PRESERVATIVES

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1.- Permitted levels

1.1.-Recommended additives to inhibit micro-organisms

- CHEMICAL PRESERVATIVES -

Preservative

Sulphites and sulphur dioxide. Sulphur dioxide gas and sodium or potassium sulphite, bisulphite or metabisulphite are the most common forms used.

Commonly used levels

0.005-0.2%

Comments

Fruit puree can be preserved by adding 600ppm sulphur dioxide (SO2) and sealing in drums. The semi-processed fruit can be stored for several months. Most of the SO2 that is absorbed during storage is lost during drying, but it is recommended that the puree is boiled before drying to reduce the levels of residual SO_2.

Preservative

Sorbic acid. Sorbic acid and sodium and potassium sorbate are used to inhibit the growth of moulds and yeasts. The activity of sorbic acid increases as the pH decreases. Sorbic acid and its salts are tasteless and odourless when used at levels below 0.3%.

Commonly used levels

0.05-0.2%

Preservative

Benzoic acid. Benzoic acid, in the form of sodium benzoate, is a widely used food preservative suitable for acid foods. Benzoic acid is often used in combination with sorbic acid at levels of 0.05 to 0.1%.

Commonly used levels

0.03-0.2%

Preservative

Citric acid. Citric acid is found naturally in citrus fruit. It is widely used in carbonated drinks and as an acidifier of foods. It is less effective at controlling the growth of yeasts and mould than the other acids.

Commonly used levels

no limit

Preservatives - permitted levels in fruit products

The use of chemical preservatives is regulated by maximum permitted levels. These amounts vary between countries. Processors should check with their local authorities for the local regulations and for the regulations in the country of sale.

Chemical preservatives cannot be used to cover up for poor quality raw materials. They are only added as a precaution to extend the shelf life of products by inhibiting microbial spoilage.

Some chemical preservatives can taint the flavour of fruit juices if the recommended level is exceeded. Some consumers prefer to consume fruit juices with no chemical additives. They may be prepared to pay a premium for these products.

1.2.-Recommended additives to reduce PH

Organic acids, which are both naturally present in foods during fermentation or which are added to foods during processing, have been used for many years for food preservation. The most commonly used organic acids include citric, succinic, malic, tartaric, benzoic, lactic and propionic acids.

Citric acid is found in citrus fruits. This acid is more effective than acetic and lactic acids at inhibiting the growth of thermophilic bacteria.

Malic acid is widely found in fruit and vegetables. It inhibits the growth of yeasts and some bacteria due to a decrease in pH.

Tartaric acid is present in grapes and pineapples.

Benzoic acid is the oldest and most widely used preservative. It occurs naturally in cranberries, raspberries, plums, prunes, cinnamon and cloves.

Benzoic acid is primarily used as an antifungal agent in fruit-based and fruit beverages, fruit products, bakery products and margarine. Lactic acid is not naturally present in foods, but is formed during fermentation of sugar by lactic acid bacteria. Lactic acid inhibits the growth of spore forming bacteria at pH 5.0 but does not affect the growth of yeast and moulds.

Propionic acid occurs in foods by natural processing. It is found in Swiss cheese at concentrations of up to 1%. It is effective against moulds and bacteria.

2.- Sulphuring or sulphiting

Sulphur dioxide is used to preserve the colour and increase the shelf life of dried foods. There are two main methods of adding sulphur to foods - sulphuring and sulphiting. Sulphuring is more common for fruits and sulphiting for vegetables. Sulphuring uses rock sulphur which may be more readily available than sodium or potassium metabisulphite. One of the disadvantages of sulphiting is that it wets the fruit (the fruit is dipped into a solution of metabisulphite). This prolongs the drying period required.

- Sulphuring -

Sulphuring involves burning elemental sulphur in an enclosed chamber. Sulphur dioxide gas is given off, which is absorbed by the food. The sulphur chamber is either a cabinet or tent in which perforated trays are stacked on top of each other. Food is placed on the trays inside the cabinet. The sulphur is placed in a box close to the trays and allowed to burn for 1-3 hours. A simple sulphur tent can be made from a rack of shelves that are covered with an airtight polythene sheet. It is essential that the cover does not have holes and that it is firmly anchored down at the ground to prevent sulphur dioxide gas from escaping. The amount of sulphur used and the time of exposure depends on the commodity, its moisture content, the sizes of the pieces and the permitted final levels in the product. For most fruits, 5-6g of sulphur per kg of food is adequate. For most vegetables, 10-12g sulphur per kg food is sufficient. Sulphuring should always be carried out in a well-ventilated place - preferably outdoors - as the fumes of burning sulphur are unpleasant and can be dangerous if inhaled.

Sulphur dioxide gas is corrosive, therefore the cabinet used for sulphuring should not be made of metal. Wooden or plastic-coated metal shelves should be used within a wooden cabinet or a polythene tent.

3.- Sulphiting

Sulphiting uses sulphite salts such as sodium or potassium sulphite or metabisulphite. The fruit or vegetable is either soaked in a sulphite solution or, if the commodity is being blanched in water, sulphite can be added to the blanching water.

Adding sulphite to the blanching water is attractive since it combines two operations into one. However, if the vegetables are steam blanched, or if they are not blanched at all, they need to be dipped into a sulphite solution.

The strength of the sulphite solution and the dipping, spraying or blanching times depend on the type, size and composition of fruit or vegetable.

Dipping and spraying sulphite are not generally recommended for small-scale processors. Immersion blanching in a sodium metabisulphite solution is the most appropriate method, provided that the chemicals are available locally.

Sulphiting must be controlled accurately to obtain the correct levels of SO_2 in the food. Too much SO_2 gives the food an unpleasant smell and may be illegal according to local permitted levels. The strength of sodium metabisulphite solution is expressed as parts per million (ppm) or mg per kg. As a conversion, 10,000ppm SO_2 is equivalent to a 1% solution. 1.5g of sodium metabisulphite dissolved in 1 litre of water will give 1000ppm (0.1%) SO_2. The most practical way to make a sulphite solution is to prepare a stock solution of 8,000ppm (0.8%). This is done by dissolving 12g (2.5 level teaspoons) sodium metabisulphite in 1 litre of water. The stock solution can be diluted by adding extra water to give weaker solutions.

4.-Pasteurisation

4.1.-The principles of pasteurisation

Pasteurisation is a relatively mild form of heat treatment, generally at a temperature lower than the boiling point of water. Because it is a mild heat treatment, pasteurisation causes minimal changes in the taste, colour and nutritive value of a food. Foods (fruit and vegetable juices and purees) are generally pasteurised to reduce enzyme and microbial activity and thereby increase the shelf life. Pasteurisation extends the storage life of bottled fruits and juices by several months. Pasteurisation is often combined with another form of preservation such as concentration, acidification and chemical preservation. The severity of heat treatment and the resulting extension of shelf life are mostly determined by the pH of the food. In low acid foods (pH>4.5) the main purpose is to destroy pathogenic bacteria. In foods with pH below 4.5, the main purpose is to destroy spoilage micro-organisms and prevent enzyme activity. Blanching is a form of pasteurisation that is applied to vegetables to inactivate enzymes and to preserve colour. If it is carried out for long enough, it may also destroy some micro-organisms. Some low pH foods, for example fruit juices and pickles, are pasteurised in their containers after packaging. The process is similar to canning, but the heat treatment is less severe. The benefit of pasteurising in containers is that the risk of contamination of the product after packaging is greatly reduced.

The main factors that influence pasteurisation of a food are as follows:

- Temperature and time

- Acidity of the products

- Air remaining in the containers

4.2.-Practical aspects of pasteurisation

In terms of practical processing of fruit juices, there are two main types of pasteurisation:

Low Temperature Long Time (LTLT) The temperature used is fairly low and the food is held at this temperature for several minutes. There are three distinct phases of treatment: heating to the desired temperature, holding at this temperature for the required time, cooling the product. Two typical time and temperature combinations used for fruit juices are as follows: 63-65°C for 30 minutes 75°C for 8-10 minutes This is the method of pasteurisation most regularly used by small-scale processors as it requires very little equipment and produces a safe product.

High Temperature Short Time (HTST) High temperature short time pasteurisation has fewer damaging effects on the nutritional value, especially on the vitamin content of foods. However, it requires more accurate temperature control and slightly more sophisticated equipment. Depending on the pH of the food, the type of product and the result required, there are a number of different combinations of time and temperature that are commonly used. 88°C for 1 minute 100°C for 12 seconds 121°C for 2 seconds

4.3.-Pasteurisation of packaged foods

Fruit juices and purees are usually pasteurised after filling in to containers. Hot water is normally used if the food is packaged in glass, to reduce the risk of cracking the glass. The maximum temperature differences between the container and the water are 20°C for heating and 10°C for cooling. Metal or plastic containers are pasteurised using steam and air as there is less risk of the containers breaking. The food is then cooled to about 40°C to evaporate any surface water and minimise corrosion to the container of cap.

Hot water pasteurisers may be batch or continuous. The simplest form of batch equipment is a hot water bath in which crates of packaged food are heated to a pre-set temperature and held for the required length of time. Cold water is then pumped in to cool the product. A continuous version contains a conveyer belt that carries the bottles through heating and cooling stages.

During heating it is essential that the heat penetrates through to the centre of the bottled product. The time taken for this to happen is dependent on the volume of bottle and the type of contents. This is facilitated if the bottles are shaken or vibrated during heating, to mix the contents of the bottle.

It is only possible to measure the internal temperature of the products by opening the bottles. One or two bottles per batch should be used as test samples to monitor the temperature. These cannot be used for sale as they have been opened and will therefore have a reduced shelf life.

4.4.-Pasteurisation of unpackaged liquid foods

At the small-scale, open boiling pans or surface heat exchangers are used to pasteurise small batches of juice. However, for larger scale activities, plate heat exchangers are widely used.

Equipment for pasteurisation

The simplest form of pasteuriser is a hot water bath in which bottles are immersed. A more advanced pasteurising unit includes plate heat exchangers and tubes through which the liquid to be pasteurised passes. This is quite expensive and usually recommended for large-scale operations.

5.-Quality Assurance

5.1.-The preservation index

The Preservation Index is a measure of the preserving power of combinations of acid and sugar (sugar is measured as total solids). The index is used to assess whether a chutney or pickle is safe from food spoilage and food poisoning micro-organisms.

A correct balance between the levels of sugar and acid is needed to prevent the growth of mould after the chutney is opened.

The preservation index can be used to calculate the amounts of ingredients (sugar and acid) that need to be added to ensure a product will be preserved after opening.

The preservation index is calculated as follows:

$$\frac{\text{total acidity} \times 100}{(100 - \text{total solid})} = \text{not less than } 3.6\%$$

The measurement of total solids and acidity is described below. If the processor does not have access to the type of equipment required, it is advisable to take a sample to a local bureau of standards or food testing laboratory for analysis.

5.2.-Measurement of pH

PH is an indication of the acidity of a solution. It is measured on a scale of 1 to 14 where pH1-6 is acid, pH8-14 is alkali and pH7 is neutral. It can be measured by sipping a piece of pH paper into a sample of liquid food and comparing the colour change with a chart supplied with the paper. For greater accuracy a pH meter should be used.

The measurement of pH does not measure the amount of acid present. This is important in pickling when preservation is achieved by the correct combination of acids, salt and sugar. Another method should be used.

5.3.-Measurement of acidity

The following method is used to calculate the total amount of acid (citric acid or acetic acid) in a product.

1. Take a 10g sample of food and mix with 90ml distilled water.

2. Add 0.3ml of indicator solution such as phenolphthalein.

3. Titrate the solution with 0.1M sodium hydroxide until the pink colour does not change. This should be done by carefully adding sodium hydroxide from a graduated vessel such as a burette.

4. Make a note of the amount of sodium hydroxide used to reach the end point.

5. Calculate the amount of acid according to the following formula:

% acid = number of ml sodium hydroxide x conversion factor

Conversion factors:

Acetic acid 0,06

Citric acid 0,064

Tartaric acid 0,075

Lactic acid 0,09

It is necessary to know the type of acid before selecting the conversion factor.

6.4.- Measurement of total solids

The soluble solids content of a solution is determined by the index of refraction. This is measured using a refractometer, and is referred to as the degrees Brix. It is widely used during fruit and vegetable processing to determine the concentration of sugar in the products.

Sugar concentration is expressed in degrees Brix. At 20°C, the Brix is equivalent to the percentage of sucrose (sugar) in the solution (60° Brix is equivalent to a sugar content of 60%). The measurement must be made at 20°C to get an accurate value.

6.5.-Measurement of degrees brix

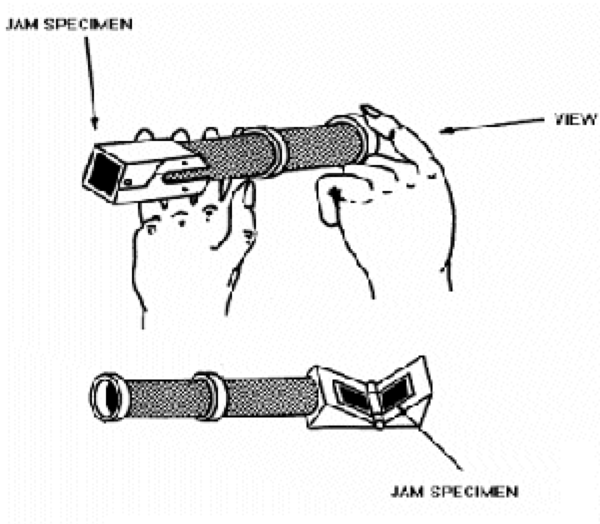
1. Ensure the solution is at a temperature of 20°C.

2. Place one or two drops of sample onto the prism and close the prism carefully. The sample should be evenly spread over the surface of the prism.

3. Hold the refractometer near a source of light and look though the field of vision.

4. The line between the dark and light fields will be seen in the field of vision. Read the corresponding number on the scale. This is the percentage of sugar in the sample.

5. Open the prism and remove the sample with a piece of paper or clean wet cotton.



6.6.-Measurement of salt concentration

The concentration of salt in pickling brines can be measured using a brine hydrometer. A sample of brine at 20°C is filled into a large clear glass or plastic cylinder and the hydrometer placed in the liquid.

When the hydrometer has stopped moving, the scale is read at the surface of the liquid.

The reading is converted to % salt using a conversion table suppled with the hydrometer.