing tropical species including barramundi, black tiger prawns and cooked king prawns.

TORRY ASSESSMENT SCHEMES

Basic principles

TORRY uses the same basic indicators as QIM and shares the same simple descriptions of each indicator.

However, as TORRY divides each indicator up into 10 different scores with 10 representing the best quality possible, TORRY scoring is a very different approach to QIM scoring.

In theory (and indeed usually in practice as well) a fish that scores 8 for one particular indicator will tend to score 8 for all of them. Sometimes an indicator will shade over to a possible 7 or perhaps an 8.

Unlike QIM scores, TORRY scores are more of an average. To explain this more clearly, let's look at the cod indicators from a few pages earlier.

The cod we are considering had a QIM score of 10 from the following description - *dull skin but firm flesh; eyes that had only just started to cloud over and flatten but which still had a black pupil; gills that are discoloured, grassy, with some milky mucus; white milky flesh and dark red blood.* Using the TORRY scheme for cod what would we get? (See appendix 2 for the raw cod TORRY scheme.)

Indicator	**TORRY Score**
dull skin	7 or 8
firm flesh	7 or 8
eyes slightly cloudy	7 or 8
eyes slightly flattened	7 or 8
black pupil	9
gills that are discoloured,	7 or 8
gills with grassy odour	8
gills with some milky mucus	8
white milky flesh	7 or 8
dark red blood	8

The TORRY score is not 7.8, but 8 as some of the indicators seem closer to 9 than to 6. The pupil score of 9 tends to push the possible 7 score into a firmer 8.

TORRY Cooked Schemes

Unlike QIM, (almost) every TORRY raw scheme has an equivalent cooked scheme where indicators are given a score from 10 down to a minimum score of around 3 or so. Below a score of 3 the fish flesh is pretty unpleasant to taste.

The raw and cooked schemes are arranged in such a way that a TORRY 8 raw cod is highly likely to score as an 8 on the cooked scheme as well.

The cooked schemes are simpler, with fewer indicators and tend to be easier to apply for inexperienced assessors. The three main indicators – odour, flavour and texture apply to steamed or microwave cooked material.

Appendix 2 also shows the cooked scheme for cod.

Taking a fillet from our TORRY 8 cod, and cooking a 150g portion for about 2 mins should present the following results.

Odour – When the lidded dish is first opened the aroma will be weak but should still have traces of boiled meats, raw green plants. There should not be any indication of wood shavings or sap which are indicative of a 7 score.

Flavour - The flavour on initial chewing will show sweet and characteristic flavours of cod, but these will not be as intense and will disappear more quickly than we would expect from a fresher fish.

Texture – The white and opaque flesh will on further chewing be fibrous and succulent. Very fresh fish sufferers from a dry fibrous texture, while staler fish become much softer and eventually slimy.

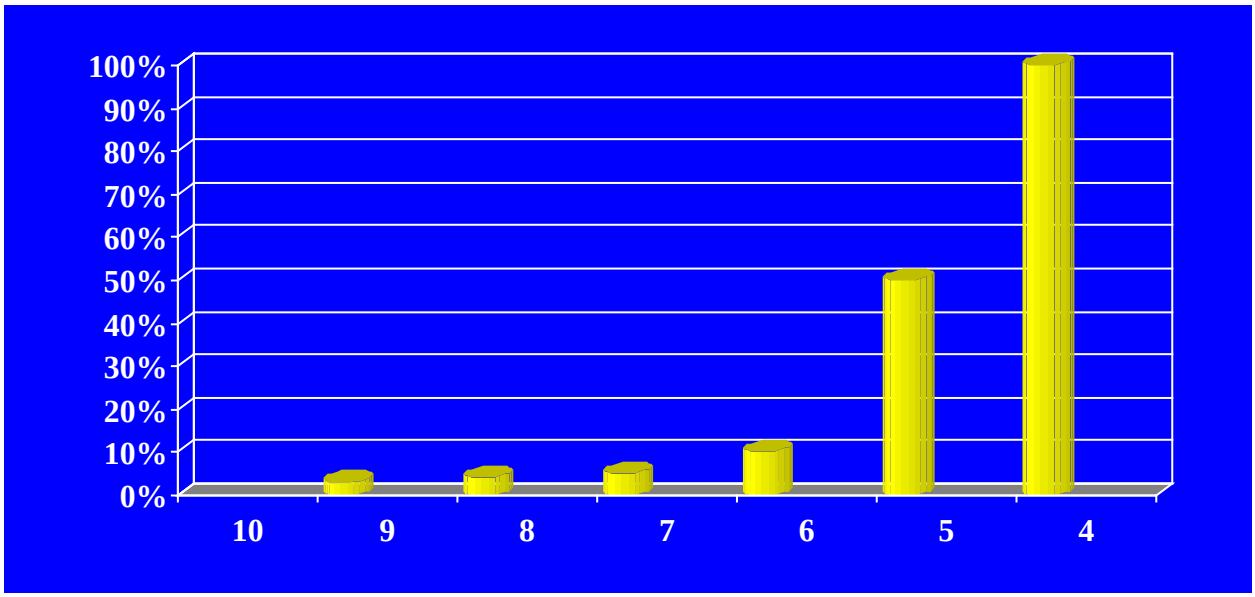
For the best possible results with the TORRY schemes you should think about combining assessments of raw fish and shellfish with the cooked assessments.

The TORRY scheme for cod is actually a general scheme for white roundfish and can be applied to haddock, etc, while the plaice scheme can also be applied to most flatfish.

TORRY also have simple schemes for assessing the impact of freezing and smoking on the quality or freshness of fish.

TORRY / Taste and Plate Waste

An exercise carried out by Seafish into the perceptions of seafood eaters identified a relationship between the percentage of fish left on the plate and the TORRY score of the fish.



What does the graph show?

- Seafish did not assess fish with a TORRY score of 10 – fish that fresh is not readily available;
- Even with the fresher fish (9 to 7) there is some plate waste as not all the fish is eaten by most consumers;
- No-one would eat any fish with a score of 4 (look at the descriptions of the indicators to see why);
- Between a score of 6 and 5 there is a five-fold increase in the rejection rate.

Seafish concluded from this that no fish or shellfish with a score below a TORRY 6 should be presented for sale to the public and industry should strive towards improving the quality of fish on sale to TORRY 7 or better.

As a rule of Thumb, each TORRY point counts as about three days on ice, so TORRY 6 fish are equivalent to about 15 days on ice, which is around the maximum acceptable shelf life.

Unfortunately, during 2008/09 fish with scores as low as 5 and 4 were occasionally found for sale in UK supermarkets by participants on Seafish's Advanced Seafood Quality Assessment course.

ACTIVITY – assessment of quality using TORRY Cooked Scheme

If using the cod cooked scheme (appendix 2) is new to you then this will prove a useful exercise.

How you approach this activity depends on how you obtain your fish, and how frequently you receive deliveries.

Over a period of a week or more you need to develop a series of chilled fillets that range from the freshest, to one that is as poor as you are prepared to taste, with 2-3 samples in between if possible.

To simplify this we recommend that you buy from your local supermarket a pack of frozen whitefish fillets. Use frozen at sea fillets if possible, as these will give the highest quality fillets when correctly defrosted.

Starting on a Monday, defrost a fillet[4], then another on Wednesday and one on Friday. On the next Monday cook up a small piece from each defrosted fillet, along with a portion from a fillet defrosted that day. Keep all the samples labelled and start assessments with the freshest. Continue to defrost fillets on Wednesday and Friday.

On the Friday taste all of the fillets, starting with the freshest. See the assessment plan in appendix 3 for more information.

Cooking: Microwave on a low setting. Use just a small piece of the fillet – perhaps around 50gms and add a little water to the lidded container to keep the fish moist.

Quality Assessment:

1. Use the Torry scale in appendix 1.
2. Lift the lid of the cooked fish and gently smell the steam given off – take care not to scorch your nose! Look down the scale for odour, do you smell any of the descriptions? Write down what it smells like to you.
3. Flavour – take a bite, have a chew and suck out the juices from the flesh. What flavours do you detect? Write down what it tastes like to you.
4. Texture and mouth feel – chew some more of the fish. Does it get firmer and drier as you chew, or sloppy? Does it fit neatly within the

[4] In a refrigerator or in ice

descriptions on the Torry scale? Write down your own impressions of the texture.

5. Repeat this for each fish sample, ending with the oldest.

Congratulations, you have completed your first ‘objective’ fish quality assessment. We say objective because when describing the odour, flavour and texture of the fish you should have used words such as *milky, sweet, fibrous* and not words like *horrible* or *nice.*

SECTION THREE:

QUALITY ASSESSMENT AND QUALITY ASSURANCE

Quality assurance, quality control and food safety tend to become a little tangled up at points in the seafood supply chain.

Quality assurance in food manufacturing is a complex process for the control, evaluation and auditing of food processing systems. Its main function is to provide confidence to management and customers alike that their products are safe, and of the quality desired and expected by the customer.

Although raw materials and product specifications may make reference to seafood of certain minimum quality levels or minimum shelf lives, the most common indicators used by customers to check on their suppliers are variations on TVC or bacterial counts. Other indicators such as volatile nitrogen may also be used.

As we have explained earlier, there are limitations to the use of these types of tests as a means of assessing seafood quality. They are useful as a means of evaluating food safety, but the best possible means of assessing the quality of seafood is to actually assess the quality using a TORRY or QIM scheme.

An effective quality assessment ability within a business would make a significant contribution to the quality assurance function, but only if it is used correctly.

As a minimum, quality should be assessed twice – at materials intake, and as part of the post production dispatch within a fish processing factory.

In a fish retail business there should again be two checks on quality – when supplies are received into the chill store, and as required during display.

While QIM and TORRY schemes allow for the assessment of whole raw fish, it is strongly recommended that businesses also make appropriate use of the cooked schemes to assess part processed fish as well. Given that the cooked schemes come closest to the actual experience of the customer when they eat the fish, it is recommended that wherever possible cooked schemes should take precedence over raw schemes.

For such a programme to be effective it should be recognised that shelf lives of seafood and seafood products should take full account of the assessed quality of the material being processed and sold.

All too often shelf life is based on naïve assumptions regarding the temperature control and handling practices that the seafood:

- should have experienced during harvesting and processing,
- will be subjected to by the customer.

While we have little control over how the customer will handle it after it's sold, we can at least account for its handling before we get it by objectively assessing its freshness ourselves.

Quality assurance is a powerful tool but it requires accurate information if it is to be effective. The actual quality of the raw material is one measurement needed, and the actual quality of the finished product is another.

DEVELOPING NEW ASSESSMENT SCHEMES

New assessment schemes for QIM are occasionally developed by organisations. Their development process may be lengthy if the schemes are intended to become new international standards. Sadly, it is unlikely that new TORRY schemes for international use will be developed unless some organisation or group takes up the challenge.

However, there is a half way house between no scheme at all and an accredited international scheme. It is feasible for a processor or group of processors to develop their own informal scheme. If such a scheme is to be effective and deliver benefits then there are certain steps that must be undertaken to ensure the quality assessment scheme is a good one.

The essential component for developing an informal scheme include the following:

- Consistent supplies of known age fish or shellfish;
- A small, highly competent assessment team;
- Suitable facilities for the storage (ageing) and assessment of samples;
- A systematic approach to the collection and interpretation of data.

The researchers at TORRY collected their samples while onboard their own research vessel. Samples from each catch were iced down and analysed as they aged, while the researchers remained onboard the vessel.

The team onboard the vessel were experienced quality assessors who had undergone regular training and calibration exercises.

And as scientists and technicians they were comfortable with the handling of complex data.

Should you wish to develop your own assessment scheme for a species that is not covered then we make the following recommendations:

- Consider developing a TORRY type scheme as these are easier to develop;
    - Develop both raw and cooked schemes.

- Engage with other industry businesses and be prepared to share information;
    - This reduces the workload;
    - Makes schemes more likely to be adopted;
    - Enhances your reputation as a leading business;
    - Avoids the calamity of someone publishing a similar scheme just before you finish your work.

- Engage with other organisations such as the Sea Fish Industry Authority or Campden BRI who may have the specialist expertise you will require.

MANAGING QUALITY ASSESSMENT

Quality Assessment seems to mean different things to different businesses. Many businesses in the seafood industry would state that they have a quality assessment system in place, but in reality this is often not so.

Formal quality assessment, used by designated trained staff and based on an objective formally accredited system is a rare thing in any sector.

The processing sector is the one that seems to have the best systems in place. Buyers are often able to assess the quality of auction market fish with some accuracy against company specific criteria, while the larger processing businesses are more likely to have a function dedicated to the objective assessment of quality using an appropriate scheme.

An effective system would not only carefully assess the quality of supplies upon intake, but would carefully manage the chilled chain during production and have an efficient stock rotation and dispatch system in place.

Seafood retail businesses fall naturally into two types:

- Multiple retailers who have their own in-house systems based around:
    - Central assessment aimed at verifying supplier compliance with delivery specifications;
    - In store simple guides that enable untrained (in quality assessment) staff to identify out-of-specification product.
- Independent fishmongers who while generally untrained (in quality assessment) have a keen interest in the quality of the seafood they sell.

Seafood restaurants and fish and chip shops are unlikely to have staff who are trained in quality assessment techniques, but they are often in the best position to assess the effectiveness of their sourcing policies, as they can and do taste their final products.

Quality assessment in the seafood service sector can be improved by a number of simple changes to the way in which they taste and assess the quality of their seafood.

- Assess the quality of the cooked seafood on a regular basis, and:
    - Taste the fish without batter or sauce, simply:
        - Microwave it;

        - Steam it.
    - Write down your findings:
        - Describe what you taste and try and give it a (TORRY) score;
    - Discuss your findings with your supplier whether they are good or not.

In conclusion. While individual businesses may make a more than adequate job of managing quality assessment, overall the seafood industry is much less effective. Despite initiatives from Seafish to improve quality and the assessment of quality, it is our view that industry has failed to fully grasp the challenge and opportunity of assessment-led quality improvements.

ACTIVITY

Discuss with colleagues and write a short report to answer the following questions about quality assessment in your company.

1. Are any formal quality assessment schemes used within the company? If yes which ones?

2. Who in the business is responsible for the quality of raw materials and finished products, and who actually carries out the assessments?

3. How are assessors trained, how often are training courses carried out?

4. How would you, and your quality assessment colleagues, like to see quality assessment improved generally in the seafood industry?

QUALITY ASSESSMENT AND THE LAW.

There are common sense reasons for carrying out quality assessment:

- Ensuring suppliers meet your expectations regarding quality and shelf life;
- Minimising complaints from customers and losses due to poor quality.

And then there are reasons that are more related to your legal obligations to provide a seafood product that is not only safe, but is of a certain standard or quality.

While not comprehensive, here are a few UK regulations that may impact upon your need to carry out appropriate[5] quality assessments.

While the Food Safety Act 1990 (FSA90) is broadly similar to the EU Food Safety Regulation 178/2002, it does contain extra provisions not in the EU Regulation that are not food safety concerns, but more related to quality.

Section 8 of the FSA90 - Selling food not complying with food safety requirements.

The text in the section that seems most related to quality are '*unfit for human consumption*' and '*it is so contaminated that it would not be reasonable to expect it to be used for human consumption'*.

These would seem to be really quality issues but in the UK Act are regarded as 'not complying with food safety requirements'. If fish is not as fresh as expected than it would be 'unfit', so there is an argument here that some form of assessment is a legal requirement to ensure fish is not 'unfit'

The other quality issue is in Section 14 of FSA90 - Selling food not of the nature or substance or quality demanded.

This creates an offence for food to not be of a quality expected by the average consumer. Therefore if the consumer expects fish to be a certain 'freshness', then to be less 'fresh' than this would be to their prejudice and an offence may have been committed.

[5] These may be formal Torry assessments or much more informal 'scratch and sniff' assessments of your own.

How freshness is determined or measured is not relevant. It is consumer expectation that is the key. That expectation of 'freshness' may be different depending on the source and the products presentationeg quayside sales vs supermarket, fresh vs frozen.

So again there is an argument here that quality assessment may be necessary to ensure it is of a standard expected by the consumer.

There are other quality requirements in Regulation 853/2004 for example:

1. For bivalves[6]

They must have organoleptic characteristics associated with freshness and viability, including

- shells free of dirt
- an adequate response to percussion and
- normal amounts of intravalvular liquid.

2. For fishery products[7]

    a. Organoleptic properties of fishery products

Food business operators must carry out an organoleptic examination of fishery products. In particular, this examination must ensure that fishery products comply with any freshness criteria.

    b. Total volatile nitrogen

Unprocessed fishery products must not be placed on the market if chemical tests reveal that the limits with regard to "tvb"-n or "tma"-n have been exceeded.

So, depending on your business, it may not only be good sense to assess fish and shellfish quality, but a requirement as well.

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[6] Annex III, Section VII, CHAPTER V: HEALTH STANDARDS FOR LIVE BIVALVE MOLLUSCS

[7] Annex III, Section VIII CHAPTER V: HEALTH STANDARDS FOR FISHERY PRODUCTS

SECTION FOUR: ADDITIONAL RESOURCES

QUALITY RELATED

1. Introductory Seafood Quality Assessment – Half day training programme with a mix of theory and practical sessions. Seafood Training Academy recognised and delivered by Seafish approved trainers.

2. Advanced Seafood Quality Assessment – A five day training programme with a mix of theory and practical sessions. Suitable for managers and quality assessment specialist, potential trainers and others who need to develop a substantial understanding of the theory and practice of fish quality assessment.

3. Video demonstrations – online at www.seafoodacademy.org

4. *Seafood and Eat It* – This 6 DVD masterclass on fish and shellfish processing also contains a DVD on quality assessment. (DVDs available individually).

GENERAL

1. Food Safety training courses from level 1 to level 3:
    a. Available in various languages;
    b. Available as taught courses, open learning programmes and by eLearning[8];
    c. CIEH and REHIS approved.

2. Health and Safety training courses:
    a. Level 1 taught course;
    b. Level 2 as a taught course or open learning module;
    c. CIEH and REHIS approved.

For information on all of these training resources and others, contact Seafish:

Seafish Training

[8] A free to study, level 2 course is available at www.seafoodacademy.org

Sea Fish Industry Authority
Humber Seafood Institute
Europarc
Grimsby
DN37 9TZ

Tel 01472 252300
Email training @seafish.co.uk

See also: www.seafish.org and www.seafoodacademy.org

For up to date information on resources please visit the Library on the Seafood Training Academy website www.seafoodacademy.org and download the Library Guide for FDQ Learner Workbooks, where you will find links to the above documents and much more.

Appendix 1 - EU (EAB) Criteria

	E Grade	A Grade	B Grade	C Grade (Unfit))
Skin	bright, shining, iridescent (not redfish) or opalescent, no bleaching	waxy, slight loss of bloom, very slight bleaching	dull	dull, gritty, marked bleaching and shrinkage
Outer slime	transparent; water white	milky	yellowish-grey, some clotting	yellow-brown, very clotted and thick
Eyes	convex, black pupil, translucent cornea	plane, slightly opaque pupil, slightly opalescent	slightly concave, grey pupil; opaque cornea	completely sunken, grey pupil opaque discoloured cornea
Gills	dark red or bright red, mucus translucent	red or pink, mucus slightly opaque	brown/grey and bleached, mucus opaque and thick	brown or bleached mucus yellowish grey and clotted
Peritoneum (in gutted fish)	glossy, brilliant; difficult to tear from flesh	slightly dull, difficult to tear from flesh	gritty; fairly easy to tear from flesh	gritty, easily torn from flesh
Gill and internal odours (not plaice)	fresh, seaweedy, shellfishy	no odour; neutral odour; trace musty, mousy, milky, capryllic, garlic or peppery	definite musty, mousy, milky, capryllic, garlic or peppery; bready, malty, beery, lactic, slightly sour	acetic, butyric, fruity; turnipy, amines, sulphide, faecal
Gill and internal odours (plaice)	fresh oil, metallic, fresh-cut grass, earthy, peppery	oily; seaweedy, aromatic, trace musty, mousy, or critic	oily; definite musty, mousy, or critic, bready, malty, beery, slightly rancid, painty	muddy, grassy, fruity, acetic, butyric, rancid, amines, sulphide, faecal

Appendix 2 Cod Torry Schemes

Torry Freshness Scoring System for Iced Raw Cod

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 around	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 opalescent 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(e.g. 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 - Cooked Fillet

Score	Odour	Flavour	Texture, Mouth Feel and Appearance
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, crumbly with short tough fibres
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
8	Loss of odour, neutral odour	Sweet and characteristic flavours but reduced in intensity	
7	Wood shavings, wood sap, vanillin	Neutral	
6	Condensed milk, caramel, toffee-like	Insipid, tasteless as if chewing cotton wool	
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
4	Lactic acid, sour milk, byre-like	Stronger sourness, slight bitterness, strong 'off' flavours, some ammonia	
3	Lower fatty acids(e.g. acetic or butyric acids), composted grass, soapy, turnipy, tallowy	Strong bitterness, rubber, sulphide, definite ammonia	

Appendix 3 - whitefish assessment plan.

Day	Mon	Tues	Weds	Thurs	Fri	Sat	Sun	Mon	Tues	Weds	Thurs	Fri
Defrost	S1		S2		S3			S4		S5		S6
Assessment								Assessment 1				Assessment 2

	Assessment 1		Assessment 2		
Sample	Age (Days)	Taste Result	Age (Days)	Taste Result	
S1	7		11		
S2	5		9		
S3	3		7		
S4			4		
S5			2		
S6			0		

Using this Plan you will have an opportunity of tasting fish samples that of known ages from defrosting of:
0, 2, 3, 4, 5, 7, 9, and 11 days. If the fish was frozen at sea then day 11 fish should still be of reasonable quality and you may wish to repeat the tasting session on the Monday when the fish ages will be 14 days to 3 days.

Note: keep labelled, keep chilled and don't dry out. Defrosted fish will usually seem a little firmer when cooked than fish that has never been frozen, but the key indicators of taste and odour will be unchanged.