

## **PRESERVATION BY USING CHEMICALS**

A preservative is defined as only substance which is capable of inhibiting, retarding or arresting the growth of microorganisms.

Microbial spoilage of food products is also controlled by using chemical preservatives. The inhibitory action of preservatives is due to their interfering with the mechanism of cell division, permeability of cell membrane and activity of enzymes.

Pasteurized squashes, cordials and crushes have a cooked flavour. After the container is opened, they ferment and spoil within a short period, particularly in a tropical climate. To avoid this, it is necessary to use chemical preservatives. Chemically preserved squashes and crushes can be kept for a fairly long time even after opening the seal of the bottle. It is however, essential that the use of chemicals is properly controlled, as their indiscriminate use is likely to be harmful. The preservative used should not be injurious to health and should be non-irritant. It should be easy to detect and estimate.

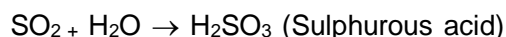
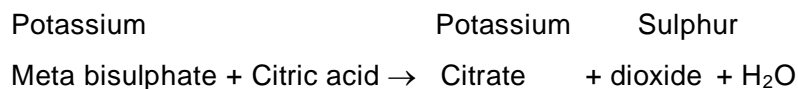
Two important chemical preservatives are permitted to beverages according to the FPO (1955).

1. Sulphur dioxide and
2. Benzoic acid

### SULPHUR DIOXIDE

It is widely used throughout the world in the preservation of juice, pulp, nectar, squash, crush, cordial and other products. It has good preserving action against bacteria and moulds and inhibits enzymes, etc. In addition, it acts as an antioxidant and bleaching agent. These properties help in the retention of ascorbic acid, carotene and other oxidizable compounds. It also retards the development of nonenzymatic browning or discolouration of the product. It is generally used in the form of its salts such as sulphite, bisulphate and metabisulphite.

Potassium metabisulphite ( $K_2O \cdot 2SO_2$  (or)  $K_2S_2O_5$ ) is commonly used as a stable source of  $SO_2$ . Being a solid, it is easier to use than liquid (or) gaseous  $SO_2$ . It is fairly stable in neutral (or) alkaline media but decomposed by weak acids like carbonic, citric, tartaric acid and malic acids. When added to fruit juice (or) squash it reacts with the acid in the juice forming the potassium salt and  $SO_2$ , which is liberated and forms sulphurous acid with the water of the juice. The reactions involved are as follows



$SO_2$  has a better preservative action than sodium benzoate against bacteria and moulds. It also retards the development of yeasts in juice, but cannot arrest their multiplication, once their number has reached a high value.

It is well known that fruit juices with high acidity do not undergo fermentation readily. The preservative action of the fruit acid is due to its hydrogen ion concentration. The pH for the growth of moulds ranges from 1.5 to 8.5, that of yeasts from 2.5-8.0, and of bacteria from 4.0 to 7.5. As fruit beverage like citrus squashes and cordials have generally a pH of 2.5 to 3.5, the growth of moulds and yeasts in them cannot be prevented by acidity alone. Bacteria, however, cannot grow. The pH is therefore, of great importance in the preservation of food product and by regulating it, one or more kinds of microorganisms in the beverage can be eliminated.

The concentration of  $\text{SO}_2$  required preventing the growth of microorganism at different pH levels are as under.

pH	<b>S.ellipsoideus</b> <b>(yeasts)</b>	<b>Mucor</b> <b>(mold)</b>	<b>Penicillium</b> <b>(mold)</b>	<b>Mixed bacteria</b>
2.5	200	200	300	100
3.5	800	600	600	300
7.0	Above 5000	Above 5000	Above 5000	Above 1000

The toxicity of  $\text{SO}_2$  increases at high temperature. Hence its effectiveness depends on the acidity, pH, temperature and substances present in fruit juice.

According to FPO, the maximum amount of  $\text{SO}_2$  allowed in fruit juice is 700 ppm, in squash, crush and cordial 350 ppm and in RTS and nectar 100 ppm. The advantages of using  $\text{SO}_2$  are a) It has a better preserving action than sodium benzoate against bacterial fermentation b) it helps to retain the colour of the beverage for a longer time than sodium benzoate ( c) being a gas, it helps in preserving the surface layer of juices also (d) being highly soluble in juices and squashes, it ensures better mixing and hence their preservation and (e) any excess of  $\text{SO}_2$  present can be removed either by heating the juice to about  $71^\circ\text{C}$  or by passing air through it or by subjecting the juice to vacuum. This causes some loss of the flavouring materials due to volatilization, which can be compensated by adding flavours.

#### Disadvantages (or) limitations

- It cannot be used in the case of some naturally coloured juices like those of jamun, pomegranate, strawberry, coloured grapes, plum etc. on account of its bleaching action.
- It cannot also be used for juices which are to be packed in tin containers because it not only corrodes the tin causing pinholes, but also forms  $\text{H}_2\text{S}$  which has a disagreeable smell and reacts with the iron of the tin container to form a black compound, both of which are highly undesirable and

- c. SO<sub>2</sub> gives a slight taste and colour to freshly prepared beverages but these are not serious defects if the beverage is diluted before drinking.

## II. Benzoic acid

It is only partially soluble in H<sub>2</sub>O hence its salt, sodium benzoate is used. One part of sodium benzoate is soluble in 1.8 parts of water at ordinary temperature, whereas only 0.34 parts of benzoic acid is soluble in 100 parts of water. Sodium benzoate is thus nearly 170 times as soluble as benzoic acid, pure sodium benzoate is tasteless and odourless.

The antibacterial action of benzoic acid is increased in the presence of CO<sub>2</sub> and acid e.g. *Bacillus subtilis* cannot survive in benzoic acid solution in the presence of CO<sub>2</sub>. Benzoic acid is more effective against yeasts than against moulds. It does not stop lactic acid and acetic acid fermentation.

The quantity of benzoic acid required depends on the nature of the product to be preserved, particularly its acidity. In case of juices having a pH of 3.5-4.0, which is the range of a majority of fruit juices, addition of 0.06 to 0.10% of sodium benzoate has been found to be sufficient. In case of less acid juices such as grape juice at least 0.3% is necessary. The action of benzoic acid is reduced considerably at pH 5.0. Sodium benzoate in excess of 0.1% may produce a disagreeable burning taste. According to FPO its permitted level in RTS and nectar is 100 ppm and in squash, crush and cordial 600 ppm.

In the long run benzoic acid may darken the product. It is, therefore, mostly used in coloured products of tomato, jamun, pomegranate, plum, watermelon, strawberry, coloured grapes etc.

## Preservation by Using Radiation

Radiation may be defined as the emission and propagation of energy through space or through a material medium. The type of radiation of primary interest in food preservation is electromagnetic.

Initially, the destruction of microorganisms in foods by ionizing radiation was referred to by terminology brought over from heat and chemical destruction of microorganisms. Although microorganisms can indeed be destroyed by chemicals, heat, and radiation, there is, nevertheless, a lack of precision in the use of this terminology for radiation-treated foods. Consequently, in 1964 an international group of microbiologists suggested the following terminology for radiation treatment of foods.<sup>24</sup>

## Radappertization

Is equivalent to radiation sterilization or "commercial sterility," as it is understood in the canning industry. Typical levels of irradiation are 3(MK) kGy.

## Radicalization

Is equivalent to pasteurization— of milk, for example. Specifically, it refers to the reduction of the number of viable specific nonspore-forming pathogens, other than viruses, so that none is detectable by any standard method. Typical levels to achieve this process are 2.5-10 kGy.

## Radurization

May be considered equivalent to pasteurization. It refers to the enhancement of the keeping quality of a food by causing substantial reduction in the numbers of viable specific spoilage microbes by radiation. Common dose levels are 0.75-2.5 kGy for fresh meats, poultry, seafood, fruits, vegetables, and cereal grains.

## Radappertization

Radappertization of any foods may be achieved by application of the proper dose of radiation under the proper conditions.

## Preservation by Using High temperature

The use of high temperatures to preserve food is based on their destructive effects on microorganisms.

By high temperatures are meant any and all temperatures above ambient. With respect to food preservation, there are two temperature categories in common use: **pasteurization and sterilization.**

**Pasteurization:** by use of heat implies either the destruction of all disease-producing organisms (for example, pasteurization of milk) or the destruction or reduction in the number of spoilage organisms in certain foods, as in the pasteurization of vinegar. The pasteurization of milk is achieved by heating as follows:

145°F (63°C) for 30 minutes (low temperature, long time [LTLT]) 161°F (72°C) for 15 seconds (primary high temperature, short time [HTST] method) 191°F(89°C) for 1.0 second, 194°F (90°C) for 0.5 second, 201°F(94°C)for0.1 second, 212°F (100°C) for 0.01 second. These treatments are equivalent and are sufficient to destroy the most heat resistant of the nonspore-forming pathogenic organisms—*Mycobacterium tuberculosis* and *Coxiella burnetii*. When six different strains of *M. paratuberculosis* were added to milk at levels from 40 to 100,000 colony-forming units (cfu)/mL followed by pasteurization by LTLT or HTST, no survivors were detected on suitable culture media incubated for 4 months. Milk pasteurization temperatures are sufficient to destroy, in addition, all yeasts, molds, gram negative bacteria, and many gram positives. The two groups of organisms that survive milk pasteurization are placed into one of two groups: thermotolerants and thermophiles. Thermotolerant organisms are those that can survive

exposure to relatively high temperatures but do not necessarily grow at these temperatures. The nonsporeforming organisms that survive milk pasteurization generally belong to the genera *Streptococcus* and *Lactobacillus*, and sometimes to other genera. Thermophilic organisms are those that not only survive relatively high temperatures but *require* high temperatures for their growth and metabolic activities. The genera *Bacillus* and *Clostridium* contain the thermophiles of greatest importance in foods. Pasteurization (to destroy spoilage biota) of beers in the brewing industry is carried out usually for 8-15 minutes at 60°C.

**Sterilization:** means the destruction of all viable organisms as may be measured by an appropriate plating or enumerating technique. Canned foods are sometimes called "commercially sterile" to indicate that no viable organisms can be detected by the usual cultural methods employed or that the number of survivors is so low as to be of no significance under the conditions of canning and storage. Also, microorganisms may be present in canned foods that cannot grow in the product by reason of undesirable pH, oxidation-reduction potential (Eh), or temperature of storage.