

# Freezing in Food Processing and Preservation

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Over time, yeasts, molds, bacteria and other forces cause food to spoil, making it foul-tasting, less nutritious and potentially unsafe to eat. Preservation allows people to ship foods over greater distances, stock them in stores longer and enjoy them for a greater part of the year with more nutrients intact. Processing can also help to inhibit or destroy pathogens (disease-causing organisms) that may contaminate food. Preservation techniques such as refrigeration, fermentation, dehydration and the use of salt, sugar or chemical preservatives can slow or stop the growth of pathogens. Heat processes, such as pasteurization and cooking, are used to destroy them. Although industries use food processing techniques to reduce food safety risks. Modern methods include canning, pasteurization, freezing, irradiation and the addition of chemicals. Advances in packaging materials have played an important role in modern food preservation.

## Freezing

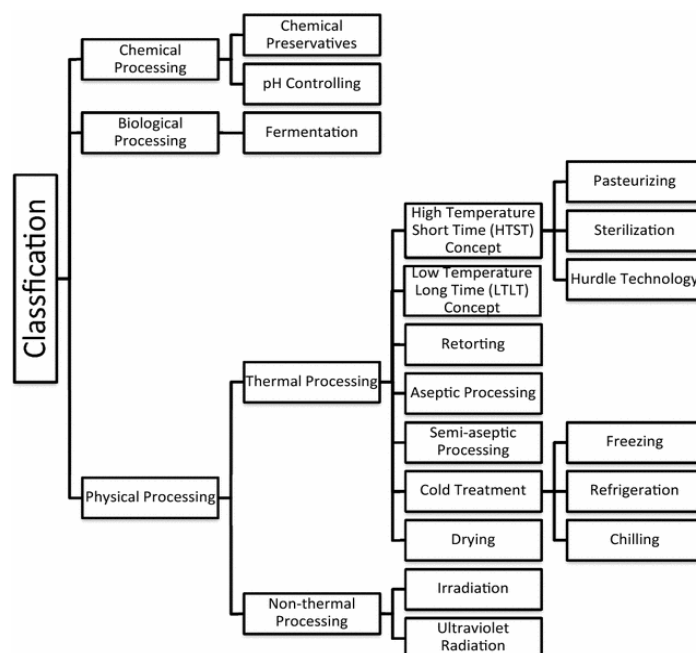
Freezing is a food preservation process that involves reducing the temperature of food to below its freezing point, which is the point when the product's qualities change and it converts into ice, solidifying all of the water or moisture it contains. This temperature range often lies between  $-18^{\circ}\text{C}$  and  $-35^{\circ}\text{C}$ , however it really depends on the kind of product that has to be frozen. It aims to completely eradicate any bacterial or microorganism activity from the food without drastically changing its nutritional value or causing it to deteriorate. Furthermore, freezing significantly reduces enzymatic and chemical activity, such as food oxidation.

Freezing retains the quality of agricultural products over long storage periods. It is generally believed that this method of long-term fruit and vegetable preservation retains more of the fruits' sensory qualities and nutritional value than canning or dehydrating. The safety and nutrition quality of frozen products are emphasized when high quality raw materials are used, good manufacturing practices are employed in the preservation process and the products are kept under specified temperatures.

## Need for freezing and frozen storage

Freezing has been successfully employed for the long-term preservation of many foods, providing

a significantly extended shelf life. Usually,  $-18^{\circ}\text{C}$  or below is the lowest temperature at which the product is lowered during the procedure. When energy is taken out by cooling food material below the freezing temperature, the substance's physical state is altered. Severe cold interferes with the development of bacteria and declines chemical changes that impact food quality or lead to spoilage. In the context of insufficient food processing technology, industrial freezing remains the most effective way to maintain food quality over extended periods of storage. In terms of cost, energy consumption, and product quality, freezing has the lowest processing time requirements.



**Fig. 1: Classification of food preservation and processing methods**

The main requirements that are met when freezing food raw materials and products are formulated as follows:

1. Cooling media (solid, liquid and gas) should not have a harmful effect on a frozen product.
2. Heat from a product should be removed simultaneously from all sides.
3. Freezing rate should satisfy the conditions of the best preservation of product quality and the best conditions of exploitation.
4. Freezers in use should be simple and reliable in exploitation.

Food raw material and product freezing can be carried out by different methods according to a refrigerant type:

1. by air - slow (quick), intensive and fast;
2. by a liquid phase (brine) - contact and non-contact (between cooled metal plates);
3. in contact with gas cooling agent having low boiling temperature.

#### Role of Freezing in Food Processing and Preservation

1. **Inhibition of Microbial Growth:** Freezing slows down or halts the growth of microorganisms such as bacteria, yeasts and molds, which are responsible for food spoilage and foodborne illnesses.
2. **Enzyme Activity Reduction:** Freezing reduces the activity of enzymes that can cause spoilage and degradation of food quality. However, some enzymes can remain active even at low temperatures, so blanching (a quick heat treatment) is often used prior to freezing to inactivate these enzymes.
3. **Nutrient Retention:** Freezing preserves the nutritional value of food by minimizing nutrient loss that can occur through other preservation methods such as canning or drying.
4. **Flavor and Texture Preservation:** Proper freezing techniques help maintain the original flavor, texture and color of foods, making them more appealing when thawed and prepared.

#### Benefits of Freezing

- **Longer Shelf Life:** Foods can be stored for extended periods, ranging from months to even years, without significant loss of quality.
- **Convenience:** Pre-frozen foods are often more convenient for consumers, allowing for quick meal preparation.
- **Reduced Waste:** Freezing helps in reducing food waste by allowing excess produce to be stored and used later.
- **Food Safety:** Freezing can make some food products safer by killing parasites and reducing the levels of harmful microorganisms.

#### Methods of Freezing

1. **Air Freezing:** This involves exposing food to cold air, either in still air or with fans to circulate the air (blast freezing). It's commonly used for a variety of foods including fruits, vegetables and meats.

2. **Cryogenic Freezing:** Involves the use of extremely low-temperature substances, such as liquid nitrogen or carbon dioxide, to freeze food rapidly. This method is particularly effective for preserving the texture and quality of high-value products like seafood and ready-to-eat meals.
3. **Plate Freezing:** Food is placed between cold metal plates that rapidly conduct heat away from the food, freezing it quickly. This method is commonly used for flat, packaged items like fish fillets and burger patties.
4. **Immersion Freezing:** Food is immersed in a freezing liquid, such as brine or a glycol solution. This method is effective for irregularly shaped items and ensures even freezing.
5. **Flash Freezing:** A quick-freezing process that minimizes the formation of ice crystals, preserving the texture and quality of food. Often used for individually quick frozen (IQF) products like berries and shrimp.

#### Complications

- **Freezer Burn:** Improper packaging or extended storage can lead to freezer burn, where dehydration and oxidation occur, affecting the food's quality.
- **Thawing:** Proper thawing methods are crucial to prevent the growth of microorganisms. Thawing in the refrigerator, cold water or microwave are common methods.
- **Energy Consumption:** Freezing and maintaining frozen storage require significant energy, making it important to optimize freezing methods and storage conditions to reduce energy costs.

#### Applications

- **Meat and Seafood:** Maintains quality and safety by preventing microbial growth.
- **Fruits and Vegetables:** Preserves freshness, nutritional value and sensory attributes.
- **Prepared Foods:** Allows for the production of convenient, ready-to-eat meals.
- **Dairy Products:** Used for items like ice cream and frozen yogurt, though care must be taken to prevent texture changes.

#### Conclusion

Freezing plays a critical role in food processing and preservation, offering numerous benefits such as extending shelf life, maintaining nutritional value and preserving flavor and texture. By inhibiting microbial growth and reducing enzyme activity, freezing

effectively prevents spoilage and foodborne illnesses. Despite challenges like freezer burn and energy consumption, proper freezing techniques and storage conditions can mitigate these issues, making freezing a reliable and efficient method for preserving a wide range of food products. In conclusion, freezing is a cornerstone of modern food preservation, essential for maintaining the quality, safety and convenience of the food supply.

### Reference

Amit, Sadat & Uddin, Md & Rahman, Rizwanur & Islam, S M Rezwanul & Khan, Mohidus Samad. (2017). A review on mechanisms and commercial aspects of food preservation and processing. Agriculture & Food Security. 6. 10.1186/s40066-017-0130-8.

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