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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARMENT OF BIOTECHNOLOGY

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Preservation by low temperature

The use of low temperatures to preserve foods is based upon the fact that the activities of food-borne microorganisms and enzyme reactions can be slowed down and/or stopped at temperatures above freezing and generally stopped at subfreezing temperatures. Low temperature can be produced by:

1.Refrigeration or chilling

2.Freezing

1. Preservation of food by CHILLING

1.1 Chilling:

- Preservation of foods at temperatures above freezing and below 15ºC is known as refrigeration or chilling.
- It is used to reduce the rate of biochemical and microbiological changes and hence to extend shelf life of fresh and processed foods.
- It causes minimal changes to sensory characteristics and nutritional properties of foods.

Chilling retards:

- Growth of microorganisms.
- Postharvest and post slaughter metabolic activities of plant and animal tissues respectively.
- Deteriorative chemical reactions, including enzyme-catalyzed oxidative browning or oxidation of lipids and chemical changes associated with color degradation, autolysis of fish and loss of nutritive value of foods.
- Moisture loss.

Categories of chilled food:

According to storage temperature range:

- -1ºC to 1ºC (fresh fish, meats, sausages, smoked meat and ground meat).
- 0ºC to 5ºC (pasteurized milk, canned meat, cream, yoghurt, salad, sandwiches, baked foods, soups and sauces).
- 0ºC to 8ºC (Soft fruits and fruit juices, cooked rice, hard cheese and butter) Fellows, (2000)

Chilling equipments:

- Mechanical refrigerators: This have four basic elements: an evaporator, a compressor, a condenser and an expansion valve. A refrigerant circulates between the four elements of the refrigerator, changing state from liquid to gas and back to liquid.
- Cryogenic systems: Cryogenic chillers use solid carbon dioxide, liquid carbon dioxide and liquid nitrogen. Solid carbon dioxide removes latent heat of sublimation and liquid cryogens remove latent heat of vaporisation.

Effect on foods:

- The most significant effect of chilling on the sensory characteristics of processed foods is hardening due to solidification of fats and oils.
- Other effects include enzymatic browning, lipolysis, colour and flavour deterioration and retrogradation of starch to cause staling of bread, protein denaturation, vitamin degradation.

Desirable consequences of chilling temperature:

- Growth of mesophilic and thermophilic microbes is greatly retarded at chilling temperature. Psychrotrophic microorganism, of course, grow well in the range of 0ºC to 15ºC but is much slower in this range.

- Rate of respiration and ripening usually declines as the temperature is reduced below 4ºC in case of climacteric fruits.

Undesirable consequences of chilling temperature

- Cold shortening: Animal muscle which is exposed immediately after slaughter can undergo a detrimental occurrence known as cold shortening if it is promptly cooled to a temperature range of 0ºC to 5ºC.
- Chilling injury: A substantial number of fruits and vegetables especially those of tropical or subtropical origin, develop a physiological disorder when exposed to temperature but above freezing temperature

1.2 Superchilling

Superchilling is one of the methods that can be used to maintain food products at a low temperature. Generally, superchilling is positioned between freezing and refrigeration (conventional chilling), where the surrounding temperature is set below the initial freezing point. It is a process by which the temperature of a food product is lowered to -1 to -4 °C, by means of slurry ice or in superchilled chambers without ice.

Superchilling is that where temperature of food is maintained below 0°C but ice crystals are not generated. Superchilling is defined as a technology where food is stored just below the initial freezing temperature.

Quality aspects in relation to superchilling technology

- Storage of cold-smoked salmon at -2 °C for 14 days did not have any serious consequences on the quality compared to controls (absence of superchilling).
- During superchilled storage of kuruma prawn, the brightness of tail colour could be retained compared to traditional refrigeration.
- Drip loss was found to be lower in superchilled samples than in chilled samples both in cod and salmon fillets as well as in pork roasts.