AUCTORES
Globalize your Research

Journal of Nutrition and Food Processing

Mahendra Pal*

Open Access

Research Article

Application of Cold for Food Preservation

Mahendra Pal [1]* and Vishwani [2]

[1]Narayan Consultancy of Veterinary Public Health, and Microbiology, B-103, Sapphire Lifestyle, Makatmapur Road, Bharuch - 392 012, Gujarat, India

[2]Flat No.1503, Tower No.5, Emaar Imperial Garden, Sector No.102, Gurugram, Haryana, India

Corresponding author: Mahendra Pal, Professor, Managing Director of Narayan Consultancy on Veterinary Public Health and Microbiology, B-103, Sapphire Lifestyle, Bharuch, Gujarat, India.

Received date: January 02, 2026; **Accepted date:** January 27, 2026; **Published date:** February 11, 2026

Citation: Mahendra Pal and Vishwani, (2026), Application of Cold for Food Preservation, *J. Nutrition and Food Processing,* 9(1); **DOI:**10.31579/2637-8914/352

Abstract:

The food either obtained from plants sources or from animals, is a rich source of several nutrients, which are required for human nutrition, but it can also serve as a substrate for the growth and multilocation of microbes, resulting into the spoilage of food and that's why preservation of food has been practiced since ancient times. The basic purpose of preservation is to create unfavorable conditions so that microbes may not grow to cause the spoilage of the food. Various methods, such as drying, canning, curing, smoking, irradiation, freezing, chilling/refrigeration, pressure processing, nanotechnology, and chemicals etc. are used to preserve different types of foods. The application of cold is one of the most effective and widely practiced methods of food preservation. Lowering the temperature of foods slows down microbial growth, enzymatic activity, and chemical reactions responsible for spoilage and deterioration. Cold preservation techniques, such as chilling, refrigeration, super chilling, and freezing are extensively used for preserving a variety of commodities, such as fruits, vegetables, meat, fish, dairy products, and processed foods. These methods help to extend shelf life, maintain nutritional, and sensory quality, and enhance food safety without the use of chemical preservatives.

Key words: cold; food; food safety; microorganisms; preservation; spoilage

Introduction

Food from plants (cereals, pulses, fruits, vegetables, nuts) and animals (milk, butter, cheese, meat, fish, egg) is indispensable for the survival of all living creatures on the universe. Microbes are widely prevalent in our environment and easily contaminate the food at any stage i.e. from farm to table/fork [1]. In order to prevent the spoilage of foods, the preservation of foods is practiced since the dawn of the history. Several methods, which curing, canning, heating, boiling, smoking, drying, pickling, irradiation, chilling/refrigeration, freezing, fermentation, pasteurization, pressure processing, hurdle technology, encapsulation, nanotechnology, and chemicals etc. are employed by the food industries/home/food establishments to preserve a variety of foods [2,1,3, 4,5, 6,7]. Recently, Sharma and others [8] described effect of plasma activated water (PAW) on fruits and vegetables. A wide variety of foods, such as milk, butter, cheese, yoghurt, powdered milk, rasgulla, burfi, fruits, vegetables, meat, fish, and egg are commonly preserved to keep them fresh [1,6,7]. Due to spoilage, the texture, flavour, and nutritive value of food is changed and thereby, rendering it inedible for human use. Therefore, it is highly imperative to adopt proper preservation method to keep the food fresh and safe [1]. In this context, Lisboa and co-workers [9] stated that food preservation is done to enhance food quality, safety, and environmental sustainability.

Food preservation plays a crucial role in maintaining food quality, reducing spoilage, and safeguarding public health [10]. Fresh foods are inherently perishable due to the activity of microorganisms, endogenous enzymes, and chemical reactions that result in undesirable changes in texture, flavor, color, and nutritional value. Without effective preservation methods, large quantities of food would be lost during storage, transportation, and distribution 1]. Among the various food preservation techniques, the application of cold is one of the oldest and most reliable methods used worldwide [11]. The widespread adoption of refrigeration and freezing in domestic kitchens, food industries, cold storage facilities, and global food supply chains highlights the central role of cold in modern food preservation systems. Cold preservation is considered a safe and consumer-acceptable method because it does not require chemical additives and helps retain the natural characteristics of foods [1]. It is mentioned that milk products, such as cheese, butter, rasgulla, burfi, khoa, yoghurt, and green vegetables are chilled or frozen in order to maintain their nutritional value, and sensory attributes [1].This article describes the principles of cold preservation, different cold-based preservation methods, their effects on microorganisms and food quality, advantages and limitations, and the overall importance of cold preservation in reducing post-harvest losses and ensuring food security.

Objectives of food preservation:

There are several objectives of preserving the food [1].

1.To prevent the spoilage of food

2.To enhance the keeping quality of food

3.To extend the shelf-life of food

4.To ensure the safety of food from microbes (bacteria, molds and yeasts)

5.To control the food-borne infections and intoxications

6.To decrease the financial losses

Principle of Cold Preservation

The basic principle of cold preservation is based on lowering the temperature of food to slow down biological, chemical, and enzymatic processes responsible for spoilage [2,1,6]. Microorganisms have an optimum temperature range for growth, and any deviation from this range results in reduced metabolic activity. Most spoilage and pathogenic microorganisms grow optimally between 20°C and 40°C, while growth is significantly reduced at temperatures below 10°C.

Enzymatic reactions involved in ripening, browning, and degradation of food components are also temperature-dependent. Cold storage reduces enzyme activity and slows down biochemical reactions [12]. In freezing, water present in food is converted into ice, reducing water availability for microbial growth and enzymatic reactions.

Methods of Cold Preservation

1.Chilling and Refrigeration

Chilling and refrigeration involve storing foods at temperatures between 0°C and 4°C. Refrigeration is the most commonly used method for short-term preservation of perishable foods such as fruits, vegetables, milk, cooked foods, and meat products [13]. At refrigeration temperatures, microbial growth and enzyme activity are slowed, thereby extending shelf life while preserving sensory and nutritional quality. However, refrigeration does not completely inhibit microbial growth. Certain psychrotrophic microorganisms, such as *Pseudomonas* spp., *Listeria monocytogenes*, *Yersinia enterocolitica*, are capable of growing at low temperatures, emphasizing the importance of proper hygiene and temperature control [2,1].

2.Super-chilling

Super-chilling is a preservation technique in which food is stored slightly below its initial freezing point, usually between –1°C and –2°C. This method results in partial freezing of water in the food and provides better preservation than conventional refrigeration, particularly for fish and seafood [11].

3.Freezing

Freezing is one of the most effective methods of food preservation and involves storing foods at temperatures of –18°C or lower. At these temperatures, microbial growth is effectively halted and enzymatic activity is greatly reduced [10]. Freezing is widely used for long-term preservation of meat, poultry, fish, fruits, vegetables, and ready-to-eat foods.

Effect of Cold on Microorganisms

Cold temperatures mainly exert a bacteriostatic effect rather than a bactericidal effect. Low temperature slows down microbial metabolism, enzyme activity, and cell division [13]. Freezing causes physical and physiological stress to microbial cells due to ice crystal formation, dehydration, and osmotic changes, although many microorganisms can survive and resume growth upon thawing [2].

Effect of Cold on Food Quality

Cold preservation helps to maintain the sensory attributes of food, including color, texture, flavor, and nutritional value. Refrigeration delays ripening and ageing in fruits and vegetables, while freezing helps retain vitamins and minerals, especially when appropriate pretreatments, such as blanching are applied [12].

Advantages and Limitations of Cold Preservation

The major advantages of cold preservation include its effectiveness, safety, and minimal impact on the natural characteristics of food [11]. However, cold preservation requires continuous energy supply and cannot destroy all pathogenic microorganisms, making proper management essential [10].

Conclusion

The primary objective of food preservation is to prevent the growth of microbes that cause spoilage of food. Microorganisms responsible for spoilage belongs to bacteria, molds, and yeasts. The application of cold is considered a fundamental and indispensable method of food preservation. By slowing down microbial growth, enzymatic activity, and chemical reactions, cold preservation efficiently extends the shelf life of foods while maintaining their quality and safety. Refrigeration, super chilling, and freezing remain key technologies in modern food systems and contribute significantly to food security and public health. It is emphasized that further work should be conducted to develop a low cost/cheaper method, which can be widely used by the poor people across the world to preserve the food.

Acknowledgements

We are grateful to Prof. Dr. R. K. Naryan for going our manuscript and giving his prudent advice. This paper is dedicated to all the scientists who made significant contribution in the field of food preservation.

Contribution of Authors

Both the authors made substantial contribution during the preparation of the manuscript.

Conflict of Authors

There was no conflict of interest among the authors

Source of Funding

We did not receive any financial support from any organization.

References

1. Pal, M. (2014). *Preservation of various foods*. Ph.D. lecture notes, Addis Ababa University, College of Veterinary Medicine and Agriculture, Debre Zeit, *Ethiopia,* pp. 1–11.
2. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). *Modern food microbiology* (7th ed.). Springer, New York, USA.
3. Pal, M. (2017). Pulsed electric field processing: An emerging technique for food preservation. *Journal of Experimental Food Chemistry*, 3, 1–2.
4. Pal, M., Shimelis, A., Mamo, W., Barot, A. M., Pinto, S. V., & Prajapati, J. P. (2017). Hurdle technology: A novel approach for food preservation. *Beverage & Food World*, 44(1), 20–23.
5. Pal, M., & Devrani, M. (2018). Application of various techniques for meat preservation. *Journal of Experimental Chemistry*, 4, 1–6.
6. Sridhar, A., Ponnuchamy, M., Kumar, P. S., & Kapoor, A. (2021). Food preservation techniques and nanotechnology for increased shelf life of fruits, vegetables, beverages and spices: A review. *Environmental Chemistry Letters*, 19, 1715–1735.
7. Sanjeet, K., & Mishra, S. (2023). Recent developments in food preservation techniques: A review. *TWIST*, 18(4), 287–296.
8. Sharma, H. P., Patel, A. H., & Pal, M. (2021). Effect of plasma-activated water (PAW) on fruits and vegetables. *American Journal of Food and Nutrition*, 9, 60–68.

9. Lisboa, H. M., Pasquali, M. B., dos Anjos, A. I., Sarinho, A. M., de Melo, E. D., Andrade, R., Batista, L., Lima, J., Diniz, Y., & Barros, A. (2024). Innovations and sustainable food preservation techniques: Enhancing food quality, safety and environmental sustainability. *Sustainability*, 16, 8223.
10. Rahman, M. S. (Ed.). (2020). *Handbook of food preservation* (3rd ed.). CRC Press.
11. Fellows, P. J. (2017). *Food processing technology: Principles and practice* (4th ed.). Woodhead Publishing, *Cambridge, UK.*
12. Fennema, O. R. (2008). *Food chemistry* (4th ed.). CRC Press, *Boca Raton*, USA.
13. Adams, M. R., & Moss, M. O. (2008). *Food microbiology* (3rd ed.). Royal Society of Chemistry, *Cambridge*, UK.

DOI:10.31579/2637-8914/352