Shellfish Quality Assessment

The following slides were originally developed for Seafish to use in a formal training course on shellfish quality assessment.

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Shellfish Quality Assessment

Course Schedule

- 0900 Welcome introductions and objectives
- 0915 Shellfish family ID - Crustaceans & Molluscs - good quality indictors*
- 0945 Outline the assessment process - scoring schemes and methods of assessment
- 1015 Causes of shellfish spoilage
- 1030 The impact of temperature, handling & seasonality on quality
- 1045 Break
- 1100 Preparing for quality assessment
- 1115 Methods of assessment – Crustacean practical
- 1300 Lunch
- 1330 Methods of assessment - Mollusc practical
- 1500 Break
- 1515 Completing the assessment process – records and managing the process.
- 1530 Review/ Q&A
- 1600 Close

0900 Welcome, introductions, and objectives:

- Introductions: before we start let's take a moment to introduce ourselves to the group.

- **Objectives:**
  - 1. Shellfish ID, focus on important UK species
  - 2. How to prepare for shellfish quality assessment
  - 3. How to assess the quality of types of shellfish
  - 4. How to complete the assessment process

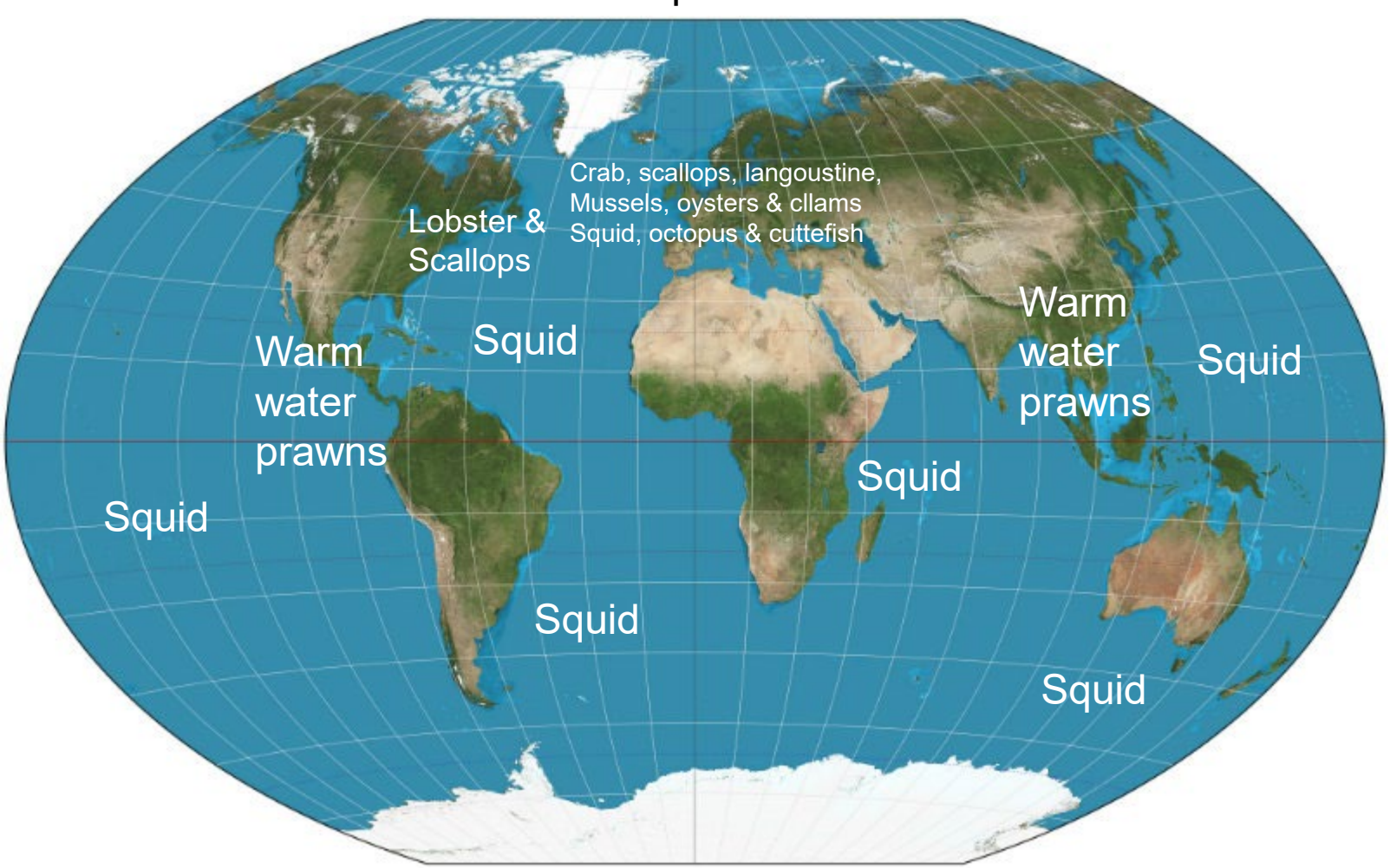
Quality products, the key to success!

- Shellfish is a highly valuable but easily perishable commodity; accurately assessing and maintaining quality fundamental to any shellfish business;

- Shellfish quality can not be improved once lost; Optimum conditions allow us to slow the spoilage process;

- **To understand quality assessment we must first look at how shellfish spoil and the impact of temperature, handling and seasonality on quality.**

0915 Introduction to Shellfish



Shellfish commonly eaten in the UK

Crustaceans:

Brown Crab, Lobster (North American and native), cold water prawns, warm water prawns, langoustine (scampi)

Molluscs:

Bivalves: Mussels, scallops, oysters, clam selection

Gastropods: Whelks and winkles

Cephalopods: Squid, Octopus and cuttlefish

Overview of good shellfish quality

Shellfish	Quality Characteristics
Crustaceans (prawns, crabs, lobster)	• Shell is clean, intact, bright & glossy. Prawns should not have any blackspots (an enzymic spoilage) on the shell or a “gritty” feel about them. • Firmly attached head and limbs. • Moist, firm, white flesh. • Odourless to mild pleasant odour.
Squid and octopus	• Bright skin, no staining and intact. • Pure white very firm flesh, not slimy. No "gritty” feel about them • Almost no smell.

Overview of good shellfish quality

Shellfish	Quality Characteristics
Live shellfish (mussels & oysters)	• Clean (no sand, mud, barnacles). • Intact closed shell, or closes when tapped. • No unpleasant odours.
Shellfish (scallops, mussels, oysters)	• Scallop flesh white to cream. • Mussel flesh white or orange. • Oyster flesh often grey. • Firm, plump, moist & elastic flesh. • Orange roe, firmly attached. • No excess liquid in package. • No unpleasant odours.

Overview of good shellfish quality

Shellfish	Quality Characteristics
Frozen shellfish	• Hard frozen. • Package intact. • No ice build up (indicates thawing and refreezing). • Individually plastic wrapped or layer packed with plastic sheets. • Bright and glossy colour, no gaping of tissues. • Clean fresh frozen smell.

Shellfish ID slides

- Depending upon the facilities and samples available the following links can be used to assist shellfish ID during the course of or left out if not required.
- Crustaceans - http://seafoodacademy.org/Shellfish-Crustaceans.php#Topic46
- Bivalves - http://seafoodacademy.org/Shellfish-Molluscs.php#Topic48
- Cephalopods
  - Squid - http://seafoodacademy.org/Squid.php
  - Cuttlefish - http://seafoodacademy.org/Cuttlefish.php
  - Octopus - http://seafoodacademy.org/Octopus.php

Crustaceans: Brown Crab.

Crustaceans: Lobster

Crustacean: warm water prawns

Crustaceans: Cold water prawns

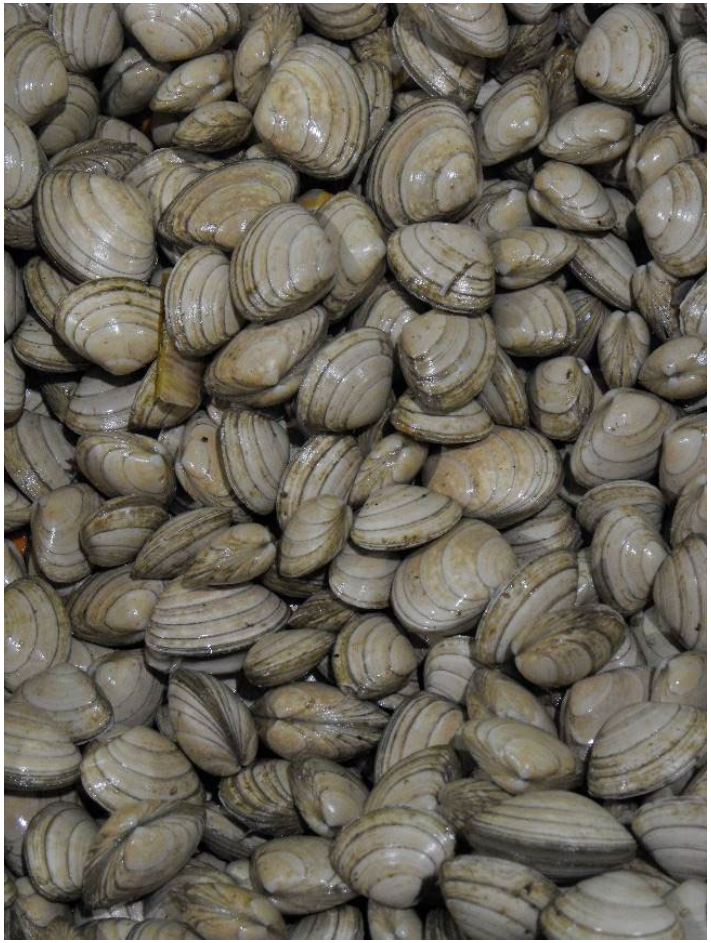
Crustaceans: Nephrops/ Langoustine/ Scampi

Molluscs: Bivalves - Mussels

Molluscs: Bivalves - Scallops

Molluscs: Bivalves Oysters

Molluscs: Bivalves - Clam selection



Bivalve Quality Indicators

Check	Higher Quality	Lesser Quality	Comment
Shell	Clean, intact	Chipped or dirty	Mussels have byssal threads (filaments) that are used to attach the mussel to a surface. These may be present but do not affect the eating quality. In live animals, gaping shells suggest that the animal is dead or dying and should be discarded (it may have been in this condition for some time and could be contaminated).
Liquid (liquor)	Clear	Slightly opalescent (oysters), or slightly milky in colour	
Flesh Texture	Juicy, moist, plump and firm	Starting to shrink and look flat	Oysters are often turned over when shucked to give a "plump" look.

Bivalve Quality Indicators

Check	Higher Quality	Lesser Quality	Comment
Colour	Mussels are either white or orange; oysters vary naturally from greenish grey to white or ivory	Mussels fade; oysters darken (but may be a brilliant white or greenish)	Living environment and feed can influence flesh colour. Mussels range from cream to pale or deep orange with a black rim. Female mussels are orange in colour; males are whitish. To determine if an oyster shell is original or re-used, check for a muscle remnant. In a "freshly" opened oyster, presented on a half shell, the muscle that attaches the flesh to the shell will have been cut, and the flesh turned over. When the shell is re-used, it is cleaned and the muscle remnant removed. Note re-using shells can be a health risk, and may be in contravention of food laws.

Molluscs: Gastropods Whelks and Winkles.

Molluscs: Cephalopods - Squid

Molluscs: Cephalopods - Octopus

Picture of
octopus good
quality required

Molluscs: Cephalopods - Cuttlefish

0945 Quality Assessment methods

Methods of quality assessment measure different attributes giving a score.

Methods can rely on:

Microbiological tests;

Chemical tests;

Electrochemical assessment;

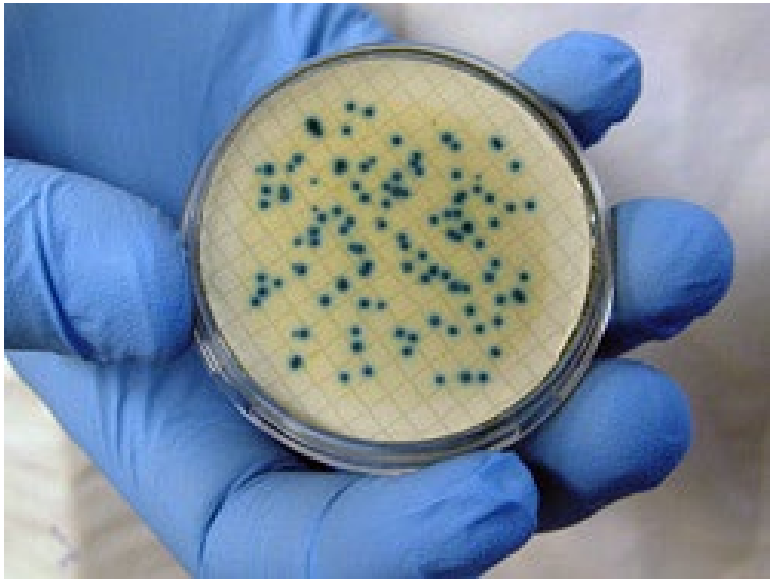
Sensory Assessment.

Microbiological Quality Assessment

Measures the amount of bacteria present, however the process is time consuming, can take 24-48 (or longer) hours to get a result;

Number of bacteria not always a good indicator of quality varies with handling and catch area;

Useful in ready to eat sector (for food safety) and with bivalve molluscs such as oysters that are often eaten raw.



Chemical Analysis assessment

- Looks for chemicals that are produced as the shellfish spoil, these include:
- TMA (Tri-methylamine); TVB (total volatile bases) or TVN (total volatile nitrogen); Hypoxanthine; ATP/ADP/AMP ratios; Peroxide value – measure of fat oxidation.
- This form of assessment is expensive, time consuming and not that useful for high quality, better at indicating poor quality.

Electrochemical assessment

- Chemical changes in fish flesh can be measured electronically;
- Equipment is expensive but gives a very quick result;
- Difficult to use with previously frozen product unless re-calibrated for this type of product.

Sensory Assessment

- Using our senses to judge the appearance, taste, smell and feel of shellfish to determine its quality.
- **Hedonic** scoring (personal like or dislike) of limited use (consumer taste panels).
- An **objective** approach is better because:
- Quick; consistent, use human senses to detect the sequence of changes during spoilage. Unfortunately most research and development has been for fish quality. Examples include: Torry Schemes & Quality Index Method (QIM)

Senses used in quality assessment

Sense used	Aspect of Quality determined
Sight	General appearance and condition, size, shape, physical blemishes, colour, gloss, identity.
Smell	Freshness, off-odours, taint, oiliness, rancidity, smokiness
Taste	Freshness, off-flavours, taints, oiliness, rancidity, smokiness, astringency, the primary tastes of acidity, bitterness, saltiness, sweetness.
Touch (using fingers and mouth)	General texture, hardness, softness, elasticity, brittleness, roughness, smoothness, grittiness, wetness, dryness, crispness, presence of bones.

Sensory Assessment – Torry Schemes & Quality Index Method QIM

- **Torry schemes**
- Available for raw and cooked pink and brown shrimps, cooked squid, raw and cooked langoustine tail and cooked scallops.
- Schemes up to mid 1990s when the Torry Research Lab was closed down.
- Uses physical indicators to assess quality such as appearance, odour, flavour, texture, mouth feel;
- Scores for indicators are averaged giving a score linked to freshness (higher the better)
- Advantages: widely used, effective (QC and scientific trials); gives detailed evaluation of quality, schemes available for raw and cooked.
- Disadvantages: requires training, limited shellfish species covered, no new schemes coming through.

Sensory Assessment – Torry Schemes & Quality Index Method QIM

- **Quality Index Method**

- Schemes are available for Octopus and cuttlefish
- Developed in the 1990s modifying an Australian scheme.
- Uses similar indicators as Torry but lower scores are the freshest and each indicator is added to get a total score.

- Examples of scoring schemes and further information can be seen:

- See resources page http://seafoodacademy.org/shellfish_quality_assessment.htm

1015 Causes of shellfish spoilage

- Bacteria; enzymes, oxygen, dehydration.
- **Bacteria**
- Bacteria present and those that come in contact with soft tissue after death will:
- Lead to bad taste and smell
- Decompose the flesh, changing how it looks
- Spoilage bacteria does not cause food poisoning, unlike pathogenic bacteria from careless handling or contaminated water supplies.
- Growth of bacteria is typically controlled by temperature less than 4 degrees, (live shellfish have optimum shelf life if stored 4-8 degrees)

Causes of shellfish spoilage

- **Enzymes**
- **Enzymes** are biological catalysts - catalysts are substances that increase the rate of chemical reactions without being used up;
- Are vital to the shellfish's well being when alive but then start to break down the cells they are found in after death;
- Are mainly found in the gut of shellfish, after death these then penetrate the flesh
- Enzymes produce a chemical spoilage that can even continue (slowly) in frozen products, particularly product with freezer burn that has experienced fluctuating temperatures.

Causes of shellfish spoilage

- **Dehydration**
- The drying out of shellfish flesh leads to a reduction of flavour, juices and loss of weight, Severe dehydration of frozen product is often referred to as freezer burn. It may result in a dry ‘woody’ appearance or the build up of icicles within pre-packaged goods
- Dehydration can be minimised by reducing the time of processing and storage. Also using correct packaging such as a plastic film barrier and glazing, of frozen product that is kept at a constant temperature of frozen product below -30°C.

Causes of shellfish spoilage

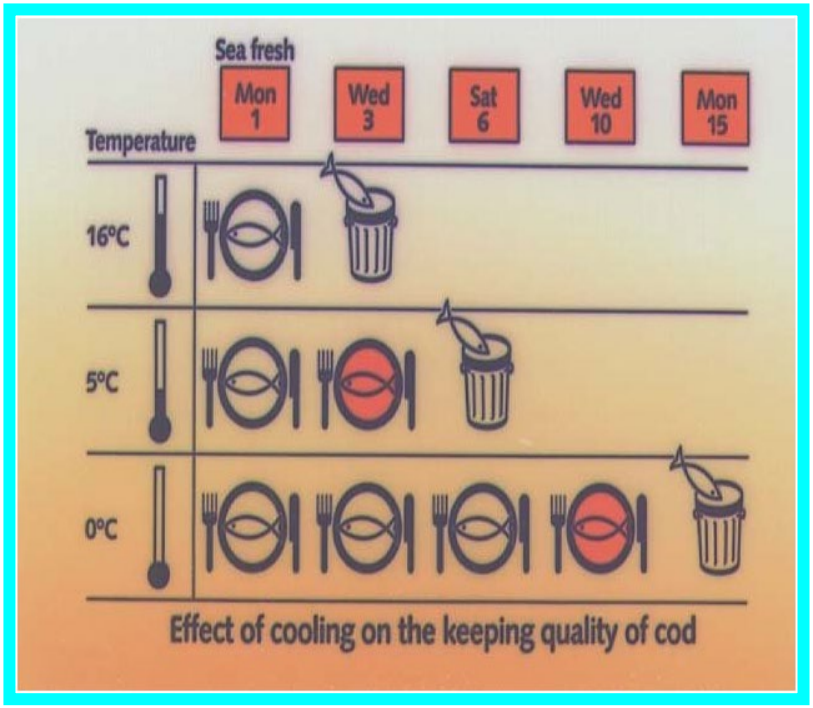
- **Oxygen**
- Particularly a problem associated with long term cold storage as fats can be changed by oxidisation producing a rancid bad smell and taste.
- The effect of oxidisation takes a period of time and is not normally an issue for chilled short life products
- The effect of oxygen will depend upon the level of fat in the product which will vary throughout the year depending upon feeding and breeding seasons when harvested.
- Oxygen is normally excluded by vacuum packing.

1030 The impact of temperature, handling & seasonality on quality

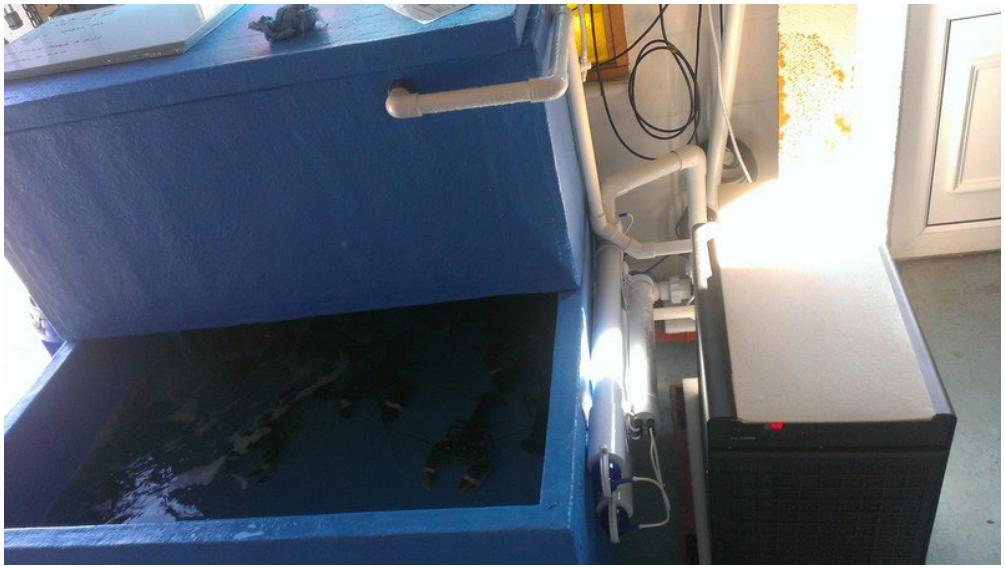
- Temperature - direct link to bacterial growth & action of enzymes, minimised at temperatures less than 4 degrees. The most significant cause of quality loss.

- The nature of shellfish flesh is soft and easy to damage, rough handling throughout the supply chain can easily loose quality.

- Product quality will vary due to seasonal variations in food availability, breeding seasons, crustacea moulting and farm environmental conditions (e.g. algal blooms on a mussel farm).



Handling and storage of live crustaceans:

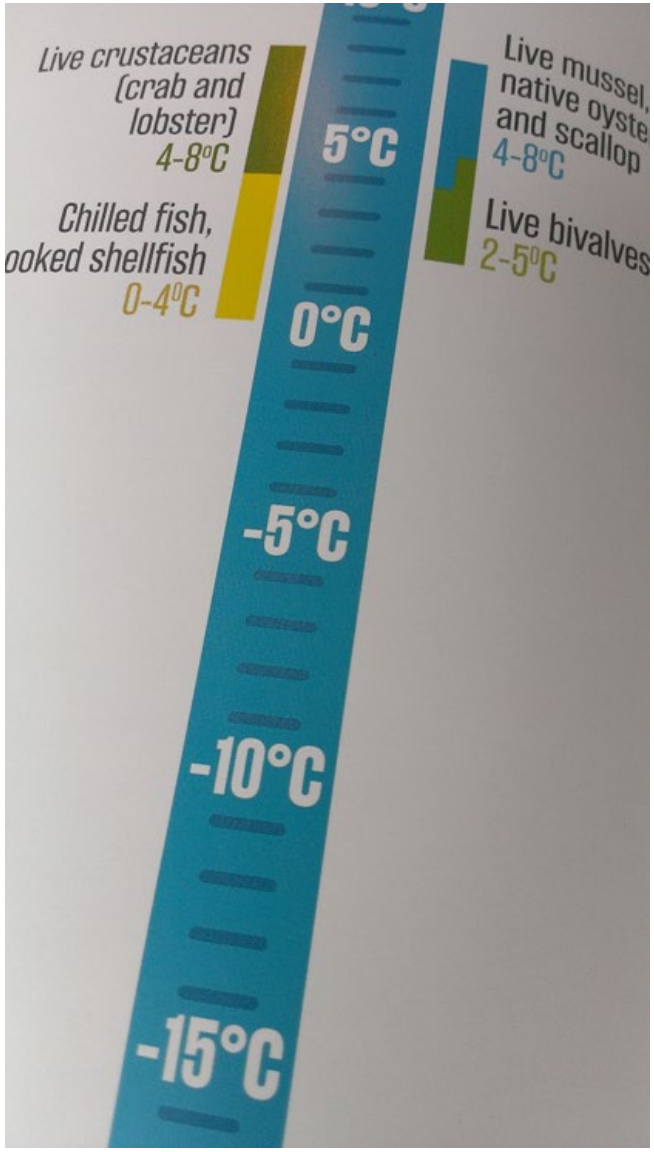


Handling and storage of raw crustaceans

Spot the product shown here at most risk….

Handling and storage of cooked crustaceans

- Chilled: should be quickly cooled and stored ideally 0-1 degrees and less than 4 degrees to minimise bacterial growth.
- Cooked crustaceans are then often hand processed requiring skill and high standards of food safety.
- Frozen: should be blast frozen (quickly) to maintain quality, products such as cold water prawns are cooked quickly after capture then frozen on board high tech ocean going factory ships



Handling and storage of live molluscs

Best stored in damp condition 4-8 degrees;

in breathable packaging handled carefully;

Oysters stored dish shell down to hold internal fluid as oysters open and close.

Handling and storage of raw molluscs

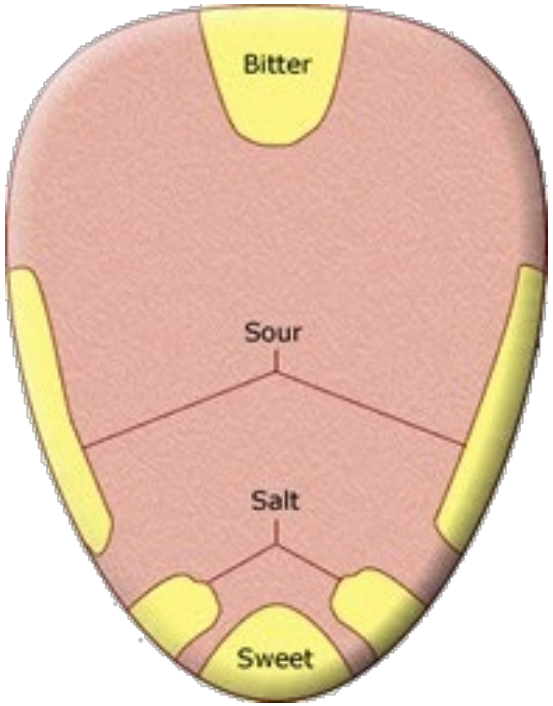
- Stored raw molluscs are usually cephalopods (bivalves must be sold alive if raw & gastropods need to be cooked to be extracted from their shell).
- Squid, octopus and cuttlefish are sold whole and raw in ice at landing ports and wholesale markets.
- Cephalopods are also sold widely frozen raw from global supplies.

Handling and storage of cooked molluscs

- Cooked molluscs such as mussels are often further processed e.g. into a frozen seafood mix. Cooked whelks are usually sold chilled in vac packs or frozen in the UK wholesale market

1045 Break

1100 Preparing for quality assessment



- Taste Calibration is a great way to check assessor's sensitivity to the four key flavours.
- Individuals also learn to identify where in their mouth these different sensations are detected.
- This can help when experiencing the more complex flavours from real samples.

Good working practises

- Quality Assessment should be carried out systematically to minimise errors by trained staff.
- Careful and consistent labelling of samples under hygienic conditions will reduce the risk mistakes and contamination of samples by the assessor or assessment station.
- In preparing for quality assessment training samples for comparison must be gathered, labelled accurately and carefully. These are then stored under ideal conditions often in ice, requiring re-icing throughout the storage period.
- HACCP documentation is used to describe good working practices within any food business. They identify points critical to the food safety of the product during the process and require monitoring of these regularly to document due diligence in food production.

Food safety and traceability

Live bivalve molluscs must be harvested from appropriately graded waters from around the UK; most require depuration and a health mark to ensure food safety and allow traceability. A retailer must retain all health marks for 60 days

Water Classifications.

Following regular testing of harvest and areas of aquaculture:

1: Classification A (Cleanest waters can be gathered for direct consumption)

2: Classification B (require treatment in a purification centre, relaying or heat treatment)

3: Classification C (require relaying of at least 2 months, followed by purification or heat treatment).

Bivalve Molluscs: Harvest to sale

- Local Authority – raises a ‘Movement document’
- Gathered from harvesting area to purification/ despatch centre;
- Health mark produced with name (scientific), origin, date of despatch, centre number, batch number.
- Retail outlet – incoming supplies record, keep health mark for 60 days.

How can we tell shellfish is safe to eat

- Bivalve molluscs: Health marks are a legal requirements following live bivalves from depuration to retail sale.

Healthmark	
Common name: Mussels	Scientific name: Mytilus Edulis
Country of Origin: Date of packing:	Scotland. 12th Dec 2004.
Establishment / Purification centre No: RB 1204	
Statutory warning: These shellfish must be alive when sold	

Handling of shellfish samples

What should be considered during the assessment process?

Handling should be: Hygienic; Careful & Accurate

How to prepare & handle samples

Samples must be:

- Representative
- Securely stored
- Labelled accurately
- Recorded accurately

Limitations of assessment methods

- The main limitation of shellfish sensory assessment methods is that there are few documented sensory assessment schemes available;
- Microbiological assessment - Number of bacteria not always a good indicator of quality varies with handling and catch area;
- Chemical assessment - This form of assessment is expensive, time consuming and not that useful for high quality, better at indicating poor quality.
- Electro-chemical assessment – The equipment is expensive and difficult to use with previously frozen product unless re-calibrated for this type of product

1115 Methods of assessment – Crustacean practical

- Assess the quality of raw crustacean shellfish based on appearance, texture and odour;
- Assess the quality of cooked crustacean shellfish based on appearance, odour, flavour and texture.

Crustacean practical

- Limited schemes available, these are:
- Torry Assessment Pink & brown shrimp, cooked and raw (difficult to obtain fresh)
- Torry Assessment Raw and cooked langoustine tails
- Use of BIM Brown crab – Quality and Handling document

Raw Torry shrimp scoresheet – Pink & Brown

S	Flesh colour & opacity	Head	Brown shrimp body	Connective tissue	Head	Pink shrimp body	Odours
5	translucent	Light brown/grey through transparent casing	Pale grey, darker grey spots	Grey	Brown/dark red	Orange/pink (eggs turquoise)	Fresh seaweed; delicate; watery
4	Slight opacity towards anterior	Slight greening or yellowing	Grey/slight mauve tinge. Pale yellow ventrally	Duller grey	Darkening	Slight green/yellow tinge laterally. Pale yellow ventrally (eggs: dirty ferrous green)	Seaweed; sweet; milky; fresh cut grass; metallic; iodine
3	Opacity extended half way along flesh from anterior end which is beginning to turn yellow	Blackening			Dark green/ purple		Tangy / sherbet lemon; "sharp"; musty-mouldy leaves; hay
2	May still show translucency at tips of tail. Anterior: yellow/green	Grey/green/yellow			Green/ yellow		Compost; silage; rotting vegetables; humus; muddy; ditch-water; NH3
1	All opaque	Covered in large green/black blotches. Blackening of head extending along the body	Covered in large green/black blotches. Blackening of head extending along the body	Yellowing	Green/ black	Dirty yellow / brown/orange. Covered in pale yellow slime	Urinal; doggy; amines; byres; sweaty; NH3

Torry Assessment of raw and cooked Nephrops (langoustine) tails
Assessment 1: Raw samples (link to days on ice?)

Score	Appearance	Odour
5	Shells bright, clean, rosy pink. Telson and swimmerets clean. Flesh on ventral side clean, white and translucent.	Shellfish, marine, seaweed
4	Loss of brightness of shell with some dulling. Loss of translucence of flesh on ventral side. No blackening of shell apparent.	Slight shellfish, slight marine, very slight ammonia
3	Some darkening of shell along the joint between the segments. Shells appear dull. Some slight discoloration on the telson. Swimmerets showing some darkening.	Slight ammonia, loss of characteristic shellfish odour
2	Darkening of the shell more apparent. Dark lines between the segments extend and join together. Dark spots on telson. Swimmerets show intensive darkening and black spots.	Moderate ammonia, sour and off
1	Generalised blackening of the shell with discoloration from the segment joints spreading to the complete shell.	Strong ammonia, strong, sour and off, stale
0	Shells completely black.	Very strong ammonia, putrid

Torry Assessment of raw and cooked Nephrops (langoustine) tails
Assessment 1: Cooked samples

Score	Odour	Flavour	Texture, mouthfeel & appearance
5	Milky-sweet, seaweed. Slightly sulphurous, characteristic shellfish	Intensely sweet, metallic	Very firm, crisp
4	Milky, creamy, slight ammonia	Very sweet, creamy, milky	Firm
3	Slight ammonia, loss of milkiness	Sweet	Slightly soft
2	Ammonia	Loss of sweetness, neutral	Soft
1	Strong ammonia	Sour, off, creamy sour	Very soft
0	Strong ammonia, sour	Strong off-flavour, bitter, very sour	Sloppy, little texture

Torry Assessment of Pink & brown shrimp, Nephrops, raw and cooked practical

- Use samples: As fresh possible 0-3 days; 3-6 days, 6-9 days

Brown crab assessment (taken from BIM Handling & Quality Guide)

Expected meat yield	High	Low
Topside	Shell darkly coloured throughout. Pie-crust edge is dark in colour.	Shell lightly coloured throughout. Pie-crust edge is light in colour with pale indentations.
Underside	Abdomen or flap darkly coloured Shell pale yellow to light brown in colour with visible hairs. Shell hard when the underside of the shell is pressed.	Abdomen or flap lightly coloured. Shell white or cream in colour with no visible hairs. Shell soft when the underside of the shell is pressed.
Claws	Claws dark brown in colour with cream underside.	Claws light brown in colour with off-white underside.

Brown crab practical: dressing

- Illustrate yields and flesh quality of male/ female & good and bad quality if practical demo not possible can use YouTube resources and buy in cooked white and brown flesh.

1300 Lunch – Dressed crab!

1330 Methods of assessment - Mollusc practical

- Assess the quality of cephalopods based on colour, adherence, texture and odour
- Assess the quality of live bivalve molluscs and gastropods based on the percussion test
- Assess the quality of molluscs meats based on odour and flavour.

Squid quality assessment : Appearance

Check	Higher quality	Lesser Quality	Comment
Flesh colour	White, slightly translucent when raw	Darkens to a strong pink tinge	When "freshly" caught, squid have an attractive translucent flesh. If you put your fingers inside the tube, you should be able to see them clearly. After death, chemicals are released that discolour the flesh. This process can be aggravated by damage to the internal organs through rough handling. Discolouration is clearly visible when the skin is removed.

Squid quality assessment – skin condition

Check	Higher Quality	Lesser Quality	Comments
Skin condition	Intact, with distinct patches of iridescence in squid and cuttlefish	Some tears in the skin, some broken arms	If trawled, the skin may have been rubbed off or torn; this does not necessarily indicate poor-quality flesh. Ink on a squid or cuttlefish does not mean poor eating quality, but is a warning of poor handling. It can encourage bacterial growth and should be washed off immediately.

Squid quality assessment - Flesh

Check	Higher Quality	Lesser Quality	Comments
Flesh	Elastic, very firm, not slimy	Loss of elasticity, soft, slimy or gritty	Squid and cuttlefish are often perceived as being overly tough. The flesh is naturally firm but can be toughened by incorrect cooking or overcooking. Grittiness can be caused by foreign matter such as sand. Octopus is naturally firmer than squid and cuttlefish.

Mussel quality

Rope grown farmed mussels are cleaner and have thinner shells compared to the thicker shelled wild dredged mussel which often have barnacles on the outside;

Rope grown are available most of the year (will spawn in the summer). Dredged wild mussel can be cheaper but require cleaning;

Mussels have excellent sustainability credentials, but require health marks for food safety

Mussels attach to their growing areas with a beard or sticky thread that should be removed just before cooking as removal will weaken the mussel

Percussion test for bivalves and gastropods

The percussion test is a simple test for life of uncooked bivalves and gastropods.

Bivalves should be tightly closed and gastropods have their operculum (trap door) tightly closed.

When weakened the bivalves shells open (as shown) and the gastropods operculum opens.

By tapping the shells on a work surface the live shellfish will close again, meaning they are still alive and safe for cooking. Shellfish that do not respond should be discarded.

Dry king scallop sold in 2 Kg tubs

Cooked mollusc meat assessed for quality on odour & flavour - scallops

Score	Cooked Odour	Cooked Flavour	Cooked Texture
5	Sweet milky; condensed milk	Intensely sweet, cloying	Chewy; fibrous; rubbery
4	Slight milky sweet; seaweed	Less sweet; milky	Chewy; fibrous; rubbery
3	Neutral; musty	Neutral; slightly musty; some residual sweetness	Slightly chewy; slightly soft.
2	Slightly sour	Sour; bitter; off; some sweetness may still be detectable	Slightly chewy; slightly soft/ Soft gelatinous; sticky
1	Sour; sweaty; ammoniacal	Sour; bitter; off; some sweetness may still be detectable	Soft; gelatinous; sticky.
0	Sulphide; faecal; stale cabbage	Very bitter; off; rubber; nauseating	

Cooked mollusc meat assessed for quality on cooked flavour - squid

Score	Cooked flavour of squid	Days in ice
10	Fresh, characteristic of shellfish, sweet, meaty	0-1
9	slight loss of freshness, creamy, sweet, meaty, metallic	
8	slightly sweet, slightly meaty, creamy, milky	6-8
7	no sweetness, caramel	
6	neutral	
5	Slightly sour	8-10
4	Sour, musty, cabbage	
3	Slightly bitter, overripe cheese, oily, slight sulphide	13-14
2	Bitter sulphide	
1	Strongly bitter, putrid	

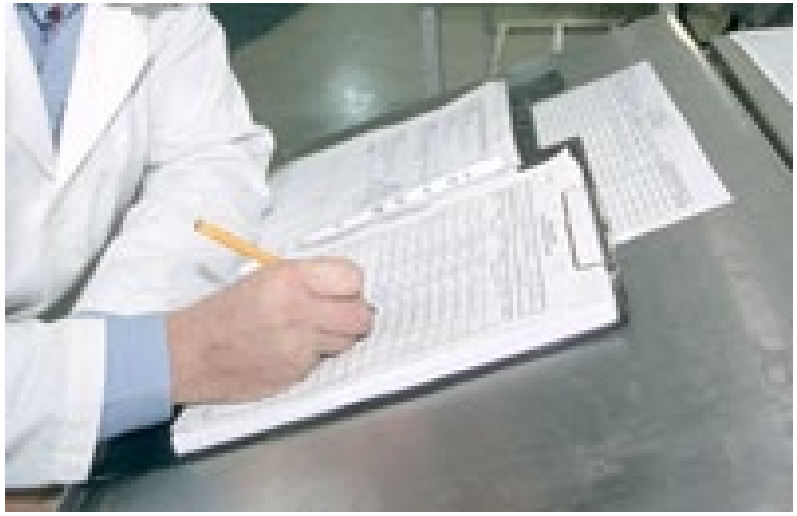
Mollusc practical samples

For each practical assessment collect three sets of samples at:
0-3, 3-6, and 6-9 days.

1500 Break

1515 Completing the quality assessment records

- Records completed after assessment will include:
- Supplier of samples
- Delivery and storage times
- Product and codes allocated
- Assessment sheets completed
- Person completing inspection
- Identify & address any discrepancies between assessed and anticipated freshness, consider temp. abuse, handling & seasonality,



1530 Review/ Q&A

1600 Close