



# FOOD CHEMISTRY

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## Chemical preservation of food

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# Chemical Preservation of Food

- **Preservative** => chemical compound => when applied to food
- **retard alterations** caused by growth of microorganisms or
- enable the physical properties, chemical composition and nutritive value => **remain unaffected** by microbial growth.
- Some chemicals => have been used **traditionally** => several decades as => **direct or indirect inhibitors** of microbial growth and are still => **widely used** despite their limitations

- majority of food preservation operations used today => also employ **chemical additive** => reduce spoilage.
- chemical additives available => designed
- either to **kill** or **retard the growth** of pathogens or
- to **prevent** or **retard** chemical reactions
- that result in => **oxidation** of foods

Examples of => **former class** of food additives :

- sodium benzoate and benzoic acid;
- calcium, sodium propionate, and propionic acid;
- calcium, potassium, sodium sorbate, and sorbic acid; and
- sodium and potassium sulfite.

➤ Examples of => **latter class** of additives :

- calcium, sodium ascorbate, and ascorbic acid (vitamin C)
- butylated hydroxy anisole (BHA) and butylated hydroxytoluene (BHT)
- lecithin and
- sodium and potassium sulfite and sulphur dioxide.

# Classification of preservatives

According to FSSAI rules → class I and class II preservatives

## Class I preservatives

- a. Common salt
- b. Sugar
- c. Dextrose
- d. Glucose
- e. Spices
- f. Vinegar or acetic acid
- g. Honey
- h. Edible vegetable oil

Addition of **class I preservatives** => any food is **not restricted**, unless otherwise provide in the rule.

## Class II preservatives

- a. Benzoic acid including salts their of
- b. Sulphurous acid including salts their of
- c. [Nitrates of] nitrites of sodium or potassium
- d. Sorbic acid including its sodium, potassium and calcium salts
- e. Nicin
- f. Propionic acid including salts their of
- g. Methyl or propyl para-hydroxy benzoate
- h. Sodium diacetate
- i. Sodium, potassium and calcium salts of lactic acid

- Use of class II preservatives is **restricted**.
- They shall be added => to only **specified product** and
- at a **concentration** => not exceeding the proportion **specified** for the product
- Use of **more than one** class II preservative is **prohibited**.
- No person shall use in or upon a food => **more than one class II preservative**

## Benzoic acid and its salt

- Widely used as => **antimicrobial agent**.
- Benzoate is more effective against **yeasts and bacteria** than molds.
- Antimicrobial activity is achieved by **inhibition in enzymatic system** of microbial cells, affecting -
  - ❖ acetic acid metabolism,
  - ❖ citric acid cycle and
  - ❖ oxidative phosphorylation.
- Antimicrobial activity => affected by **pH** of medium
- maximum inhibition occurs at pH value of **2.5 to 4.0** and it **decreases when pH rises above 4.5**.



**Food products** preserved with benzoate include :

- **fruit juices and drinks,**
- **salads,**
- **jams and jellies,**
- **pickles,**
- **dried fruits and preserves,**
- **ketchup and sauce,**
- **syrup, carbonated beverages,**
- **bakery items,**
- **salad dressings,**
- **margarine and other fat spreads,**
- **spices.**



## Sulphur dioxide and sulfites

- Sulphur dioxide (SO<sub>2</sub>) gas => one of the oldest antimicrobial agents.
- colorless, non-flammable gaseous compound or liquid under pressure with a suffocating pungent odor.
- When dissolved in water of foods => it yields => sulphurous acid and its ions (owing to its solubility in water).

- Sulphite salts such as
  - sodium sulphite,
  - sodium bisulphite,
  - sodium metabisulphite,
  - potassium sulphite,
  - potassium bisulphite,
  - potassium metabisulphite => used as **preservatives**.



- When dissolved in water, form => sulphurous acid, bisulphite and ions.
- **Sulphurous acid** => active **antimicrobial** substance.

- Effectiveness of sulphurous acid => **enhanced** at **low pH** values.
- Antimicrobial activity of sulfites against yeasts, molds and bacteria is **selective** => with certain species being more sensitive to inhibition than others.
- **Bacteria** => generally **more sensitive** to inhibition than yeasts and molds.
- they are also used => to prevent **enzymatic and non enzymatic changes** as well as **discoloration** in some foods.
- Sulphur dioxide and sulphites => used in **fruit products** => fruit juice concentrate, squashes, pickles and chutneys.

## Sorbic acid and its salts

- Sorbic acid and its salts (calcium, potassium or sodium salts) => effective **antimicrobial agents** against yeast and molds, as well as bacteria.
- less effective against bacteria.
- Sorbate has an upper pH limit for => activity around **6.0-6.5**.

## food products preserved with sorbates :

- carbonated beverages,
- salad dressings,
- tomato products,
- jams,
- jellies,
- syrup,
- candy and chocolate syrup,
- cheese,
- sausages,
- smoked fish,
- fruit juices,
- grains,
- breads and cakes.



## Propionic acid and its salts

- Propionic acid and its salts (Ca and Na) => used most extensively
- prevention of mold growth and rope development in **baked goods** and
- for mold inhibition in many **cheese foods and spreads**.
- They are => **more effective against molds** as compared to yeasts and bacteria.
- Propionates has an upper pH limit for activity around **5 to 6**.



biopreservation-lactic-acid-bacteria

- ## Lactic Acid and Its Salts
- Lactic acid is formed => during fermentation of lactose by lactic acid bacteria.
  - Lactic acid and its salts => not very common and not easily available.
  - It can be used => pickles ( with acetic acid), fermented dough crispy biscuits, some beverages, dairy products and meat & meat products.
  - Calcium lactate is used => as a firming agent in => **pickles, fruits and vegetables.**
  - Na and K lactate are also recommended with sodium diacetate for => control of food poisoning and other bacteria in meat product.

## Acetic Acid

- Acetic acid => antimicrobial properties.
- action tends to be static rather than cidal.
- more effective against **bacteria and yeast** than molds.
  
- A **5 to 10 % solution of acetic acid** => known as **Vinegar**.
  
- Acetic acid in the form of vinegar is used in => **mayonnaise, pickles, sauce, pickled sausage etc.**



## **Sodium Chloride (Common salt)**

- Antimicrobial action of NaCl arises => from its => **lowering water activity (aw)** of => food product.
- This **reduces** => **available water** in food => which renders condition => **unfavorable** for microbial growth.
- At higher concentration => it has a **pronounced bacteriostatic action**.
- 10 % NaCl inhibits => **growth of most bacteria**.
- Delaying action upon microorganisms => **Creates dehydration of microbial cell** => **by osmosis** => results into **plasmolysis** of the cell.
- Reduction in solubility of oxygen in water => **decreases oxygen** level in food => **reduce** growth of aerobic microorganisms.

## EXAMPLES OF PICKLING AND SALTING

FISH IN BRINE SOLUTION

PICKLES



- It is more effective against **bacteria & mold** compared to yeast.
- One of the traditional method of => food preservation.
- Mainly used => preserve **pickles, meat & fish**.
- **Fish** is usually salted by => immersing in brine or by mixing with dry salt.
- Important as a preservative => **cheese and table butter**.
- Depending upon => type of cheese => salt content varied from **1 to 5 %**.
- In **table butter** => salt is added at a max concentration => **3 %**.

## Sucrose (Sugar)



- **More effective** => **bacteria and mold** compared to yeast.
- **Antimicrobial action** of sucrose arises from => lowering **water activity (aw)** of food product => which renders condition unfavorable for microbial growth.
- This creates dehydration of microbial cell => by osmosis => results into **plasmolysis** of cells.
- Food products preserved with sugar :
  - ❖ **fruit products - jam, jellies, squash etc.,**
  - ❖ **dairy products - sweetened condensed milk, sweets.**



**THANKS**