

## Conventional and Modern Methods of Preservation of Foods

**Nasrullah, Aslam M, Yousaf S, Atiq G and Iqbal RK\***

Institute of molecular Biology & Biotechnology, Bahauddin Zakariya University,  
Multan- 60800, Pakistan

**\*Corresponding author:** Rana Khalid Iqbal, Institute of molecular Biology &  
Biotechnology, Bahauddin Zakariya University, Multan- 60800, Pakistan, Email:  
khalid.iqbal@bzu.edu.pk

### Review article

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### Abstract

Food preservation is a great concern for long times. Different techniques are used widespread including both commercial and modern methods. This article throw light on the different methods like use of antimicrobial agents from plants and animals and some physical methods like drying heating pasteurization and fewer biological and chemical methods limitations of the processes are discussed. Several modern techniques like nanotechnology and use of edible coatings and HPP technique CAP and MAP.

**Keywords:** Bacteriocins; Lectoferin; Hurdle Technology; Pasteurization

**Abbreviations:** CAPS: Controlled Atmosphere Packaging; MAPS: Modified Atmosphere Packaging; EGCG: Epigallocatechin Gallate; AITC: Allicin and Allyl Isothiocyanate; NDGA: Nor-Dihydroguaiaretic Acid

### Introduction

Different foods have been harvested and processed in the world. There is also spoilage of food and many ripened food effects every year. But different methods have been used now a day to enhance their shelf life. Several conventional methods and now modern techniques also prevail. But now a days modern method prefer over conventional method due to its more efficiency and reliability [1]. With the passage of time to preserve different food items for different durations several modern methods have also been developed which are working efficiently even though some processes have certain disadvantages which are being replaced by some other methods and we can store our food articles for longer time without losing their flavor, nutritional value, quality, aroma, taste and freshness. There are several methods reviewed which have been used for several years [2,3].

### Nanotechnology

Nanotechnology is the method in which we use Nano size particles for food processing. Although this method is used widespread but it is also not useful. It causes various health and environmental problems. These Nano structured materials accumulate in the human bodies and have lethal effects. These limitations are covered by studying the physiochemical and biological prospects of these Nano sized particles. Food coloring and the solubility of vitamins is preserved during food processing. Active food packaging is also important as it prevents the food from microbes [4]. SiO<sub>2</sub> is used as fragrance enhancer in different foods and beta carotene is used as coloring agent but it is very unstable so it is avoided. Different polymers are used as Nanocomposites like silicates that are uses to prevent food from UV. Nano biosensors are used to detect the food borne pathogens or food spoiling material [5,6].

People do not want fully or highly processed food rather they are interested in minimally processed food. But the minimal processing of food decreases shelf life as it increases the metabolic activity (respiration) which

produces high concentration of ethylene hence exposure to the microbial agents [7]. Like mango is processed and is widely found in tropical and subtropical area. The shelf life of such minimally processed foods in cutting slices has been done through the processes like chemical dipping and by forming a pectin coat which do not cause softening and browning of flesh [8,9]. Alginate and Pectin forms a gel type material on coating when applied with calcium and forms barrier against water vapors which prevent food from spoilage and exposure to microbes. , glycerol is also being used as plasticizer [10].

### **Meat Preservation**

Meat preservation has been done by chilling or freezing of meat. People suggest their own methods of preservation of food and are not satisfied with the methods used in markets. They prefer hot meat rather than freeze or chilled but Chinese like pork as chilled. People are ignorant most of the time so they do not know which is better and how. The latest methods used for the preservation are CAPS and MAPS. Controlled atmosphere packaging (CAPS) is the method of food preservation in which we self-regulate the concentrations of various gases like oxygen carbon-dioxide nitrogen and humidity also. Modified atmosphere packaging (MAPS) [4] is the process of addition of several gasses' mixture depending on the nature of food which enhances the shelf life of minimally processed food. Different other conventional and modern methods for the preservation of food have been used to prevent spoilage of food [6,11,12].

### **Pectin Hydrolysis**

Pectin hydrolysis is the method of inhibiting the activity of pectinase enzyme. During food ripening, the pectin in the cell wall of fruits starts producing the pectinase which causes the spoilage and softening of food. Mechanical damage may also activate the pectinase. By the use of Pectin methyl esterase, the spoilage is prevented. Pectin and alginate are most commonly used coatings on food that are mostly used on the minimally processed food to enhance their shelf life and long-lasting freshness. Some other methods which may be conventional are used like physical or some chemical methods or biological [10, 3].

### **Dehydration**

Dehydration is the physical method of preservation of food. Microbes grow on moisture content so dehydration causes low water content and no microbial growth. Dehydration is done through the process of evaporation. Because microbes and enzymes require specific water

content below which their activity is inhibited so evaporation causes loss of water and microbes cannot act to spoil the food. However, this process also has limitations. In some cases, significant loss of flavor and aroma has been observed after drying. Some functional compounds like vitamin C, thiamin, protein, and lipid are also lost because of drying [2,13,14].

### **Pasteurization**

Pasteurization is also a way of preservation of food. In this method, the food material is heated to kill the microbes which increase the shelf life of food. In this method, all the microbes that cause spoilage of food are killed, but the temperature given or the heat duration given should not be so high enough to damage several useful products like vitamins and proteins. Generally, the PEF treatment time is less than one second. This technique was introduced by the scientist Louis Pasteur, who introduced the method of preserving milk and foods containing milk and other foods. Some modern methods are also available such as PEF and HPP [2,15].

### **Pulse Electric Field**

Pulse Electric Field is the method in which food is placed between two electrodes and exposed to pulse high voltage field for less than a second. It is effective for destroying gram negative bacteria. The electric field causes the destruction of the cell membranes of the microorganisms. Vegetative microbes are very easily killed but spores are resistant to it so it is not useful. HPP is more effective than this thermal process because this method is not much effective and also costly and only useful for liquids [5,13,15].

### **High Pressure Food Preservation**

High Pressure Food Preservation is the process involving pressure which only affects the non-covalent bonds of food particles which maintains the nutrition and prevents food from spoilage by altering food configuration. This method works by reducing the volume and enhancing the temperature [16,3].

### **Hurdle Technology**

Hurdle Technology is the use of several agents that inhibit or slow down the metabolic activity of the food. These are several preservatives. These hurdles may be the temperature, water, pH and several lactic acid bacteria which do not allow fermentation of food. Several other hurdles may be the irradiation and ultra-high pressure [17,18].

### Antimicrobial Agents

Antimicrobial agents are also been used as food preservation agents by inhibiting the growth of microbes. These may be taken from some plants or sometime by the animals. Plant anti-microbial agents like bacteriocins which kill gram positive and gram-negative bacteria [19]. Animals are also source of antimicrobial agents as Lysozymes present in eggs are used as preservative. Lactoferin is also being used as an antimicrobial agent. It is taken from the mammalian secretions like saliva or their tears which reduces the iron concentration in the environment and hence bacterial cell cannot grow and foods are not spoiled by the bacteria [5].

### Microwave Heating Technology

Microwave Heating Technology was used for preservation of kiwi puree to increase its shelf life and for the preservation of color and bioactive compounds. Microwave heating cause high penetrative power, faster heating rate than conventional heating method and it enhance the heating efficiency reducing the processing time, thus this technology is very effective for microbial an enzyme degradation that cause damages to fruit plant but also help conserve the color, bioactive compound, and antioxidants as compared to other conventional technologies thus this technology is employed for safe, high quality and minimally processed food [2,14].

### Non Thermal Technologies

In some cases, non-thermal technologies are used to extend the shelf life of food and to preserve the nutritional value of raw products. Sea food consumption become popular nowadays, and times the products is transferred to areas where there is less production of seafood [5]. In these cases, preservation of sea food is important as to avoid the complications that may be caused due to poor or spoiled products from sea food industry. Following method is used for their preservation [3].

### Ozone Treatment

Ozone treatment by using gaseous or dissolved form of ozone with seafood products it oxidizes cellular components of damaging species of vibrios causing the leakage of membrane and eventually cell death. As pathogenic vibrios are removed with this method [5]. Washing of sea food with ozone treated water is used to extend the shelf life of seafood. It eliminates vibrios or other damaging species, so shelf life of seafood is increased. Ice slurries can be made with ozonized water for better maintenance of seafood. Slurry ice provide a pre

cooling medium as it provides faster chilling and reduce the physical damages to seafood [5,20].

### Natural Organic Treatment

Natural organic treatment when essential oil, tea polyphenols, and organic acid are added to sea food products that damages the pathogens and prevent their growth Essential oils such as thyme, oregano, rosemary, turmeric, and shallots are used [16]. A variety of polyphenols including catechins, epigallocatechin gallate (EGCG), epigallocatechin, epicatechin gallate, and epicatechin, can be extracted from tea and have shown to have antioxidant and antimicrobial properties that damages the pathogen [21]. Organic acids such as citric acid and lactic acid are used to increase shelf life thus limiting the influence caused by pathogens [19].

### Phage Treatment

Phage treatment two phage group siphoviridae phage pVp-I and VP phage isolated from V.P Arahaemolyticus helps in controlling population of V.PARAHAEMOLYTCUS present in raw oyster [9].

### Irradiation

Irradiation it causes inactivation of organisms in frozen food. Gamma irradiation and x-ray are effective to eliminate pathogenic strains of bacteria. Gamma sterilization process uses cobalt 60 radiation to kill macro-organisms they are easily penetrating radiations hence used to remove vibrios in live oyster [5]. A certain concentration of these radiations is needed for efficient removal of micro-organisms [22].

### For the Preservation of Fish

For the preservation of fish different temperature-based techniques are used. These include cooling, chilling or deep chilling and freezing. Cooling does not kill the microorganisms but its slow down their metabolic and growth rates, cooling should be done as soon as possible after killing the fish , this increases the shelf life of stored fish ice slurries can also be used for preservation as it allow higher heat exchange capacity and prevent fish from dehydration [11,20]. It also prevents the physical damages. Different additives are used in combination with these slurries like natural antioxidants, ozone or organic acid mixtures to enhance their effect [14]. Chilling is also effective for increasing shelf life. Slow freezing should be done carefully; if the homogenous mixture is used smaller crystals are formed during freezing so there is less chance of texture damage to fish. Freezing slow down the microbial and enzymatic activity so shelf life of fish is

increased and help preserve the flavor and nutritional properties of stored fish [7]. Vacuum packaging is also done for the preservation of food. CO<sub>2</sub> concentrations are used to inhibit aerobic bacteria i.e. *Pseudomonas* and *Acinetobacter*. Other gases typically used are oxygen (O<sub>2</sub>), nitrogen (N<sub>2</sub>) and carbon monoxide (CO). O<sub>2</sub> is used for meat that keep the bright red color of meat presenting freshness. Nitrogen is used as filter gas to prevent collapsing and stabilized packaging [23,24].

### Essential oils

Those are aromatic and volatile components extracted from plants. These oils possess antimicrobial activities. So, they work against series of pathogenic microorganism causing their destruction and help in the preservation of food. Essential oil constituents include low molecular weight organic compounds with large differences in antimicrobial activity. They are more effective in their action in bacterial species than yeast and mold [25]. These mainly include terpenes, terpenoids, phenylpropenes, and others. These differ in their action on different types of pathogenic micro-organisms. Terpenes are hydrocarbon chains, they can be cyclic compound, they are synthesized in cytoplasm of plant cell via mevalonic acid pathways starting from acetyl COA. Examples of terpenes include p-cymene, limonene, terpinene, sabinene, and pinene. P-cymene is a mono-terpene that has a benzene ring without any functional groups on its side chains but it potentiates the activity of compounds like carvacrol and polymyxin B nonapeptide it causes membrane expansion decreasing its enthalpy and membrane expansion. Terpenoid are terpene with additional oxygen molecule and methyl group being moved or removed via enzymatic reactions. Examples of terpenoids are: thymol, carvacrol, linalool, linalyl acetate, citronellal, piperitone, menthol, and geraniol. The anti-microbial activity of terpenes is linked to the type of functional group, the hydroxyl group and delocalized electron are important for antimicrobial activity. The most active compound is carvacrol and thymol that are active against a broad spectrum of micro-organisms. Phenyl-propenes are synthesized from amino acid precursor phenylalanine in plant these include eugenol, isoeugenol, vanillin, safrole, and cinnamaldehyde. Their antimicrobial property is dependent on microbial stains, the number and kind of substituents on aromatic ring and experimental parameter such as temperature [19]. Other example of essential oil includes sulfur- and nitrogen-containing compounds with antimicrobial activity that is allicin and allyl isothiocyanate (AITC). Allicin is present in garlic and help in plant defense system [16]. Alin is present in garlic and have no microbial activity. Conversion of alliin to the

antimicrobial allicin requires the enzyme alliinase. Allicin has a pungent smell of garlic and exhibits antibacterial, antifungal, antiparasitic, and antiviral properties. Isothiocyanates, also known as mustard oils, Allyl isothiocyanate in vapor and liquid forms has demonstrated high bactericidal activity against various food spoilage micro-organisms and food pathogens, including *E. coli* [3].

*Larreadivaricata* Cavplants are used in food preservation. Its leaf extract contains nordihydroguaiaretic acid (NDGA) is a polyphenolic compound. It acts as an antioxidant, antimicrobial and anti-inflammatory. It also prevents the oxidation of vitamin C in orange juice thus helping in preservation of food [21].

### Cold Plasma Technique

This is used in food preservation Plasma is referred to as the fourth state of matter, next to solids, liquids, and gases. It causes the microbial inactivation thus maintaining the quality of fresh food. But it is not effective against in vitro models like microbes and enzymes present in tissues as it is surface phenomenon. This causes the cell disruption by electroporation methods limiting the microbial growth. The efficiency of microbial inactivation depends upon the surface of treating procedure, plasma device, gas composition, and mode of exposure. The efficiency of microbial reduction was improved with increase in humidity of air. Cold plasma is much more effective against microbial spores thus helps in the preservation of various food. The application of plasma results in formation of malondialdehyde (MDA) in microbial cells, which participates in the formation of DNA, adducts resulting in damage to cells. The effect of plasma depend on the presence of water its reactivity rate is higher in moist state. When microbial species react with water causing the formation of OH<sup>+</sup> ions that are most reactive and harmful to cell [7]. The lipid bilayer of microbial cell when react with atomic oxygen it causes damage to lipids, protein, and DNA of cells [25]. Enzymes are also deactivated using plasma as plasma changes the 3D structure of most reactive enzymes that are responsible for damaging the food product due to their increased activity rate [14]. Plasma also helps in formation of phenolic compound and antioxidants in food thus helping to increase longevity and preservation of food [9,11]. It also affects the germination rate of seeds. Plasma help in breaking the dormancy of seed leading to seed germination. In cases where delay of seed

germination is needed, the cold plasma is treated with CF4 and octadecafluorodecalin [26].

### Preservation of Butter

The acidification and reduction in moisture content of butter enhances the storage stability and produce effective result in the preservation of butter for longer duration of time. The treatment of butter includes traditional ghee, spiced, salted, melted, untreated, frozen (-20°C) and butter stored at 4°C. The butter has melted and certain additives or ingredients for aroma are added, continuous stirring is done until foaming has stopped. Then it is removed from stove and prepared ghee is stored in steel container for months [7]. Butter was thoroughly mixed with NaCl and kept in high density poly ethylene bucket and was placed at room temperature for 3 months. Spiced butter includes the addition of cumin to butter and can be kept for three months in polyethylene bucket. Frozen butter includes the butter kept in high density poly ethylene bucket and placed in deep freeze at -20°C for 3 months [15].

### Conclusion

It is concluded from the above review that since the very beginning people are using different methods without even knowing the scientific reason or methodology behind them because they work. With the passage of time to preserve different food items for different durations several modern methods have also been developed which are working efficiently even though some processes have certain disadvantages which are being replaced by some other methods and we can store our food articles for longer time without losing their flavor, nutritional value and freshness.

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