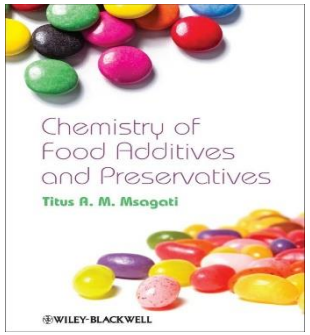
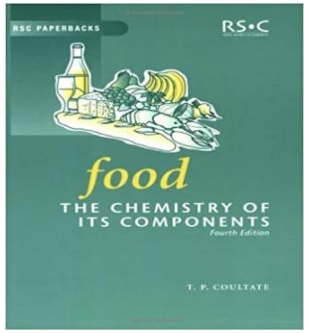
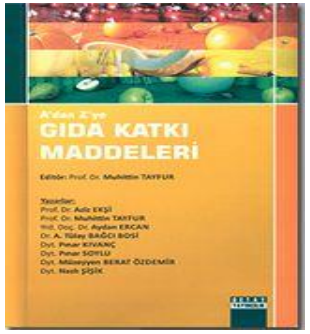
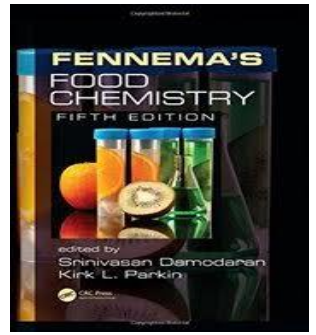
5. Week: PRESERVATIVE FOOD ADDITIVES

1. 

2. 

3. 

4. 

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PRESERVATIVE FOOD ADDITIVES
AND
FOOD PRESERVATION METHODS

It is permitted to be used as a food additive to around 300 chemicals in Turkey.

The permitted

* number of preservatives is 40,
* the number of colorants is 30,
* the number of sweeteners is 15,
* the number of antioxidants is around 20.

PRESERVATIVES

Preservatives in foods are added **to prevent the growth of harmful pathogens** which may not only cause food spoilage but also lead to food poisoning, affecting the health of consumers. They are also intended for extending the shelf-life of foodstuffs, allowing them to be used long after processing and storage.

The most commonly preservatives used as food additives are; sorbic acid and sorbates, benzoic acid and benzoate, esters of para-hydroxybenzoic acid (PHB), sulfur dioxide and sulfite, nitrate and nitrite, propionic acid and propionate, boric acid and borate, nisin, natamycin, hexamethylene-tetraamine, dimethyldicarbonate and lysozyme.

Preservatives **are important in terms of ensuring food safety as well as extending shelf life of foods**.

Stopping (inhibition) and lethal (bactericidal) effects occur, depending on the microorganism burden and the dosage used in the food in which the preservative food additives.

In determining the appropriate preservative for a food, factors need to be taken into account such as:

1. pH of food
2. Solubility of the preservative
3. Effective spectrum of the preservative
4. Mutual interaction of the preservatives
5. Food being affected by preservatives

pH of food

The pH of the food is important for determining the dissociation (ionization) rate of the preservative. It is the non-dissociated part of preservative food additives (sorbic, benzoic, propionic acids, etc.), which are mostly weak acids, providing antimicrobial effect. Generally, the dissociation rate decreases as the pH decreases and thus the antimicrobial effect increases.

Solubility of the preservative

The solubility of the preservative is important for its effectiveness. Because antimicrobial effect occurs if the preservative is actually dissolved. In some cases, it is preferable to use water-soluble salts of organic acids as preservatives, rather than organic acids.

The antimicrobial spectrum of the preservative

The antimicrobial spectrum of action for each preservative is different. Therefore, when determining the appropriate preservative, the microorganism group causing the deterioration and the spectrum of action of the preservative should be considered together.

Mutual interaction of preservatives

In some foods, more than one preservative may be used depending on the spectrum of action. In such cases, it is important that the preservatives interact. The effect of one preservative can increase (synergetic effect) or decrease (antagonistic effect) of the other.

Food affected by preservatives

While the preservative prevents microbial spoilage in food, it can affect the food's properties such as color, taste, texture and nutritional values.

NATURAL FOOD PRESERVATIVES

Natural food preservatives are generally favoured by consumers due to their perceived safety as opposed to artificial preservatives. Living organisms (animals, plants as well as microorganisms) contain various molecules with antimicrobial properties which have evolved as host defence mechanisms and have potential application in the food industry as preservatives.

Most if not all preservatives categorised as natural also perform a number of other important functions, for example, as antioxidants, flavourings or as antibacterials. Such preservatives tend to prolong the shelf life of many foods or foodstuffs such as meat and meat products.

1. Plant Antimicrobial Extracts

Plants, including herbs and spices, are known to contain compounds such as essential oils and other phenolic components with antimicrobial activity.

- ***Essential, volatile and ethereal oils***

Essential oils (also known as volatile or ethereal oils) **are aromatic oily liquids originating mainly from plant sources or plant parts** (flowers, buds, seeds, leaves, twigs, bark, herbs, wood, fruits and roots).

- ***Plant phenolic extracts***

Plants contain phenolic compounds that play a role as preservatives in foodstuffs. **The mechanism of action of these phenolic compounds is believed to involve the disruption of the cytoplasmic membrane**.

Plant phenolic extracts are: ***Eugenol, Cinnamaldehyde, p-cymene, Carvone, Other phenolic compounds extracted from spices (cinnamon)***

2. Natural food preservatives derived from insects

The class insecta is also known to be a source of useful compounds that are used as additives in the food industry. One of these compounds is propolis, a resinous natural product produced by bees and obtained from vegetable secretions.

3. Microbial enzymatic-derived preservative agents (lytic enzymes)

Lytic enzymes are proteinous biomolecules capable of destroying/rupturing a biological cell or degrading any unwanted biomolecules such as polysaccharides. They have the potential to be used as novel and ‘natural’ food preservatives. A number of other lytic enzymes with activity against yeast spoilage in foods are also known, including mannanases and glucanases class of lytic enzymes which destroy the mannan and glucan components of yeasts, respectively.

4. Sulphur dioxide and sulfites

Sulphur dioxide has been used as the main preservative, antiseptic and antioxidant in the winemaking industry to maintain the integrity of wine and to inhibit oxidation and the growth of harmful microbes such as wild yeast.

5. Chitosan conjugates

Chitosan (naturally from shrimp shells) has been reported in a number of articles as potential food preservers. The chitosan conjugates include xylan-chitosan; chitosan-mint mixture; and chitosan glucose complex.

ARTIFICIAL PRESERVATIVE AGENTS

The most commonly used preservative agents include:

* **Weak organic acids**
* **Caffeine**
* **Parabens**
* **Sequestrants**

In most cases, these preservative agents are used in beverages such as soft drinks.

1. Weak organic acids

A number of weak organic acids, such as benzoic acid and sorbic acid, are known to have antimicrobial properties. The undissociated fractions of weak acids are readily soluble in lipids, while the dissociated charged fraction is lipid insoluble. Since the pH of the weak acid is low compared to the pH inside the microbial cell (cytoplasm has almost neutral pH), the uncharged species of the undissociated fraction of the weak acid will tend to diffuse through the microbial cell membrane to the cytoplasm.

2. Caffeine

Caffeine-based products (structurally related to uric acid) are among the most widely consumed foods in the world in the form of tea, coffee and cocoa. Caffeine (1, 3, 7-trimethyl xanthine) is a methylated xanthine alkaloid derivative found in numerous plant species at many locations.

3. Parabens

Parabens are a group homologous series of hydroxybenzoic acid, which are esterified at the C-4 position. Examples of parabens include methyl-, ethyl-, propyl-, butyl-, heptyl- and benzyl-paraben. Their microbial inhibitory properties are believed to involve the disruption of cytoplasmic membrane and their effect on transport and mitochondrial functioning.

4. Sequestrants as food additives

Sequestrants normally perform the function of preservative in foods. Most of the sequestrant compounds are either organic or inorganic salts such as calcium disodium ethylene diamine tetra-acetate (EDTA), glucono delta-lactone, sodium gluconate, potassium gluconate, sodium tripolyphosphate and sodium hexametaphosphate.

Cyclodextrins are also sequestrants.

SAFETY CONCERNS OF FOOD PRESERVATIVES

The safety of preservatives used in foods is very important. Although preservatives are capable of introducing an environment that prohibits the growth and proliferation of harmful pathogenic microbes, this is not the case for body cells and tissues. Moreover, the guidelines which set the maximum allowed levels in food products must be observed and monitored.

The choice of antimicrobial agent has to be based on:

* the antimicrobial spectrum of the preservative
* the chemical and physical properties of both food and preservative
* the conditions of storage and handling
* the assurance of a high initial quality of the food to be preserved