

## **Segment Two**

### **Preservative Action by Salting and Smoking**



# Segment Two – Preservative Action by Salting and Smoking

## INTRODUCTION

The preservative action on fish due to these processes involves:

- The removal of water;
- The addition of salt;
- The addition of other chemicals from the smoke.

Remember that, as well as slowing down the rate of spoilage, the salting and smoking processes are primarily carried out to change the:

- flavour;
- texture;
- appearance;

of the fish products.

These changes have been carried out in response to consumer demand for those types of product.

## AIMS OF THE SEGMENT

The main aim of this segment is to help you to achieve objective 2 given on page xiii.

When you have completed this segment you should be able to:

- State the effects of adding salt to fish;
- State how high temperatures used in hot smoking help to preserve fish;
- List ways of killing bacteria through the smoking process.

## WATER CONTENT

Any process which reduces the water content of fish must have an important preservative effect. A reduction in the water content means that there is less water available for:

- taking part in chemical spoilage reactions;
- use by bacteria.

As the water content is reduced, however, the remaining water becomes more difficult to remove. Therefore some water is still available and some spoilage will still take place.

The term **Water Activity** is used to describe how much water has remained in the fish and therefore how well the fish has been preserved. Low water content means low water activity.

However figure 1 shows that it is necessary to reduce the original water content to below 40% in order to have any real effect on reducing water activity.

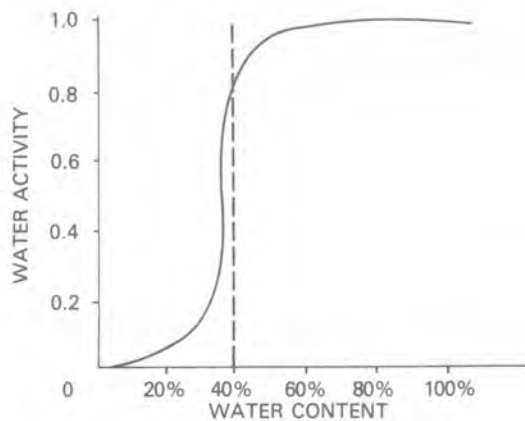


Figure 1 Variation of Water Activity with Water Content

## THE ACTION OF SALT

The main reason for introducing salt into the fish before smoking is to improve the **flavour** and the **texture**.

Nevertheless there is also a preservative effect because, when dry salt is introduced on to the fish, there is a reduction in water content. The reduction occurs because the salt draws out the water which is then lost partly due to evaporation but mainly because it drips away.

This is a two way process and, as the water is drawn out of the fish, the salt is absorbed into the flesh. Provided that the concentration of salt in the fish is sufficient it will prevent the growth of food poisoning bacteria. The salt combines readily with the water in the flesh. This water is not then available for the bacteria to use and their activity is reduced.

Both dry salting and brining may be considered as processes which prepare the fish for smoking.

### **Dry Salting**

An effective way of reducing the water content is to sprinkle or rub salt on to the surface of the fish. The main use of dry salting in the UK smoking industry is in the preparation of smoked salmon products.

### **Brining**

Brine is a liquid consisting of water and common salt mixed together so that the salt is dissolved. The main purpose of immersing fish in a brine solution is to improve the flavour. However, if a very strong brine solution is used, then this results in the fish having a higher salt content and a lower water content and a similar effect to dry salting has occurred.

An attractive appearance is largely due to the effect of the brine solution. The reaction of the surface flesh with the salt leaves a glossy skin on the fish. In addition artificial colouring can be added during the process.

A brining process is commonly used in the UK smoking industry and, together with dry salting, is dealt with more fully in Segment Four.

## **THE ACTION OF SMOKING**

As we have already seen the preservation of fish depends, to a large extent, on the reduction of the water content.

The smoking process is effective in reducing the water by evaporation.

This occurs due to:

- The movement of the gases in the smoke over the surface of the fish;
- Raising the temperature of the fish.

### Drying Rate

The speed at which water is lost from the fish is called the **drying rate**. This occurs in two distinct stages:

- **A constant drying rate** — This is the speed at which water is lost from the surface of the fish. It will increase as the velocity of the air over the surface of the fish increases.
- **A falling drying rate** — This rate depends upon the speed at which water can move to the surface from within the flesh. How quickly this happens will depend upon:
  - the nature of the fish flesh;
  - the thickness of the flesh;
  - the temperature (The water will move to the surface more rapidly as the temperature increases).

The falling drying rate is not reached in the normal smoking of white fish. This is in order to keep the weight loss low.



It is important to keep a check on the **humidity** of the air in the kiln.

A given volume of air can only hold a limited amount of water at a given temperature.

If the air passing over the fish reaches the maximum amount of water that it can hold then the drying rate will rapidly fall away.

### Chemicals in the Smoke

We noted, in Segment One, that it was also important to:

- Reduce the activity of the bacteria;
- Reduce oxidation of the fat.

Both of these are necessary to reduce the rate of spoilage. If you are in doubt about this read Segment One again.

An important effect of the smoking process is to deposit chemicals, which exist in the form of vapours in the smoke, on to the fish.

The most important chemicals are:

- Phenols;
- Formaldehyde.

The action of these chemicals on the bacteria causes some to be killed and the general level of activity of others to be reduced.

In addition the smoking process results in the penetration of the chemicals into the fish and a loss of water from the flesh. A layer is formed which reduces the effect of oxygen that enters the fish from the surrounding air. Therefore the rancidity of the fat is reduced. This layer is called the **barrier layer**.

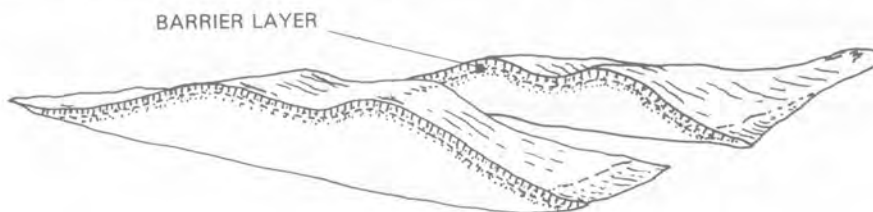


Figure 2 Barrier Layer in a Fish Fillet

Next we shall look at the brief description of hot and cold smoking. Both of these processes are described more fully in Segment Four.

### Hot Smoking

This is a process in which the fish is exposed to increasing temperatures up to at least 70°C.

These high temperatures will have the following effects:

- The fish will be cooked ;
- Enzymes will be destroyed and chemical spoilage will be reduced;
- Water content will be reduced due to evaporation;
- Surface bacteria will be killed.

### Cold Smoking

This process is carried out at a temperature up to 30°C so that cooking of the fish does not occur.

The reduction in water content is not significant in preserving the fish. The preservative effect is mainly due to the smoke chemicals killing off the surface bacteria.

The result is a less dry product and is often preferred.

There are exceptions to this such as herring prepared for some overseas markets. In these cases the fish is cold smoked for a long period and the finished product is very dry.



Care should be taken to prevent the outer layers of the fish becoming hard in the early part of the process. This is called **case hardening** and is possible if the surface water content is reduced too quickly.

The case hardened layer prevents:

- The intake of chemicals from the smoking;
- The evaporation of the water present in the inner layers of the flesh.

**The preservative effect of the process is greatly reduced.**

Now try the following SAQs:

#### SAQ27

Which, if any, of the following are responsible for killing bacteria in the smoking process?

Tick the items that you think are responsible:

1. A high temperature;
2. The removal of water;
3. Chemicals in the smoke.



**?** SAQ32

State three effects on the fish of the high temperature used in a hot smoking process.

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**?** SAQ37

Why is it important to keep cold smoking temperatures below 30°C ?

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**?** SAQ2

What are the main preservative effects of adding salt into the fish?

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Now a final SAQ for you to attempt in this segment.

**?** SAQ8

How can immersing fish in a brine solution improve its appearance?

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## SUMMARY

This segment has described how the salting and smoking processes produce the following changes in the fish:

- The water content is reduced;
- Water combines with the salt in the flesh of the fish resulting in less water available for the bacteria;
- Bacteria are reduced both in numbers and in activity;
- Enzymes are destroyed at temperatures above 40°C.

In addition, immersing fish in a brine solution prior to smoking greatly improves the flavour.

You have now completed segment two and achieved objective 2 given on page xiii.

Time for a break?