The Chilled Fish Chain

Segment One – Why do Fish Spoil?

INTRODUCTION

One of the most important points to be aware of when handling fish, is that fish is a very perishable material. As soon as the fish dies, the process of spoilage begins. Although this process is very complex, this segment will explain, in simple terms, some of these changes to you.

AIMS OF THE SEGMENT

The main aim of this segment is to help you to achieve Objective 1 given on page xiii. When you have finished this segment you should be able to:

- Explain why fish spoil;
- State the importance of gutting fish, in relation to fish spoilage;
- State the need to maintain good hygiene standards when handling fish;
- Explain the effects of temperature reduction on the rate of fish spoilage.

SPOILAGE

Spoilage occurs as a result of a series of changes in the tissues of the fish. Many of these changes are so slight, especially in the early stages after death, that only an experienced eye can detect them. These changes are **irreversible** and add together so that, over a period of time (from a few hours to a few days), changes in flavour, texture and appearance of the fish become much easier to see.

At some point in this chain of events, the customer will see the fish as being of 'lower quality' or even as 'unfit to eat'. Lower quality fish has to be sold at a lower price, and this is, of course, bad for business.

Spoilage changes in the dead fish are caused mainly by **enzymic and bacterial changes.**

WHAT ARE ENZYMIC AND BACTERIAL CHANGES?

Whilst the fish is alive, any food taken into its body is digested in the gut. Here the food is broken up into smaller units which pass through the walls of the gut into the bloodstream.

The bloodstream carries the broken down food units to different sites around the body, such as the muscles. Here they are built up into larger units or broken down to release energy to fuel movements of the fish. These complex changes or reactions proceed faster in the presence of small amounts of special **proteins** called **enzymes.** Enzymes occur naturally in the fish tissue, especially the gut, and are not destroyed immediately the fish dies.

Bacteria (bugs) are very small, living organisms which cannot be seen by the naked eye. In fact they are so small that over one million would fit onto a pinhead. Bugs are found practically everywhere in nature, including the skin, the gills and in the gut of the fish.

Whilst the fish is alive, its natural defence mechanisms prevent the invasion of these bugs into the fish tissues. So the bugs feed, grow and multiply on the surface of the fish without causing any damage. In fact many of these bugs are useful to the fish. For example, bugs in the gut help the fish to breakdown its food.

It is when the surface of the fish is damaged that the problems begin. Bugs invade the flesh, and start the process of decay. Similar problems occur when the fish dies.

Before we move on to a closer look at fish spoilage let's see how much you have understood about enzymes and bacteria. Try the following two SAQ's.

SAQ8

Tick which of the following statements best describes the nature and function of **enzymes**?

a) They are living organisms which cause spoilage in fish.

b) They occur only in living tissues and cause spoilage of the fish.

c) They are proteins which accelerate chemical changes in the fish tissues.

d) They are found in the gut and help to produce energy.

? SAQ12

Mark the following sentences as **true** or **false.**

a) Bacteria are not found in the tissues of live fish.
true/false

b) Bacteria are so small that they cannot usually be seen without the aid of a microscope.
true/false

c) Bacteria found in fish cause it no harm.
true/false

d) If the surface of the fish is cut, bacteria can enter the tissues and cause decay.
true/false

HOW DO FISH SPOIL?

When the fish dies a whole series of irreversible changes begin. These changes result from a complicated series of breakdowns in the tissues.

Autolysis

Major changes are caused by the action of enzymes in the tissues, especially the digestive juices of the fish. The process is a form of **'self-digestion'** and is known as **autolysis.**

The end products of autolysis produce changes in flavour, texture and appearance of the flesh. The **flavour** of the fresh fish changes rapidly from a sweet, meaty flavour to a rather bitter, unpleasant flavour, and the fish spoils.

The **texture** of the fish changes dramatically within a few hours of death. The muscles harden and the fish becomes quite stiff. This stiffening is known as **rigor mortis** and is caused by **autolytic changes** in the muscles. The fish may remain rigid for periods of several hours to several days. Then the muscles begin to soften again, as further **enzymic changes** take place. In rigor, the fish may distort and begin to bend.

⚠
Rough handling at this stage, such as forcible straightening of the fish, must be avoided.

Bad treatment can lead to texture damage when the fish is filleted.

⚠
Filleting of fish pre-rigor or in rigor should also be avoided.

Once the fillet is removed from the bone, the fillet will shrink without a skeleton to support it.

The **appearance** of fish changes dramatically as the fish spoils. Changes can be observed in the appearance of the eyes, gills and skin. These changes may be used to estimate the quality of a sample of fish (see Segment Four).

Bacterial Spoilage

Many of these changes in flavour, texture and appearance may also be due to **bacterial spoilage**.

As we saw earlier, bacteria from the surface, gills and guts of the fish invade the tissues after death. These bugs 'feed' on the tissues breaking them down with enzymes from the bugs themselves. The bugs grow and multiply during storage of the fish.

- As they increase in numbers they produce a thick **slime** on the skin and gills of the fish.
- **Unpleasant odours** are also produced, often with a strong smell of **ammonia.**
- The flesh becomes softened and in ungutted fish, the gut wall eventually bursts.

This process of breakdown of dead tissues by bacteria, is known as **putrefaction.**

Chemical Changes

One final series of changes that can occur during spoilage is due to **chemical changes not involving enzymes.**

These chemical changes involve oxygen from the air and fat in the fish. In fatty fish such as herring or mackerel, these chemical changes produce **rancid odours and flavours.** Oxidation (rancidity) of fat is a major problem when fish is stored for long periods, even under frozen conditions.

? SAQ16
In what ways does gutting help and improve the quality of many types of fish?

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SAQ20

Standards for fish working premises recommend that 'all working surfaces should be made from materials which do not soak up water and which can easily be cleaned.' What problems with fish quality might you expect to occur, if this simple rule is not carried out?

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HOW CAN FISH BE KEPT FRESH?

Spoilage begins as soon as the fish is caught. Freshness is soon lost. However, both bacterial and autolytic spoilage occur most at certain temperatures. For example, the bacteria and enzymes in fish from cold waters, are adapted to sea temperatures of between 5°C – 10°C. A reduction in fish temperature below this will reduce the rate of spoilage. The control of spoilage by reduction of temperature offers the most common and practical way of keeping fish fresh.

The lower the temperature the longer the fish will take to spoil.

Two methods of lowering temperature that are used by fish processors are:

- **Chilling** – the fish are held at a temperature as close to 0°C as possible **(but not below)**. Chilling should be regarded as a short term storage method. However, it can increase the storage life of some fish by between 14 – 21 days.

- **Freezing** – the temperature of the fish is reduced so that the water in the fish freezes. Usually temperatures of between –30°C to –18°C are used to store frozen fish. This enables the fish to be kept in good condition for much longer periods than chilling. (Freezing of fish is the subject of a separate module in this series).

? SAQ1

Which of the temperature histories, shown below, will result in the best quality fish reaching the consumer?

	(a)	(b)	(c)	(d)
Landing	0°C	0°C	0°C	0°C
Sale	5°C	0°C	1°C	0°C
Transport to processors	0°C	0°C	3°C	0°C
Filleting	10°C	0°C	4°C	0°C
Storage	0°C	0°C	5°C	5°C
			CONSUMER	

SUMMARY

- Changes in the fish due to spoilage are additive.
- Quality, once lost, cannot be regained.
- Temperature rises should be avoided as much as possible when handling fish.
- Chilling and freezing maintains quality if carried out correctly.

Well that brings us to the end of this segment. I hope that you have found it interesting and informative.

You have now achieved Objective 1 given on page xiii.

If you have found any of the sections difficult, read them again, before starting the next segment.