Segment Two – Methods of Chilling Fish

INTRODUCTION

In segment one you learnt that chilling is used to slow down fish spoilage and extend shelf life. I hope you remember that, for the best results, chilling must be carried out as quickly as possible and in a way that does not damage the fish.

In this segment we are going to look at different methods of cooling fish and why some methods are used more often than others.

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 finished this segment you should be able to:

- Recognise why ice is so widely used as a means of cooling fish;
- Identify how much ice is needed to cool a given weight of fish;
- Explain the disadvantages of chilling fish in cold air;
- State the differences between chilled seawater and refrigerated seawater and their application to chilling fish;
- Explain super chilling and its application to chilling of fish;
- Choose the most suitable method of chilling fish for different situations.

ICE

To chill fish we must surround them with materials which are colder than the fish itself. Ice is the most popular cooling material but cold air and cold water can also be used. If we are to use these materials properly, we need to understand how they work.

Let's look firstly at **ice,** which has often been called the **ideal cooling medium.**

Ice is a portable cooling system. It can be moved around from one place to another. It is formed when water freezes, at temperatures of 0°C.

For freezing to occur, large amounts of heat have to be removed from the water. This is removed by a refrigeration system. Before the ice is able to melt, this same amount of heat must be added back to the ice. This is a big advantage when using ice to cool fish.

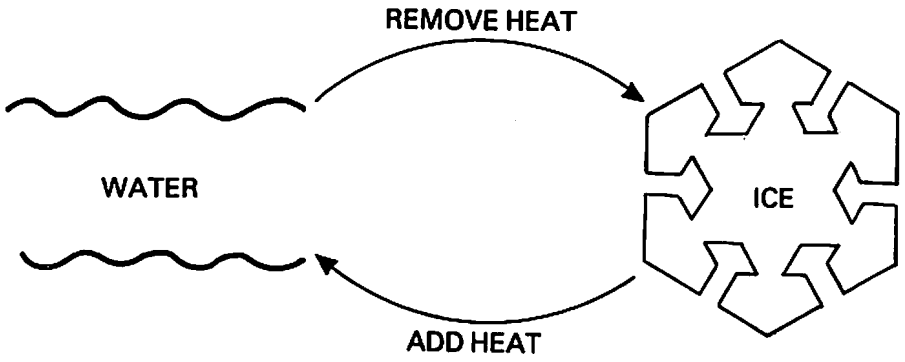

Figure 1.

Since ice will absorb large amounts of heat when it melts, it is said to have a **large cooling capacity** and so it can cool fish rapidly, if used correctly.

Just as water freezes at 0°C, ice will melt at a constant temperature of 0°C when heat is added to it. Thus melting ice, if present in sufficient amounts, will maintain fish at a temperature of 0°C. By the way, fish begin to freeze when the temperature is below 0°C, usually between –1°C to –2°C. **So fish in melting ice will never freeze.** This is important since freezing can affect the quality of the fish, unless it is carried out under very carefully controlled conditions.

Another advantage of ice is that the melt water, formed from the melting ice, flows over the fish and helps to keep the fish looking moist and shiny.

Now let's check if you have understood why ice is such a useful material for cooling fish.

? SAQ5

Which of the following do you think are good reasons for using ice to cool fish? Just tick **yes** or **no** as appropriate.

a) Ice can cool fish quickly when used correctly. yes/no

b) Ice is harmless to the fish. yes/no

c) Ice keeps the fish moist and shiny. yes/no

d) Ice will not freeze the fish. yes/no

e) Ice is a portable chilling system and is easily transported from one place to another. yes/no

f) Ice has a large cooling capacity. yes/no

So how much ice do I need to cool fish properly?

The quantity of heat to be removed from the fish will set how much ice is needed. Both depend on:

- The weight of fish to be cooled;
- The temperature of the fish at the start of chilling;

- The length of time the fish are required to be kept chilled;
- How much the fish and ice are protected from outside heat sources.

It is possible to calculate how much ice is required to chill fish, but in practice a rough guide is to use at least **1 part ice:1 part fish by weight** for the initial chilling. Extra ice can then be added as needed. It is good practice to always have some ice present at all stages of storage and distribution.

Now try this SAQ as a check that you understand how much ice you would need to use in practice.

? SAQ9

You have 250kg of ice available. Using the rough guide given above which of the following alternatives would be possible? Just tick the boxes beside the correct ones for both (i) and (ii).

(i) Which of the following weights of fish could you cool down to 0°C?

a) 100 kg ☐
b) 200 kg ☐
c) 250 kg ☐
d) 500 kg ☐

(ii) Which, if any, of the following weights of fish could you store at 0°C for 7 days?

a) 100 kg ☐
b) 200 kg ☐
c) 250 kg ☐
d) 500 kg ☐

COLD AIR

An alternative cooling agent to ice is chilled (refrigerated) air. Cold air passed over the surface of a fish will rapidly cool it.

In a chill room, heat from the fish will warm the air around it. The warm air rises and is cooled by the refrigeration system. This cold air then falls or is blown by fans, back to the fish surface.

Good circulation of air is necessary to maintain uniform temperatures in the fish in store.

Unfortunately 10,000 times less heat is required to warm a given volume of air from 0 to 0.5°C, than the same volume of crushed ice. Thus, compared with ice, large refrigeration systems and larger volumes of air are needed to cool a given weight of fish. Cooling with cold air is therefore generally more inefficient and more expensive than cooling with ice.

Now try this SAQ.

? SAQ13

Tick which of the phrases below correctly complete the sentence:

"Passing refrigerated air over fish in a chill room is a less efficient method of chilling than using ice because .....

a) A given volume of ice absorbs more heat than the same volume of air.

b) The air has to be circulated around the store.

c) The air only cools the fish containers.

d) Air has to be chilled before use.

Fish that are cooled in cold air soon become dry. This is because the air removes moisture from the fish surface causing loss of weight and loss of eating quality. The water travels with the air to the cooling coils where it is deposited as ice (frost). This can interfere with the cooling of the air, as it acts as an insulating layer. **The evaporator must be regularly defrosted to prevent this.**

Fish stacked high up in the chill room, close to the evaporator, will receive the coldest air. If the average store temperature is set at 1°C, the air temperature at the evaporator will be less than 0°C and the fish here may freeze.

Often chill rooms are used together with ice, which helps to slow down the speed at which the ice melts. It is important to remember that, for ice to cool effectively, it must be allowed to melt and the chill room temperature should not fall below 2°C to 3°C.

? SAQ17

Cold air can be used for cooling fish, but which of the following problems might you expect to occur with batches of fish stored in this way? Indicate **yes** or **no** as appropriate.

a)	Loss of weight	yes/no
b)	Loss of eating quality	yes/no
c)	Uneven fish temperatures	yes/no
d)	Prolonged cooling time	yes/no

CHILLED AND REFRIGERATED SEAWATER

The immersion of fish in chilled seawater cooled by the addition of ice (CSW) or by mechanical refrigeration (RSW) can provide an alternative method of icing.

This chilling method is particularly useful for cooling large numbers of small fish at one time. It is sometimes used on board fishing boats fishing for pelagic fish such as herring, mackerel and sardine.

? SAQ2

Use words from below to fill in the blank spaces.

..... is produced by chilling seawater by the addition of ice.

..... is produced by chilling seawater by the use of a mechanical refrigeration system.

Chilled seawater
Ice
Cold air
Refrigerated seawater

Ice, of course, can be produced from seawater, but only by freezing, not just chilling.

Icing of large numbers of small fish is slow and difficult to carry out properly. RSW and CSW provide a method which give:

- More rapid cooling;
- Less risk of damage to the fish during storage;
- Easy washing and bleeding of the fish in the seawater tanks.

A major disadvantage of RSW/CSW cooling is the salty flavour that results from absorption of salt from the seawater.

The increase in salt content of the fish also reduces the storage life of the fatty fish types, compared with ice.

SAQ6

Which cooling method is best for rapid, on-board chilling of large catches of pelagic fish?

.....

CHILLING

This is a chilling technique in which the temperature of the fish is reduced so that about **half the water** in the fish is frozen. This occurs between –2°C and –3°C and results in the shelf life of the fish being extended by **over 50%**. This extension of shelf life is mainly due to the lower temperature slowing down of the growth of bacteria on the fish.

Superchilling is sometimes used on board fishing boats to enable longer trips between landings. The chilling is carried out by cooling firstly in ice and then by cooling to below 0°C using cold air in a chill room.

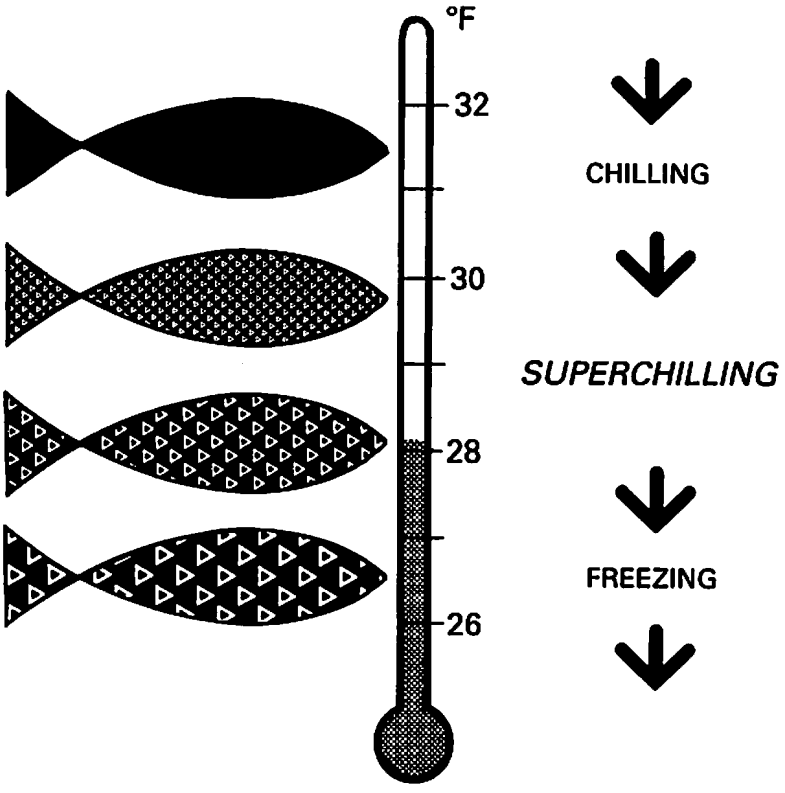

Figure 2: Chilling

Quality problems can occur if the temperature is not carefully controlled. Below –3°C more water will freeze in the fish and the texture will be affected. Because of this problem superchilling is not often used.

? SAQ10

Fill in the space from the alternatives given below.

"Superchilling requires fish to be cooled to ..... °C

a) 0°C
b) –2°C to –3°C
c) 10°C

SUMMARY

This segment has described the following methods of cooling fish:

- Use of ice;
- Use of cold air;
- Chilling and Superchilling. (including the use of seawater.)

I hope that you have found it instructive. You should now have a better understanding of the principles of different methods of cooling fish.

You have now completed Segment Two and achieved Objective 2 given on page xiii. Well done! Time for a break?