International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 10-04-2023, Accepted: 25-04-2023, Published: 10-05-2023
Volume 8, Issue 2, 2023, Page No. 25-29

Preserving food safety is more science than art

Dr. D Padmavathi[1], Dr. Praveen[2]
[1] M.Sc., M.Phil., Ph.D, Department of Science& Engineering, Post doctoral research scholar, Srinivas University, Mangaluru, Karnataka, India
[2] B.M, Director, Research and Innovation Council, Mukka, Mangaluru, Karnataka, India

Abstract
When the availability of food is more than the present use it is preserved for future consumption. Preservation helps the food to be available in off-season and in any place. Delay in the use of fresh food alters its freshness, it palatability and its nutritive value hence such food is preserved and use for long time. Many foods cannot be preserved as such and need some type of treatment. Food preservation has been part of just about every culture throughout history. Prior to today's technology, ancient societies froze meat and seafood in icy climates or dried foods in tropical ones. Regardless of the century, all harvested or butchered food begins to spoil immediately. Food preservation methods are employed to slow down these spoilage processes and in some cases, stop them from taking place altogether. Let's take a look at the different methods used for preserving food today.

Keywords: preservation, preservatives, nutrition, nutrients, chemicals, food spoilage, food microbiology

Introduction

Food preservation procedures include those that limit the growth of germs like yeasts (although other methods work by adding harmless bacteria or fungus to the food) and reduce the oxidation of lipids that produce rancidity. Processes that prevent aesthetic deterioration, such as the enzymatic browning reaction in apples after they are chopped during meal preparation, are examples of food preservation. Food waste can be decreased by preserving food, which is an important approach to lower production costs and improve food system efficiency, improve food security and nutrition, and contribute to environmental sustainability.

Why Preserve Food?

Food spoilage is the process of food becoming unsafe or unacceptable for human consumption. Spoilage is normally caused by the growth of microorganisms in foods. Other losses in quality are caused by natural activities in fresh food tissues, for example, the excessive softening in overripe fruit caused by fruit enzymes. Spoilage and quality losses are partially or completely controlled in properly preserved foods. Food preservation is the maintenance of safe and nutritious food for an extended period of time. Examples of preserved foods include properly packaged refrigerated, frozen, canned, and dried products.It can be defined as the process in which we treat and handle the food to slow or stop the spoilage, its loss of nutritional value, quantity, and edibility of food items. Food preservation allows us to store food for a longer time. Preservation usually involves the prevention of the growth of fungi (such as yeasts), bacteria, and other microorganisms. This food preservation is used for various food products such as fruits, vegetables, meat, and fish by applying methods of salting, drying,

There is numerous importance of food preservation few of them are

- It increases the food shelf life.
- It allows us to taste a variety of food products in any season and in any area.
- It reduced the wastage of food items.
- In food preservation, there is no change in the taste, color, and nutritional value of food.
- Food products can be stored easily

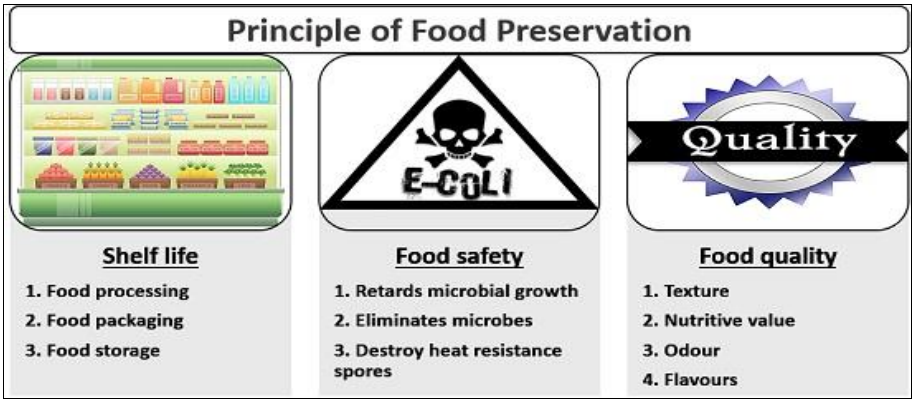

Fig 1

Principle of Food Preservation

The principle of food preservation includes prevention against microbial decomposition, prevention of self-decomposing foods, and prevention against the various chemical, physical and mechanical damage of the food.

1. Prevents or delay of microbial decomposition

It either involves inhibition of microbial growth (microbiostatic) or killing of microorganisms (microbicidal). Food preservation maintains asepsis, which means "keeping out microbes" by eliminating or filtrating microbes. It restricts microbial growth by various methods like chilling, freezing, smoking etc. and destroys microorganisms by methods like pasteurization, irradiation etc.

2. Prevents self-decomposition of food items

It either involves inactivation of food enzymes by methods like pickling, salting, sugaring etc. or elimination of pro-oxidants by using antioxidants.

3. Prevents damage

caused by physical, chemical and mechanical damage by the factors like rancidity, flavour encapsulation, bruising.

There are two methods of food preservation

- Physical method
- Chemical method

Physical Method

Includes freezing, refrigeration, canning and dehydration, salting, fermentation, controlled atmosphere storage, vacuum packaging, modified atmosphere packaging, various forms of heat treatment, ionizing radiation, ultraviolet radiation, and high hydrostatic pressure.

Freezing

This is the modern version of food preservation. This process doesn't kill the bacteria and yeast, this process just slows down the spoilage in the food. As yeast and bacteria both grow rapidly at a specific temperature (40F-140F), but lowering the temperature below 40F their reproductive and metabolic actions slow down. Food items such as sliced vegetables, berries, carrots, peas, and many more are preserved by this method.

Drying

Also known as dehydration. It is an ancient method used for food preservation. In these food items are dried the number of water decreases and as a result, it stops bacterial growth. The drying process can be done by bed dryers, shelf dryers, household ovens, fluidized bed dryers, freeze-drying, spray drying, and commercial food dehydrators. In this method, the weight of food products becomes lighter which makes products transportable. Food items such as fruits, vegetables, mushrooms, meats, and many more are preserved by this method.

Salting

It is the oldest method used for food preservation. In this method, salt removes the moisture from food and make an unfavorable environment for micro-organisms. There are very few bacteria that survive this excess high salt condition. This method can be used with other methods (dehydration, acidic solution) too. Food items such as vegetables, some fruits, fish, meats, and many more are preserved by this method.

Canning

This method becomes popular with the industrial revolution. In this method, food is preserved by removing the oxygen that is a basic need of micro-organisms. But still, some organisms can grow in absence of oxygen, so this method can be used with other methods (salting or with acid). Food items such as jams, juices, vegetables, fruits, and many more are preserved by this method.

Fermentation

This method is done under anaerobic conditions which involve a chemical change in food that use organic acids to convert micro-organisms. These anaerobic conditions occur in the absence of oxygen. This environment stimulates a microbial conversion of starches and sugars into alcohol, which is already a natural preservative. Food items such as cheese, yogurt, and many more can be preserved by this method.

Vacuum Packing

This is done by food vacuum machines. In this method, food items are packed in a bag and then removed all the air present in that bag, and then seal it tight. This method increases the shelf life of food items. Food items such as cereals, nuts, cheese, coffee, and many more can be preserved by this method.

Ionizing Radiation

Irradiation is used for eliminating parasites, reducing pathogenic bacteria, and extending the shelf life cycle of food items. In this method, food undergoes the exposal of ionizing energy which suppresses microbial growth. Food items such as fruits, vegetables, spices, and many more can be preserved by this method.

Chemicals Method

Include food preservatives or antimicrobials, although benzoates, propionates, and sorbates.

Chemical Preservation

Modern industries are adopting the use of chemical preservatives. There are 3 types of chemical preservatives used for food preservation. Benzoates (such as sodium benzoate), sulfites (such as Sulphur dioxide), and nitrites(such as sodium nitrite). Before adding any chemical preservative, food goes through various processes like irradiation, cooking, and pasteurization in which ionizing radiations, heat, and high energy which kill bacteria and fungi that increase the shelf life of food. Food items such as cereals, jams, meat, juices, and many more can be preserved by these chemical preservatives.

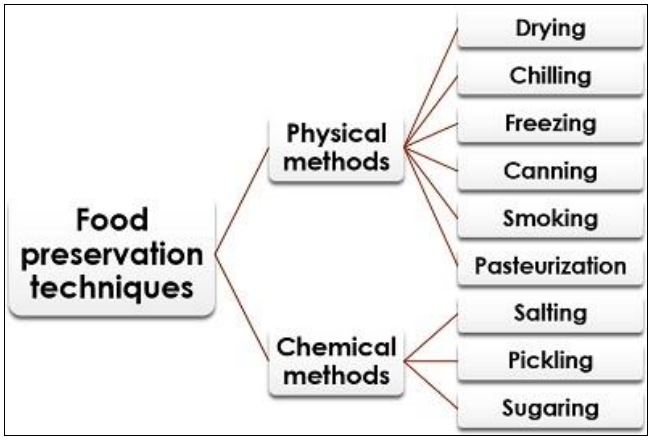

Fig 2

Physical Methods
Food can be preserved by physical methods like:

Drying
It is also called dehydration method, which removes the moisture content of the food naturally by the sunlight. Drying method was popular from the ancient times, where people used to dry various spices, vegetables and fruits etc. through the effective solar light.
We must have heard about the sundried tomato that has been originated from Southern Italy, which is known for its deliciously sweet taste.

Fig 3

In India, also drying method has been used for food products like apple, mango, chillies, herbs, different spices etc. Drying method involves exposure of food items to the direct sunlight on the clean, dry place for up to two weeks or more. Nowadays, an electric dehydrating machine is also used as an artificial method of drying

Chilling
It is also called the refrigeration method, which is most commonly used in this modern generation. Chilling is a simple method, which makes the use of cold temperature (1-4 degrees Celsius) to store the food for a few days to a few weeks depending upon the food content, food type etc. The cold temperature holds back the microbial growth, and so minimizes the food spoilage.Things like food storage, food containers, fridge temperature etc. are the factors which we must keep in mind before refrigeration. The use of sterilized containers, storage of food items on particular shelves, discarding of decayed food and the temperature between 1 to 4 degrees Celsius can increase the food longevity.

Freezing
It is an advance method over chilling. Freezing method makes the use of freezing temperature to preserve various food items, which can increase the longevity for up to a few weeks to a month. Microorganisms rarely grow at a freezing temperature. Like chilling, freezing also uses certain measures to increase the shelf life of food items such as food storage, freezing temperature and defrosting.

Fig 4

Food stored in airtight containers, freezing temperature between -18 to -20 degrees Celsius and regular defrosting are the factors, which can increase the shelf life for at least 1 month.

Canning
It is also called bottling, in which different kinds of canner are used to sterilize the jars and the food material kept in it. Water bath canners are generally used to store high acid foods, and pressure canners are used for low acid foods. In the process of canning, different food items like vegetables, fruits, fish, meat etc. are first processed then stored inside a sterilized jar or can.

Fig 5

Finally, the jars are sealed by a top lid, and it can be labelled with the information like date of processing and the name of the food item. Sir Nicholas Appert was a scientist, who is known as “Father of Canning”.
Smoking
It is a conventional method of food preservation, which makes the use of smoke released by burning a type of **wood**. The formaldehyde and the phenolic compounds of the wood add unique flavour to the smoked food items. The smoking method is now generally used for fish and meats. It preserves the food through the antimicrobial properties of the formaldehyde and phenolic compounds and through heating, the food product dries up.

Fig 6

Pasteurization

It is known after the name of a scientist "Louis Pasteur" who introduced that the food can be spoiled when exposed to the air. Air contains numerous microbes, which can deteriorate the physiochemical properties of the food. The process of pasteurization makes the use of high heat to destroy or deactivate the pathogenic microorganisms.

Commonly, there are three pasteurization methods known, namely VAT, HTST and UHT. The VAT or LTLT method comes under the category of batch pasteurization, whereas HTST and UHT methods come under the category of flash pasteurization. VAT pasteurizes the food items comparatively at a lower temperature for a long time. Oppositely, HTST and UHT method pasteurize the food items at relatively high temperature for a short time.

HTST or high-temperature short time works under 161 degrees F for 16 seconds, while UHT or ultra-high temperature works under 280-302 degrees F for up to 1-2 seconds. Pasteurized products like milk, cheese, butter, juices etc. have a long shelf life, but once the package is opened, then it must be kept inside the refrigerator**.** Preservatives are substances, both natural and artificial, that are added to a variety of goods in order to prevent premature decomposition and to prolong their shelf life. It is common to find preservatives in a large variety of foods and cosmetics. But what some may not know is that preservatives are also added to non-conventional items such as pharmaceuticals and wood.

Types of Preservatives

- **Antimicrobial:** Prevents the growth of microorganisms such as bacteria and fungi.
- **Antioxidants:** Slows down or entirely stops the oxidation process.
- **Enzymes:** Halts the expiration of cosmetics and like products.

Natural preservatives are primarily used in foods and beverages to help reduce rotting and preserve the item's color and flavor. However, they are also found in cosmetics and other hygiene products. Common examples of natural preservatives include:

- Aloe vera;
- Citric acid;
- Lemon juice;
- Rosemary extract;
- Sodium;
- Sorbic acid;
- Sugar.

Artificial chemical preservatives are man-made substances that are added to numerous products to extend their shelf life. While they too are created to prevent foods from spoiling and help them retain their shape and color, they are oftentimes filled with chemicals. Common examples of chemical preservatives include:

- Antimicrobial agents;
- Antioxidants;
- Benzoates;
- Chelating agents;
- Nitrates;
- Propionates;
- Sorbates;
- Sulfites.

Uses of Preservatives

While artificial and natural preservatives serve a similar purpose — to extend the shelf life of products — the way in which they're used varies depending on the product the preservative is added to. For instance, preservatives added to makeup products serve a different purpose than those that are added to food.

Preservatives in Food

Food has a natural expiration process that is the result of bacteria, fungus, and molds taking over the food. By adding preservatives, whether they be natural, artificial, or a combination of both — it prevents these foods from expiring as fast. Preservatives are also used to help keep the food color, shape, smell, and size — which can make the food item more appealing to the consumer.This is a practice frequently found in fast food chains and grocery stores.

Preservatives in Medicine and Pharmaceuticals

Preservatives are used in medicine and pharmaceuticals to help prevent microbial contamination. This is most commonly found in over-the-counter medicines such as acetaminophen and cough syrup.

Examples of antimicrobial preservatives that can be found in pharmaceuticals are:

- Acids (benzoic, sodium benzoate, sorbic acid);
- Alcohols;
- Parabens;
- Phenols.

Conclusion

According to the National Center for Home Food Preservation: "Food begins to spoil the moment it is harvested" To survive, our early ancestors had to find a way to make that food last through the cold months. In frozen climates, they froze meat on the ice; in tropical climates, they dried foods in the sun. These early methods of food preservation enabled ancient man to put down roots and form communities. They no longer had to consume the kill or harvest immediately but could preserve some for later.Therefore, It has been conclude that food preservation techniques provide the best way to store different food items. The motive of food preservation is to retard the microbial growth and to extend shelf life of the food by maintaining food safety and food quality.

References

1. Abd El-khalek HH, Zahran DA. Utilization of fruit by-product in ground meat preservation. Food Sci. Qual. Man,2013:11:49-60.
2. Adams M. Nisin in multifactorial food preservation, In: Roller, S. (ed.), Natural antimicrobials for the minimal processing of foods. CRC Press LLC, Boca Raton, FL, 2003, 11-33.
3. Al-Nabulsi AA, Holley RA. Effect of bovine lactoferrin against Carnobacterium viridans. Bioresource Technol,2005:22:179-187.
4. Anastasiadou S, Papagianni M, Filiousis G, Ambrosiadis I, Koidis P. Pediocin SA-1, an antimicrobial peptide from Pediococcus acidilactici NRRL B5627: Production conditions, purification and characterization. Bioresources Technol,2008:99:5384-5390. https://doi.org/10.1016/j.biortech.2007.11.015
5. Axelsson LT, Chung TC, Dobrogosz WJ, Lindgren SE. Production of a broad spectrum antimicrobial substance by Lactobacillus reuteri. Microb. Ecol. Health D.1989:2:131-136. https://doi.org/10.3109/08910608909140210
6. Badr HM. Elimination of Escherichia coli O157:H7 and Listeria monocytogenes from raw beef sausage by γ-irradiation. Mol. Nutr. Food Res,2005:49:343-349. https://doi.org/10.1002/mnfr.200400095
7. Bajpai VK, Rahman A, Dung NT, Huh MK, Kang SC. *In vitro* inhibition of food spoilage and foodbourne pathogenic bacteria by essential oil and leaf extracts of Magnolia liliflora Desr. J. Food Sci,2008:73:M314-M320.https://doi.org/10.1111/j.1750-3841.2008.00841.x
8. Barman S, Ghosh R, Mandal NC. Use of bacteriocin producing Lactococcus lactis subsp. lactis LABW4 to prevent Listeria monocytogenes induced spoilage of meat. Food Nutr. Sci,2014:5:2115-2123. https://doi.org/10.4236/fns.2014.522224
9. Bashor MP, Curtis PA, Keener KM, Sheldon BW, Kathariou S, Osborne JA. Effects of carcass washers on Campylobacter contamination in large broiler processing plants. Poultry Sci,2004:83:1232-1239. https://doi.org/10.1093/ps/83.7.1232
10. Benhabiles MS, Salah R, Lounici H, Drouiche N, Goosen MFA, Mameri N. Antibacterial activity of chitin, chitosan and its oligomers prepared from shrimp shell waste. Food Hydrocolloid,2012:29:48-56. https://doi.org/10.1016/j.foodhyd.2012.02.013
11. Ben-Shalom N, Ardi R, Pinto R, Aki C, Fallik E. Controlling gray mould caused by Botytis cinerea in cucumber plants by means of chitosan. Crop Prot,2003:22:285-290. https://doi.org/10.1016/S0261-2194(02)00149-7
12. Bhunia AK, Johnson MC, Ray B. Purification, characterization and antimicrobial spectrum of a bacteriocin produced by Pediococcus acidilactici. J. Appl. Microbiol,1988:65:261-268.
13. Bibel DJ, Miller SJ, Brown BE, Pandey BB, Elias PM, Shinefield HM, *et al*. Antimicrobial activity of stratum corneum lipids from normal and essential fatty acid-deficient mice. J. Invest. Dermatol,1989:92:632-638. https://doi.org/10.1111/1523-1747.ep12712202