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A STUDY ON GENERAL OVERWIEW ON "PRESERVATIVES" IN TODAY'S MODERN FOOD INDUSTRY

DR. DEIVASIGAMANI REVATHI
HoD / Asst. Professor
P.G. Department of Foods & Nutrition
Muthurangam Govt. Arts College (A),
Vellore. **(TN) INDIA**

DR. D. PADMAVATHI
Guest Professor,
P.G. Department of Foods & Nutrition
Muthurngam Govt. Arts College (A),
Vellore. **(TN) INDIA**

ABSTRACT

Food is a perishable commodity. It is affected by a range of physical, chemical and biological processes and under certain conditions it may deteriorate. Besides spoiling many desirable properties of foods, deterioration, together with the growth of microorganisms, may produce toxic substances which have harmful effects on the health of consumers. Through inhibiting the growth of harmful microorganisms and preventing spoilage, food preservatives and antioxidants improve the safety and palatability of foods Over the past two decades, food preservatives and antioxidants played more important roles in food processing due to the increased production of prepared, processed, and convenience foods. Preservatives and antioxidants are required to prolong the shelf-life of many foods. To protect public health, food preservatives and antioxidants have to undergo stringent evaluation by international authorities. In general, preservatives and antioxidants are permitted for food use only when they are proved to present no hazard to the health at the level of use proposed and a reasonable technological need can be demonstrated and the purpose cannot be achieved by other means which are economically and technologically practicable. Furthermore, their uses should not mislead the consumer. So, the present article discusses the need and importance of preservatives in today's modern food industry.

Keywords: *Food, Preservatives, Spoilage, Antioxidants, Food Safety, Food Industry.*

INTRODUCTION

PRESERVATIVES

All food products except for the one growing in your kitchen garden has food preservatives in them. Every manufacturer adds food preservative to the food during processing. The purpose is generally to avoid spoilage during the transportation time.

Food is so important for the survival, so food preservation is one of the oldest technologies used by human beings to avoid its spoilage. Different ways and means have been found and improved for the purpose. Boiling, freezing & refrigeration, pasteurizing, dehydrating, pickling is the traditional few. Sugar, mineral salt and salt are also often used as preservatives food. Nuclear radiation is also being used now as food preservatives. Modified packaging techniques like vacuum packing and hypobaric packing also work as food preservatives.

Food Preservation is basically done for three reasons,

- To preserve the natural characteristics of food.
- To preserve the appearance of food.
- To increase the shelf value of food for storage.

NATURAL FOOD PRESERVATIVES

In the category of natural food preservatives comes the salt, sugar, alcohol, vinegar etc. These are the traditional preservatives in food that are also used at home while making pickles, jams and juices etc. Also, the freezing, boiling, smoking, salting is considered to be the natural ways of preserving food. Coffee powder and soup are dehydrated and freeze-dried for preservation. In this section the citrus food preservatives like citrus acid and ascorbic acid work on enzymes and disrupt their metabolism leading to the preservation.

Sugar and salt are the earliest natural food preservatives that very efficiently drops the growth of bacteria in food. To preserve meat and fish, salt is still used as a natural food preservative.

CHEMICAL FOOD PRESERVATIVES

Chemical food preservatives are also being used for quite some time now. They seem to be the best and the most effective for a longer shelf life and are generally fool proof for the preservation purpose. Examples of chemical food preservatives are:

- Benzoates (such as sodium benzoate, benzoic acid).

- Nitrites (such as sodium nitrite).
- Sulphites (such as sulphur dioxide).
- Sorbates (such as sodium sorbate, potassium sorbate).

Antioxidants are also the chemical food preservatives that act as free radical scavengers. In this category of preservatives in food comes the vitamin C, BHA (butylated hydroxy anisole), bacterial growth inhibitors like sodium nitrite, sulphur dioxide and benzoic acid.

Then there is ethanol that is a one of the chemical preservatives in food, wine and food stored in brandy. Unlike natural food preservatives some of the chemical food preservatives are harmful. Sulphur dioxide and nitrites are the examples. Sulphur dioxide causes irritation in bronchial tubes and nitrites are carcinogenic.

ARTIFICIAL PRESERVATIVES

Artificial preservatives are the chemical substances that stops of delayed the growth of bacteria, spoilage and its discoloration. These artificial preservatives can be added to the food or sprayed on the food.

Types of Artificial Preservatives Food

- Antimicrobial agents.
- Antioxidants.
- Chelating agent.

In antimicrobial comes the Benzoates, Sodium benzoate, Sorbates and Nitrites.

Antioxidants include the Sulphites, Vitamin E, Vitamin C and Butylated hydroxytoluene (BHT).

Chelating agent has the Disodium ethylenediaminetetraacetic acid (EDTA), Polyphosphates and Citric acid.

HARMFUL FOOD PRESERVATIVES

Although preservatives food additives are used to keep the food fresh and to stop the bacterial growth. But still there are certain preservatives in food that are harmful if taken in more than the prescribed limits.

CERTAIN HARMFUL FOOD PRESERVATIVES BENZOATES

This group of chemical food preservative has been banned in Russia because of its role in triggering allergies, asthma and skin rashes. It is also considered to cause the brain damage. This food preservative is used in fruit juices, tea, coffee etc.

BUTYLATES

This chemical food preservative is expected to cause high blood pressure and cholesterol level. This can affect the kidney and live function. It is found in butter, vegetable oils and margarine.

BHA (BUTYLATED HYDROXYANISOLE)

BHA is expected to cause the live diseases and cancer. This food preservative is used to preserve the fresh pork and pork sausages, potato chips, instant teas, cake mixes and many more.

CARAMEL

Caramel is the colouring agent that causes the vitamin B6 deficiencies, genetic effects and cancer. It is found in candies, bread, brown coloured food and frozen pizza.

In addition to this there are many other harmful food preservatives. These are Bromates, Caffeine, Carrageenan, Chlorines, Coal Tar AZO Dies, Gallates, Glutamates, Mono- and Di-glycerides, Nitrates/Nitrites, Saccharin, Sodium Erythrobate, Sulphites and Tannin.

PRESERVATIVES AS FOOD ADDITIVES

All of these chemicals act as either antimicrobials or antioxidants or both. They either inhibit the activity of or kill the bacteria, melds, insects and other microorganisms. Antimicrobials, prevent the growth of melds, yeasts and bacteria and antioxidants keep foods from becoming rancid or developing black spots. They suppress the reaction when foods come in contact with oxygen, heat, and some metals. They also prevent the loss of some essential amino acids some vitamins.

Some common preservatives and their primary activity

Chemical Affected	Organism(s)	Action	Use in Foods
Sulphites	Insects & Microorganisms	Antioxidant	Dried Fruits, Wine, Juice
Sodium Nitrite	Clostridia	Antimicrobial	Cured Meats
Propionic Acid	Molds	Antimicrobial	Bread, Cakes, Cheeses
Sorbic Acid	Molds	Antimicrobial	Cheeses, Cakes, Salad Dressing
Benzoic Acid	Yeasts & Molds	Antimicrobial	Soft Drinks, Ketchup, Salad Dressings

There are other antioxidants like Sodium Erythorbate, Erythorbic Acid, Sodium Diacetate, Sodium Succinate, Grape Seed Extract, Pine Bark Extract, Apple Extract Tea Proplyphenols, Succinic Acid and Ascorbic Acid and food preservatives like Parabens and Sodium DE hydro Acetate used frequently for preservation. Substances not considered as preservatives or antioxidants in the Regulations

Lecithin	Ascorbic acid	Tocopherols	Sodium chloride
Sugars	Nicotine acid or its amide	Acetic acid, or its calcium, potassium or sodium salts	Lactic acid, or its calcium, potassium or sodium salts
Citric acid, or its calcium, potassium or sodium salts	Malic acid, or its calcium, potassium or sodium salts	Phosphoric acid, or its calcium, potassium or sodium salts	Polyphosphoric acid, or its calcium, potassium or sodium salts
Tartaric acid, or its calcium, potassium or sodium salts	Glycerol	Alcohol or potable spirits	Isopropyl alcohol

DIFFERENT METHODS OF PRESERVATION ADOPTED IN FOOD INDUSTRY

Food preservation prevents the growth of microorganisms (such as yeasts), or other microorganisms (although some methods work by introducing benign bacteria or fungi to the food), as well as slowing the oxidation of fats that cause rancidity. Food preservation may

also include processes that inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are cut during food preparation.

Many processes designed to preserve food involve more than one food preservation method. Preserving fruit by turning it into jam, for example, involves boiling (to reduce the fruit's moisture content and to kill bacteria, etc.), sugaring (to prevent their re-growth) and sealing within an airtight jar (to prevent recontamination). Some traditional methods of preserving food have been shown to have a lower energy input and carbon footprint, when compared to modern methods.

Some methods of food preservation are known to create carcinogens. In 2015, the International Agency for Research on Cancer of the World Health Organization classified processed meat, i.e. meat that has undergone salting, curing, fermenting, and smoking, as "carcinogenic to humans".

Maintaining or creating nutritional value, texture and flavour is an important aspect of food preservation.

Traditional techniques	**Modern industrial techniques**
Curing	Pasteurization
Cooling	Vacuum packing
Freezing	Irradiation
Boiling	Pulsed electric field electroporation
Heating	Modified atmosphere
Sugaring	Non-Thermal plasma
Pickling	Bio preservation
Lye	Hurdle technology
Canning	
Jellying	
Jugging	
Fermentation	

TRADITIONAL TECHNIQUES

New techniques of food preservation became available to the home chef from the dawn of agriculture until the Industrial Revolution.

Curing

Bag of Prague powder, also known as "curing salt" or "pink salt". It is typically a combination of salt and sodium nitrite, with the pink colour added to distinguish it from ordinary salt.

The earliest form of curing was dehydration or drying, used as early as 12,000 BC. Smoking and salting techniques improve on the drying process and add antimicrobial agents that aid in preservation. Smoke deposits a number of pyrolysis products onto the food, including the phenols syringol, guaiacol and catechol. Salt accelerates the drying process using osmosis and also inhibits the growth of several common strains of bacteria. More recently nitrites have been used to cure meat, contributing a characteristic pink colour.

Cooling

Cooling preserves food by slowing down the growth and reproduction of microorganisms and the action of enzymes that causes the food to rot. The introduction of commercial and domestic refrigerators drastically improved the diets of many in the Western world by allowing food such as fresh fruit, salads and dairy products to be stored safely for longer periods, particularly during warm weather.

Freezing

Freezing is also one of the most commonly used processes, both commercially and domestically, for preserving a very wide range of foods, including prepared foods that would not have required freezing in their unprepared state. For example, potato waffles are stored in the freezer, but potatoes themselves require only a cool dark place to ensure many months' storage. Cold stores provide large-volume, long-term storage for strategic food stocks held in case of national emergency in many countries.

Boiling

Boiling liquid food items can kill any existing microbes. Milk and water are often boiled to kill any harmful microbes that may be present in them.

Heating

Heating to temperatures which are sufficient to kill microorganisms inside the food is a method used with perpetual stews. Milk is also boiled before storing to kill many microorganisms.

Sugaring

The earliest cultures have used sugar as a preservative, and it was commonplace to store fruit in honey. Sugar is used to preserve fruits, either in an antimicrobial syrup with fruit such as apples, pears, peaches, apricots, and plums, or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel), angelica, and ginger. Also, sugaring can be used in the production of jam and jelly.

Pickling

Pickling is a method of preserving food in an edible, antimicrobial liquid. Pickling can be broadly classified into two categories: chemical pickling and fermentation pickling.
In chemical pickling, the food is placed in an edible liquid that inhibits or kills bacteria and other microorganisms. Typical pickling agents include brine (high in salt), vinegar, alcohol, and vegetable oil.

Lye

Sodium hydroxide (lye) makes food too alkaline for bacterial growth. Lye will saponify fats in the food, which will change its flavour and texture. Lutefisk uses lye in its preparation, as do some olive recipes. Modern recipes for century eggs also call for lye.

Canning

Canning involves cooking food, sealing it in sterilized cans or jars, and boiling the containers to kill or weaken any remaining bacteria as a form of sterilization. It was invented by the French confectioner Nicolas Apart. By 1806, this process was used by the French Navy to preserve meat, fruit, vegetables, and even milk. Although Apart had discovered a new way of preservation, it wasn't understood until 1864 when Louis Pasteur found the relationship between microorganisms, food spoilage, and illness.

Jellying

Food may be preserved by cooking in a material that solidifies to form a gel. Such materials include gelatine, agar, maize flour, and arrowroot flour.

A traditional British way of preserving meat (particularly shrimp) is by setting it in a pot and sealing it with a layer of fat. Also common is potted chicken liver; jellying is one of the steps in producing traditional pates.

Jugging

Meat can be preserved by jugging. Jugging is the process of stewing the meat (commonly game or fish) in a covered earthenware jug or casserole. The animal to be jugged is usually cut into pieces, placed into a tightly-sealed jug with brine or gravy, and stewed. Red wine and/or the animal's own blood is sometimes added to the cooking liquid. Jugging was a popular method of preserving meat up until the middle of the 20th century.

Fermentation

Fermentation is the microbial conversion of starch and sugars into alcohol. Not only can fermentation produce alcohol, but it can also be a valuable preservation technique. Fermentation can also make foods more nutritious and palatable. For example, drinking water in the Middle Ages was dangerous because it often contained pathogens that could spread disease. When the water is made into beer, the boiling during the brewing process kills any bacteria in the water that could make people sick. Additionally, the water now has the nutrients from the barley and other ingredients, and the microorganisms can also produce vitamins as they ferment.

MODERN INDUSTRIAL TECHNIQUES

Techniques of food preservation were developed in research laboratories for commercial applications.

Pasteurization

Pasteurization is a process for preservation of liquid food. It was originally applied to combat the souring of young local wines. Today, the process is mainly applied to dairy products. In this method, milk is heated at about 70 °C (158 °F) for 15–30 seconds to kill the bacteria present in it and cooling it quickly to 10 °C (50 °F) to prevent the remaining bacteria from growing. The milk is then stored in sterilized bottles or pouches in cold places. This method was invented by Louis Pasteur, a French chemist, in 1862.

Vacuum packing

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival. Vacuum-packing is commonly used for storing nuts to reduce loss of flavour from oxidization. A major drawback to vacuum packaging, at the consumer level, is that vacuum sealing can deform contents and rob certain foods, such as cheese, of its flavour.

Irradiation

Irradiation of food is the exposure of food to ionizing radiation. Multiple types of ionizing radiation can be used, including beta particles (high-energy electrons) and gamma rays (emitted from radioactive sources such as cobalt-60 or cesium-137). Irradiation can kill bacteria, melds, and insect pests, reduce the ripening and spoiling of fruits, and at higher doses induce sterility. The technology may be compared to pasteurization; it is sometimes called "cold pasteurization", as the product is not heated. Irradiation may allow lower-quality or contaminated foods to be rendered marketable.

Pulsed Electric Field Electroporation

Pulsed electric field (PEF) electroporation is a method for processing cells by means of brief pulses of a strong electric field. PEF holds potential as a type of low-temperature alternative pasteurization process for sterilizing food products. In PEF processing, a substance is placed between two electrodes, then the pulsed electric field is applied. The electric field enlarges the pores of the cell membranes, which kills the cells and releases their contents. PEF for food processing is a developing technology still being researched. There have been limited industrial applications of PEF processing for the pasteurization of fruit juices.

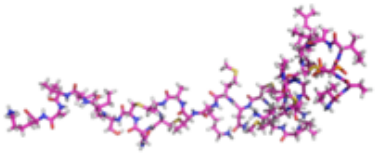
Modified Atmosphere

Modifying atmosphere is a way to preserve food by operating on the atmosphere around it. Salad crops that are notoriously difficult to preserve are now being packaged in sealed bags with an atmosphere modified to reduce the oxygen (O2) concentration and increase the carbon dioxide (CO2) concentration. There is concern that, although salad vegetables retain their appearance and texture in such conditions, this method of preservation may not retain nutrients, especially vitamins. There are two methods for preserving grains with carbon dioxide. One method is placing a block of dry ice in the bottom and filling the can with the grain. Another method is purging the container from the bottom by gaseous carbon dioxide from a cylinder or bulk supply vessel.

Non-Thermal plasma

This process subjects the surface of food to a "flame" of ionized gas molecules, such as helium or nitrogen. This causes micro-organisms to die off on the surface.

Bio Preservation



3D stick model of nisin. Some lactic acid bacteria manufacture nisin. It is a particularly effective preservative.

Bio preservation is the use of natural or controlled microbiota or antimicrobials as a way of preserving food and extending its shelf life. Beneficial bacteria or the fermentation products produced by these bacteria are used in bio preservation to control spoilage and render pathogens inactive in food. It is a benign ecological approach which is gaining increasing attention.

Hurdle Technology

Hurdle technology is a method of ensuring that pathogens in food products can be eliminated or controlled by combining more than one approach. These approaches can be thought of as "hurdles" the pathogen has to overcome if it is to remain active in the food. The right combination of hurdles can ensure all pathogens are eliminated or rendered harmless in the final product.

Hurdle technology has been defined by Leistner (2000) as an intelligent combination of hurdles that secures the microbial safety and stability as well as the organoleptic and nutritional quality and the economic viability of food products. The organoleptic quality of the food refers to its sensory properties, that is its look, taste, smell, and texture.

CONCLUSION

While the most-employed preservation, technologies have a long history of use, there is currently a real need for improved techniques, to meet the developing needs of consumers. Some improvements are being derived from the use of established techniques in new combinations or under improved control, and other improvements are being derived

essentially from the development of new techniques. These are finding, at first, new and attractive, but niche, markets. It is expected that these will expand as experience in the new techniques is gained. If the resistance of bacterial spores to some of the new techniques could be overcome, and in a manner that was widely proven and accepted to be safe, then the potential markets could be immeasurably larger. A particular attraction of the newer techniques is that they act by inactivation rather than by inhibition. With regard to reducing the incidence of food poisoning disease, the introduction of effective inactivation techniques that lead to the elimination of the pathogens must be the ultimate target of primary food producers, processors, distributors, and retailers. Occasional lapses of hygiene will continue to occur in the food service establishment and in the home but would be of no public health consequence if the organisms of concern did not enter these premises in the first place.

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