



FDE208 HEAT TRANSFER AND THERMAL PROCESSES



- Since storage of foods under cold conditions or by freezing makes the food preserve its freshness and nutritional value for a longer time period, they are quite important for both consumers and suppliers.
- The main scopes of cooling are the preservation of foods and to increase their storage time with higher nutritional value. The application of cold decreases or partly stops the enzymatic and microbial activities within the food itself and by this way increases their storage time.

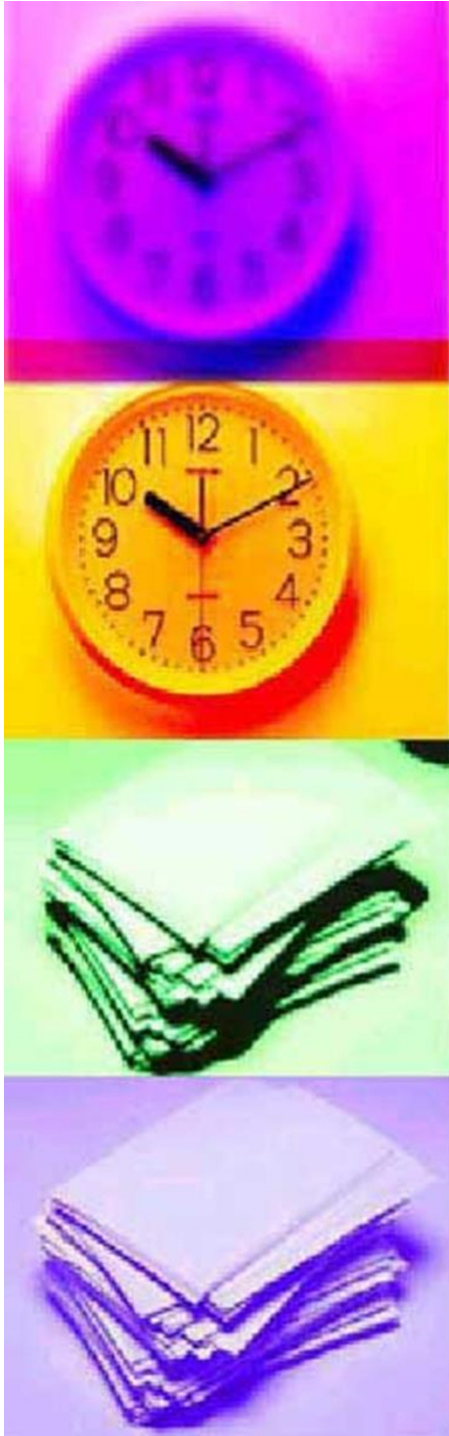
THE MAIN REASONS OF FOOD SPOILAGE AND PRESERVATION TECHNIQUES

- The reasons of food spoilage can be classified in three main groups. The first group is the **microbiological reasons**. This kind of spoilage is observed due to reproduction of microorganism in food. It is quite important for human health. The second group is the **biochemical reasons** (it can also be called as enzymatic degradation). It is not effective on human health. Finally the third group is the **chemical and physical reasons**.





- **Microbiological reasons:** The bacteria, fungi and molds are the main microbiological spoilage reasons. These microorganisms can infect food from anywhere. A healthy vegetable or fruit do not contain any microorganism in their structure but they can be found on the skin of vegetables and fruits. These microorganisms, held on to the skin of food, reproduce within time and produce some metabolites, acids, pigments and so on. Because of these reactions, the colour and taste of food change in an irreversible manner.



- **Biochemical reasons:** In alive tissues the enzymes working can be controlled, they work for the benefit of their host. But when the tissue dies (fruit or vegetable fragmented, meat cut) it is not possible to control their activity.

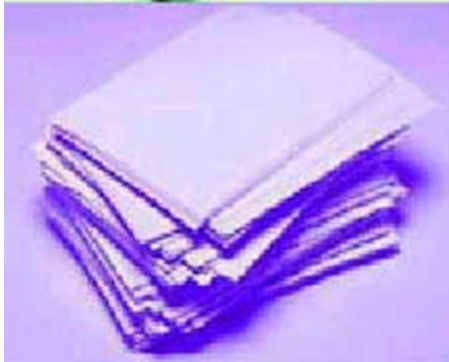


- **Chemical and physical reasons:** Some different components found in foods react with each other due to time-temperature relation. Light and oxygen makes these reactions faster.

Chilling and freezing as a food preservation technique

- The major concern is to prevent microbial spoilage completely. In case of biochemical, chemical and physical changes, the main aim is to keep them in minimum degree.





- Both chilling and freezing slows down the spoilage process with different rates
- **Freezing** slows down the spoilage process by changing some essential water into ice, a form that the bacteria cannot use.



- The storage of foods under cold conditions has tremendous advantages in terms of both suppliers and consumers. The main scope of cold technique is to provide the storage of food for a longer time period without losing their nutritional value and sensory characteristics. The applied cooling or freezing decreases the enzymatic and microbial activity.



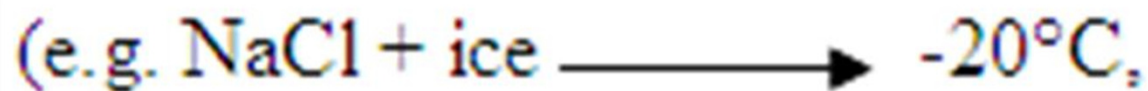
How to obtain cold?

There are three basic ways for the obtainment of cold.

- Mixing materials
- Expansion of compressed gases
- Evaporation of liquids



- **Mixing materials:** Whenever, you mix some materials which are at room temperature, due to specific endothermic reaction between them, they absorb the heat around and cause the decrement of temperature





- **Expansion of compressed gases:** As the temperature of gases which are compressed increases, whenever you cause the expansion of these compressed gases, their temperature will decrease similarly. ($PV=nRT$)

This technique is frequently used nowadays in cooling technology.



- **Evaporation of liquids:** As all we know liquids absorb heat from their surroundings during evaporation. This technique is based on this principle. For application, the liquids with a high evaporation temperature were preferred to be used such as NH_3 , CO_2 , Freon, Methyl chloride.

CHILLING and COLD STORAGE OF FOODS

- Cold storage of foods means keeping food at a certain temperature which is its freezing point minimum.
- When we consider all foods to be stored the range of this storage temperature is mostly between -1 and 8°C .

e.g. between -1 and 1°C : fresh fish, meat, sausages, smoked meat and fish, garlic, onion

between 0 and 5°C : milk, cream, yoghurt, pizza, pasta, batter and some fruits and vegetables

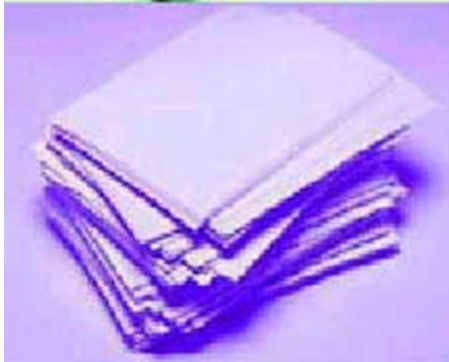
between 0 and 8°C : cheese, most of fruits and vegetables

(but some tropical fruits should be stored above 8°C)





- The industrial application of chilling and cold storage is cold storage rooms.



The facts that should be considered while planning cold storage rooms

In order to have a good project for designing a cold storage room some basic factors should be considered;

- Optimizing the moisture loss in the product
- Good insulation
- Controlling the temperature of the room
- Arrangement of the charge of the room
- Maintaining the required heat removal



- The moisture loss causes some unwanted situations and reactions such as shrinkage, colour change, fat oxidation and protein denaturation.
- Similarly temperature waving in the room may cause damages on the product so providing constant temperature during storage is critical.



- In cold storage controlling heat flow has also a great importance. For example the air at -20°C can hold three times more moisture than the air at -30°C . This shows us that fluctuation of air temperature may cause drying of product. So the inlet and outlet of everything to the room should be under control.
- Mostly storage of frozen and unfrozen food together may lead to unwanted results.



By considering all these, the most important factors which should be taken into account while preparing the project are:

- low, homogeneous and constant temperature
- good air circulation
- minimum heat inlet to the room from the outside