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Chemical Preservatives Used In Food

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ABSTRACT: Food Preservatives are chemical substances that are used in food products in order to prevent the process of decomposition caused by the growth of microbial or other chemical changes. Chemical preservatives are also used in products such as chemical drugs/ pharmaceuticals, bottled beverages, beauty products, paints, and many other different products. Chemical food preservatives are extensively used in the food industry and are customarily cheap components that are efficient against a huge range of decomposed organisms.

KEYWORDS: food, chemical, preservatives, drugs, cheap, decomposed, organisms, beverages, impact

I. INTRODUCTION

Food preservatives are engaged to ensure quality and safety from microbial, enzymatic or any other physical/ chemical reactions. There are various types of antioxidant and antimicrobial agents, each one with different modes of action.

- Chemical food preservatives are added to extend the time of degeneration in food products by discouraging the growth of antioxidants, fungi or bacteria.
- Unlike the traditional way of preservation like drying food or exposing to sun, many chemical preservatives don't require desiccation.[1,2,3]
- Some of the natural ways to prevent microbial growth are by adding sugar, salt or vinegar.

Principles of Food Preservation

Important Topics Related to Food Preservative Chemicals			
Dichloroacetic Acid	Gluconic Acid	Glutaric Acid	
Harmful Microorganisms	Food Preservation Methods	Food Microbiology MCQs	
Antibiotics Classification	Food Poisoning	Food Processing	
Hyponitrous Acid	Selenic Acid	Pyrosulphuric Acid	
Artificial Sweeteners	Oxoacids of Halogen	NCERT Solutions for Chemistry in Everyday Life	

Chemicals Used in Food Preservation

There are 3 categories of chemical preservatives mainly used in foods, they are:

- Benzoates (Such as sodium benzoate)
- Sulphites (Such as sulphur dioxide)
- Nitrites (Such as sodium nitrite)

DIFFERENT METHODS OF PRESERVE FOOD



Preservation by Oil and Vinegar



Storing in Air Tight Containers



Cold Treatment



Heat Treatment



Preservation by Common Salt



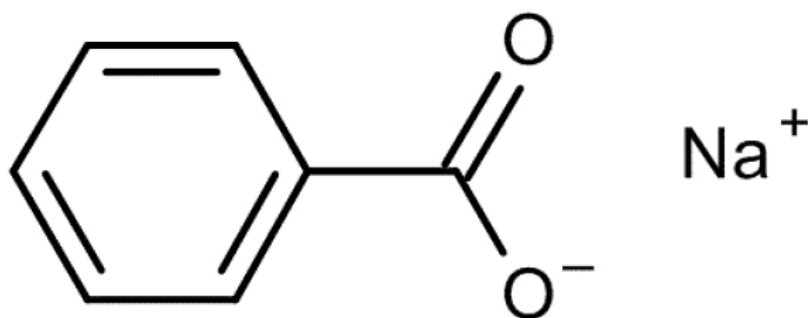
Preservation by Sugar

Types of Food Preservation

Some of the preservatives used in food are calcium sorbate, sodium benzoate, benzoic acid, erythorbic acid, potassium nitrate, etc. Before going through chemical preservation, the food product goes through other steps such as irradiation, pasteurization, and cooking in which huge energy, heat or ionizing radiations are applied. The food irradiation process consists of applying gamma rays from cesium-137 radioisotopes. Irradiation is also used in food packaging to assure sterility.[5,7,8]

Benzoates as Food Preservatives

Sodium benzoate is a salt of the conjugate base and its chemical formula is C_6H_5COONa . When sodium benzoate dissolves with water, it separates into its ions. Benzoate ion acts as base, forming hydroxide ion and conjugate acid. Sodium benzoate is created using the chemical reaction between benzoic acid and sodium hydroxide. [9,10,11]



Structural Formula

Sodium benzoate can inhibit fungal and bacterial growth, hence it is used as a food preservative. Sodium benzoate solution is acidic which makes it efficient at killing microorganisms.

Sulphites in Food Preservation

Chemically, the sulphites are used as food preservatives for dried potato, radish, dried fruits, etc. Sulphites make food look fresh by resisting the oxidation process which makes fruits and vegetables turn brown. Sulphites also help in extending the shelf value of food by eliminating fungi and bacteria.

Nitrites and Nitrates in Food Preservation

Nitrites and nitrates are mainly used as preservatives for meat products. Like other food preservatives, these chemicals also inhibit the growth of fungi and bacteria. Nitrites and nitrates particularly prevent the growth of clostridium botulinum which causes botulism. Nitrates are used in the production of cheese to resist them from bloating while being fermented.[12,13,15]



Nitrates in Food

Examples of Food Preservatives

The food we eat today consists of lots of food preservatives added in them. Let us look at some of the widely used food preservatives:

- Potassium Nitrate- used predominantly in red color meats to delay rancidity, prevent odor and an off flavor.
- Erythorbic Acid- used as an antioxidant
- Benzoic Acid- antimicrobial preservative used in carbonated foods and beverages.
- Sodium Benzoate- Prevents spoilage from bacteria, molds and yeast.
- Calcium Sorbate- prevents the growth of microbes.
- Antioxidants- these slow down the tendency to spoil the food. Examples: Butylated Hydroxyanisole (BHA), Butylated Hydroxytoluene, and Ascorbyl Palmitate.

II.DISCUSSION

Sodium Food Preservatives

Sodium benzoate is the most commonly added form of sodium in food. This is added in foods and beverages to extend the shelf-life. Another commonly added form of sodium is sodium nitrate. This is used very commonly in foods like bacon and luncheon meats. However, consumption of this causes a risk to the functioning of the heart as it damages the heart vessels.[17,18,19]

Role of Salt as Food Preservative

Salts play an important role as a fermenting agent. In fermentation, fresh foods get converted to foods which can be stored for greater duration without being affected by the action of microbes. Some of the benefits of salt addition include:

- Killing of bacteria
- Carrying out Osmosis
- Developing physical attributes to the food
- Imparting adhesive properties to doughs and baked food items

Natural Vs Artificial Food Preservative

Preservatives are added to food before their consumption. Food preservatives are used for the following:

- Extending shelf-life of the food
- Flavoring of foods
- Coloring of foods
- Nutritional supplements like vitamins and minerals

Apart from this, contaminants from manufacturing, storing or packaging can also indirectly get added into the food we eat. Microbes that rot food are inhibited by the addition of preservatives. This helps prevent them from poisoning, giving them a fresh look and taste. Some of the artificial preservatives added are:

- Chelating agents
- Antimicrobial Agents
- Antioxidants

These preservatives delay the growth of food spoiling bacteria and avoid discoloration.

Side Effects of Food Preservatives

There are some food preservatives that are harmful if consumed above the prescribed limits. Some of the harmful or unhealthy food preservatives are caramel, butyrates, and benzoates. Studies show that nitrites and nitrates are carcinogenic and very harmful for the health.[20,21]

Things to Remember

- Preservatives are substances that are used in food products to resist the process of decomposition caused by the growth of microbial and other chemical/ physical changes.
- Some of the traditional ways of preservation are fermentation, cooling, and freezing. Some are natural.
- The natural ways to prevent microbial growth are by adding salt, sugar, or vinegar.
- The three categories of chemical preservatives are sulphites (Like sulphur dioxide), benzoates (Like sodium benzoate), and nitrites (Like sodium nitrite).

III.RESULTS

All the parts of food in canning food preservation are chemicals. People eat the majority of their food made up of chemicals called carbs, fat, proteins, minerals, and water. The vitamins and natural antioxidants, antimicrobials, buffers, thickeners, emulsifiers, chelating agents, colours, and flavours are just a few of the small amounts of other chemicals found in food.

Many chemicals are added critically to make food more appealing and last longer. There are a lot of food additives out there. Still, the main ones are food colours and sweeteners, antioxidants, fat emulsifiers, stabilising agents, flour improvers (like gluten), food preservatives, and nutritional supplements like minerals, vitamins, and amino acids. Only a nutritional supplement has any nutritional value, and nothing else has it. Many types of chemicals listed below are used nowadays as food preservatives.[20]

Food additives

Food additives are food preservatives that are added to improve the look, taste, or even to keep the flavours of the food. Some of them, such as sugar and salt, are naturally occurring flavours. However, chemists have developed many different flavours, and methyl salicylate is one of them.

The following are examples of significant food additives:

1. Food colours
 2. Preservatives
 3. Enzymes
 4. Artificial flavours and sweeteners
- Colouring Agent for Food Colorings

The colourant is used as a chemical in food to alter a food substance's appearance. Colours can be found in nature and those that have been purposefully created. Caramel is an example of a naturally occurring food colour, whereas caramel colouring is an example of an artificially created food colour.

- Preservatives

Antibacterial, antifungal, and antimicrobial preservatives are chemicals used to preserve food against bacteria, yeast, and mould. Both Class-I and Class-II are subdivided into two groups: I and II, respectively. Salt, sugar, and vegetable oils are examples of class-I preservatives. Preservatives belonging to the Class II family are listed below in alphabetical order.

- Sodium benzoate

Sodium benzoate is the widest variety of preservatives used in the food market. It is also the most expensive. It is utilised as a flavouring agent in soft drinks and acidic dishes.

- Sodium metabisulphite

Foods like jams, pickles, squashes, and similar items are preserved with sodium metabisulphite.

- Sorbic acid

Mould and yeast development are inhibited by using sorbic acid and its salts. Sorbic acid is a powerful antifungal agent. A variety of items, including cheese, baked goods, and some meats, are treated to keep yeasts and moulds from growing.

- Enzymes

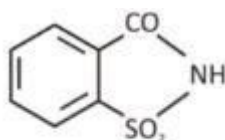
When it comes to converting processes from one material to another, enzymes are biological catalysts that are utilised. The enzymes participating in a chemical process reduce the energy and time necessary to finish. Food processing companies employ enzymes in manufacturing food preservatives items such as dairy products, fruit juices, beer, bread, and other baked goods.

- Artificial Sweeteners:

Sucrose and fructose are two of the most common natural sweeteners. Many people use artificial sweeteners because they add calories and cause tooth decay. For example, some of them are saccharin, aspartame, alitame, sucralose, cyclamate, and L-glucose.

- Saccharin

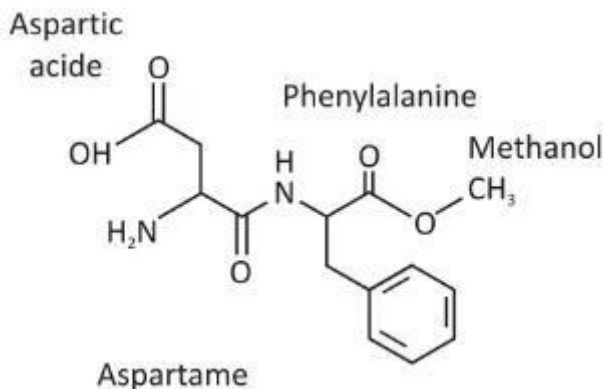
It is one of the most widely used sweetening compounds, and it may be found in a variety of items, including beverages, sweets, pharmaceuticals, and toothpaste. However, it has a severe bitter (or metallic) aftertaste at high concentrations 550 times sweeter than cane sugar.



Structure of saccharin

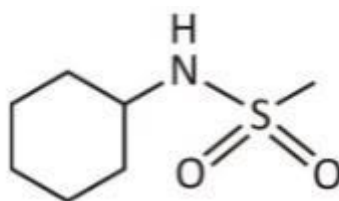
- Aspartame

Sodium aspartate is an amino acid dipeptide created by combining aspartic acid and phenylalanine to form aspartame. It is a non-saccharide sweetener that is around 200 times sweeter than cane sugar in terms of sweetness. A sweet flavour is there, but there is no unpleasant chemical (or) metallic aftertaste that has been seen with other artificial sweeteners.[21]



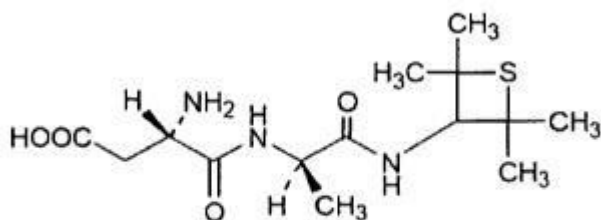
- Cyclamate

Cyclamate has a sweetness that is approximately seven times greater than sucrose in terms of sweetness. Researchers discovered that the combined sweetness of cyclamate and saccharin (10:1) was significantly sweeter than either of the two substances alone.



- Alitame

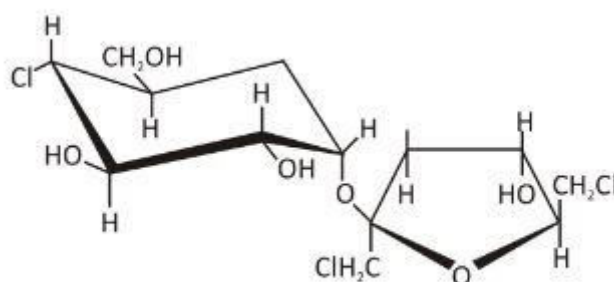
Alitame is an artificial sweetener composed of aspartic acid and alanine as part of a dipeptide bonding. It is thought that the new amine is attached to the alanine moiety of alitame. It is responsible for the increased sweetness and potency of alitame. Compared to sucrose, alitame is approximately 2000 times sweeter and is more stable than aspartame. The sweetness of food is challenging to manage when it is used as an artificial sweetener under the circumstance of high intensity of the sweetener used.



alitame

- Sucralose

A trichloro-derivative of sucrose, it is a sweetener used in baking. When cooked at the appropriate temperature, it has the appearance and flavour of sucrose. In addition to being about 600 times sweeter than sucrose, it has no known adverse effects on tooth decay or illness.



Structure of sucrose

Advantages of Food Preservatives

- The nutritional content of food can be improved or maintained by adding certain additions to the recipe.
- Ensures that food remains fresh for significantly more extended periods
- Making seasonal vegetables and fruits available all year long saves time and money.
- Cheaper
- Increase the nutritional value of food, for example, by adding vitamin C to bread.
- For example, using a sweetener instead of sugar can help you consume fewer calories overall.[18,19,20]

Disadvantages of Food Preservatives

- ADHD and other behavioural disorders have been linked to this condition.
- An allergic response can occur in certain persons, especially youngsters.
- As of yet, there is no proof that there is a relationship between the two.
- Asthma-related links may hurt specific individuals
- High blood pressure is a problem that may exacerbate.
- In canning food preservation, it is used instead of genuine ingredients. The food is less healthy.
- Calories may be more abundant.

Chemistry has helped the modern world in a lot of different ways. Food preservatives have made a big difference in eating food every day. They help keep the food safe. Most of the food we buy at the store has a shelf life of a few months to a few years. These foods can only stay fresh because they add these chemicals to prevent spoilage.

IV.CONCLUSIONS

The search for “natural” alternatives

Food additives are strongly regulated and expert scientific groups conduct risk assessments to identify whether they pose appreciable risks to consumers.

Despite the many benefits and the effectiveness in their function, there are concerns for some preservatives on both human health and environmental impact, with some studies reporting risks for humans and animals. There is therefore a growing demand for natural alternatives while keeping the same standard in terms of food safety and efficacy.

Terpenoids and polyphenols express high antimicrobial activities and are responsible for the antimicrobial properties in essential oils, which make them interesting candidates as natural preservatives in the food industry. Terpenoids derive from terpene (C_5H_8)_n, where oxygen is added to the basic structure or the methyl group is removed. Polyphenols are natural secondary metabolites, characterized by multiple phenolic units.

Unfortunately, their supply is subject to limitations being mainly dependant on plant extraction. However, microbial biosynthesis could provide a more sustainable and cost-effective alternative for the mass production of these two chemicals. There have been many studies on the production of terpenoids and polyphenols by metabolic engineering of *S. cerevisiae* and their antimicrobial activities in foods is being explored.

The tendency towards the search for natural versions concerns food additives in general, particularly colors and flavors. Recently the Food & Drug Administration (FDA) approved a spirulina extract for blue and green confectionaries. The extract contains phycocyanobilin, a blue pigment that along with chlorophyll is responsible for the blue-green color of algae.[21]

Although some additives are naturally occurring, like the vanilla flavor (vanillin), in the vast majority of the cases they are still produced by synthetic methods, since the same products obtained by natural sources have a massive impact on the production costs and ultimately lead to increased prices of the products made.

Humans have always resorted to chemistry to help in preserving and improving the properties of foods. Over the years, an increasing number of alternatives have become available, particularly considering large-scale food production, long-term preservation, and aesthetics.

Synthetic products, even when the same compound is found in nature, are still the elite choice. Nevertheless, recent progress on high-yield production methods, such as microbial biosynthesis, or extraction processes, is also fast-forwarding the search for natural products for commercial use in the future.[21]

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