UNIT 12 CHEMICAL

Structure

12.0 OBJECTIVES

After studying this unit, you should be able to:

- know about different types of chemical preservatives; and
- define the essential chemical preservative limits for the various foods.

12.1 INTRODUCTION

In this unit we will make you aware about the characteristics of various chemical preservatives with special stress on antimicrobial food preservatives. We will also brief you about different chemical preservatives permitted in processed products along with maximum levels of antimicrobials permitted in foods. You will also learn about various factors which determine/ influence the action of chemical food preservatives.

12.1.1 Need for Food Preservation

Unless you grow all your food in your own garden and prepare all your meals from scratch, it's almost impossible to eat food without preservatives added by manufacturers during processing.

Food preservation is a method of preparing food so that it can be stored for future use. Because most foods remain edible for only a brief period of time, people since the earliest ages have experimented with methods for successful food preservation. Among the products of early food conservation were cheese and butter, raisins, pemmican, sausage, bacon, and grain. Scientific investigations pointed that food spoilage was mainly caused by microorganisms widely distributed in the environment. Therefore, food preservation depends on rendering conditions unfavourable for microbial growth

12.1.2 Techniques of Food Preservation

The techniques of food preservation can be separated into two groups:

- physical
- chemical

Physical methods of preservation rely on killing the microorganisms present, or at least stopping their growth for long enough to allow the food to be safely consumed. The physical methods include canning, freezing, drying, gamma irradiation, ultraviolet or high intensity white light, ultra high pressure and filtration.

Chemical food preservatives are substances which, under certain conditions, either delay the growth of microorganisms without necessarily destroying them. These are added in very low quantities and which do not alter the organoleptic and physico-chemical properties of the foods at or only very little. These work either as direct microbial poisons or by reducing the pH to a level of acidity that prevents the growth of microorganisms.

12.2 CHARACTERISTICS OF CHEMICAL PRESERVATIVES

The Food, Drug, and Cosmetic Act permit for the use of chemical preservatives in foods if the chemical is:

1. Generally recognized as safe (GRAS) for such use; or if a food additive is covered by food additive regulations prescribing conditions of safe use.
2. Not used in such a way as to conceal damage or inferiority or to make the food appear better or of greater value than it is.
3. Properly declared on the label of the food in which used.
4. It should be food grade.
5. It should perform its intended function.
6. It should be used in accordance with good manufacturing practices and, where applicable, in accord with existing food additive regulations.

According to rules, a food manufacturer must get approval from Government regulatory authorities before using a new preservative, or before using a previously approved preservative in a new way or in a different amount. In its petition for approval, the manufacturer must demonstrate that the preservative is safe for consumers, considering:

- the probable amount of the preservative that will be consumed with the food product, or the amount of any substance formed in or on the food resulting from use of the preservative
- the cumulative effect of the preservative in the diet
- the potential toxicity (including cancer-causing) of the preservative when ingested by humans or animals.

- A preservative may not be used to deceive a consumer by changing the food to make it appear other than it is. For example, preservatives that contain sulfites are prohibited on meats because they restore the red colour, giving meat a false appearance of freshness.
- The food additive regulations require the preservative to be of food grade and be prepared and handled as a food ingredient.
- The quantity added to food must not exceed the amount needed to achieve the manufacturer's intended effect.

Regulations about the use of nitrites demonstrate the scrutiny given to the use of additives. Nitrites, used in combination with salt, serve as antimicrobials in meat to inhibit the growth of bacterial spores that cause botulism, a deadly food-borne illness. Nitrites are also used as preservatives and for flavouring and fixing colour in a number of red meat, poultry, and fish products. Since the original approvals were granted for specific uses of sodium nitrite, safety concerns have arisen. Nitrite salts can react with certain amines (derivatives of ammonia) in food to produce nitrosamines, many of which are known to cause cancer. A food manufacturer wanting to use sodium nitrites must show that nitrosamines will not form in hazardous amounts in the product under the additive's intended conditions of use. For example, regulations specify that sodium nitrite, used as an antimicrobial against the formation of botulinum toxin in smoked fish, must be present in 100 to 200 parts per million. In addition, other antioxidants, such as sodium ascorbate or sodium erythorbate, may be added to inhibit the formation of nitrosamines.

Check Your Progress Exercise 1

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What are chemical preservatives?

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2. Name three important characteristics of chemical preservatives?

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3. Name important facts that a manufacturer must demonstrate to regulatory authorities for getting a new preservative formulation approved?

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12.3 CLASSIFICATION OF PRESERVATIVES

Preservatives can be categorized into following types:

1. Antimicrobials that inhibit growth of bacteria, yeasts, or molds.
2. Antioxidants that slow air oxidation of fats and lipids, which leads to rancidity.
3. Antienzymatic that blocks the natural ripening and enzymatic processes that continue to occur in foodstuffs after harvest.
4. Preservatives from natural products.
5. Traditional preservatives

We will discuss the first type of preservatives in detail but before that brief description of other types is given below for the sake of awareness.

12.3.1 Antioxidant Preservatives

As antioxidants, they keep foods from becoming rancid, browning, or developing black spots. Rancid foods may not make you sick, but they smell and taste bad. Antioxidants suppress the reaction that occurs when foods combine with oxygen in the presence of light, heat, and some metals. Antioxidants also minimize the damage to some essential amino acids--the building blocks of proteins--and the loss of some vitamins.

Antioxidant preservatives, such as butylated hydroxytoluene, butylated hydroxyanisole, *tert*-butylhydroquinone, and propyl gallate, stop the chemical breakdown of food that happens in the presence of oxygen. Unsaturated fatty acids in oils and lipids are particularly susceptible to autooxidation. In this process, a free radical initiates peroxide formation at fatty acid double bonds. The chain reaction propagates to other double bonds, and aldehyde, ketone, and acid-termination products eventually build up to create the rancid off-flavors characteristic of oils and fats gone bad. Antioxidant preservatives sop up the free radicals that help initiate and propagate these reactions.

12.3.2 Preservatives that Targets Enzymes

These are preservatives that target enzymes in the food itself that continue to metabolize after harvest. The enzyme phenolase, for example, goes to work as soon as an apple or potato is cut. It browns the exposed surface. Acids such as citric acid and ascorbic acid (vitamin C) inhibit phenolase by making the pH uncomfortably low for the enzyme. Metal-chelating agents such as EDTA (ethylenediamine tetraacetic acid) can remove the metal cofactors that many enzymes need. Chelators also make it difficult for bacterial and fungal enzymes to carry on.

12.3.3 Preservatives from Natural Products

Some of the newest antimicrobials have been found in microorganisms themselves as they form their own chemical defenses when competing with each other for space and nutrients. For example, nisin and natamycin, the cheese preservatives called bacteriocins – are harvested from microorganisms. In the U.S., nisin is used to inhibit outgrowth of *Clostridium botulinum* spores (the cause of botulism) and toxin formation in pasteurized process cheese spreads with fruits, vegetables or meats at levels not exceeding good manufacturing practice. Current good manufacturing practice in this case is the quantity of the ingredient that delivers a maximum of 250 p.p.m. of nisin in the finished product. Nisaplin-brand nisin is also approved for liquid egg products, dressings, and sauces. In other countries it is also used in fresh and recombined milk, fermented beverages like beer, canned foods, frozen desserts, and high moisture/reduced fat foods. Nisin is considered effective at controlling a wide range of gram-positive organisms including: *Listeria enterococcus*, *Bacillus sporothermodurans*, and *clostridium*. Used alone, it is not effective on gram-negative bacteria (like *E. coli*), yeasts, and molds. However, research suggests that it may be useful against some gram-negative bacteria when used in conjunction with other preservatives.

12.3.4 Traditional Chemical Food Preservatives

Traditional chemical food preservatives and their use in fruit and vegetable processing technologies are common salt and sugar.

Common salt used in brined vegetables. There is no limit for their use.

Sugars (sucrose, glucose, fructose and syrups): foods preserved by high sugar concentrations such as jellies, preserves, syrups, juice concentrates. It acts by interaction of sugar with other ingredients or processes such as drying and heating. There is no limit for their use.

Check Your Progress Exercise 2 ✍

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Name two anti-oxidant preservatives?

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2. How does ascorbic and inhibit phenolase enzyme?

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3. Name two preservatives of microbial origin?

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4. Is there any limit for traditional food preservatives?

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12.4 ANTIMICROBIAL PRESERVATIVES

Usually accepted chemical food preservatives are detailed in Table 12.1.

Table 12.1: Commonly used antimicrobial chemical food preservatives

Agent	Acceptable Daily intake (mg/Kg body weight)	Commonly used levels (%)	Typical usage
Sorbic acid Potassium sorbate	25	0.05-0.2	fruits; vegetables; pickled products; jams, jellies
Benzoic acid Sodium benzoate	5	0.03-0.2	Vegetable pickles; preserves; jams; jellies; semi-processed products
Propionic acid Sodium propionate	10	0.1-0.3	Bakery goods, cheese spread, fruits, vegetables
Methyl paraben Ethyl paraben Propyl paraben	10	0.05-0.1	Bakery goods, fruit products; pickles; sauces
Lactic acid	No limit	No limit	Fermented meat, dairy and vegetable products, sauces and dressings, drinks.
Citric acid	No limit	No limit	fruit juices; jams; other sugar preserves
Acetic acid	No limit	No limit	vegetable pickles; other vegetable sauces, chutney
Sodium nitrite	0.2	0.01-0.02	Meat products
Sulphur dioxide	0.7	0.005-0.2	fruit juices, dried / dehydrated fruits and vegetables, semi-processed products

12.4.1 Organic Acids and Esters

Sodium Benzoate and Benzoic Acid

Benzoic acid is the compound with the antimicrobial properties, and is found naturally in cranberries, prunes, greengage plums, cinnamon, ripe cloves and apples. Sodium benzoate produces benzoic acid once it is dissolved in water.

Sodium benzoate is the sodium salt of benzoic acid and is preferred over benzoic acid in many food applications because it is 180 times more soluble in water. There is a marked pH effect for this preservative: the lower the pH, the more effective it is. Sodium benzoate will only work if the food product has a pH below 4.5; that is, if the food is naturally acidic or has been acidified.

For example, at pH 3.0 you only need approximately 0.05% of the compound to achieve the same antimicrobial effect as pH 4.0 and 0.1% benzoate. Optimum functionality occurs when the pH is between 2.5 and 4.0.

Sodium benzoate is used in fruit products, jams, relishes, beverages, dressings, salads, pie and pastry fillings, icings, olives and sauerkraut, and is effective against yeasts, some bacteria (food borne pathogens but not spoilage bacteria) and some molds. Sodium benzoate is a white granular or crystalline powder, odorless, inexpensive (at the usage level) and should be stored in a cool, dry place in watertight containers, if possible. It should be used at low levels to avoid possible off-flavours in some products. The maximum level allowable by law is 0.1%.

Sorbates

This family of compounds are available as sorbic acid, potassium sorbate, sodium sorbate or calcium sorbate. Sorbic acid is the compound with the antimicrobial properties but its salts (sorbates) are used in many cases due to differences in solubility.

Potassium sorbate is the potassium salt of sorbic acid, and is much more soluble in water than the acid. It is a white crystalline powder, inexpensive (at the usage level), with basically no noticeable flavour at normal usage concentrations. In wine processing, sorbates are used to prevent refermentation. Maximum level allowable by law is 0.1%. It produces sorbic acid once it is dissolved in water and is the most widely used food preservative in the world. It is effective up to pH 6.5 but effectiveness increases as the pH decreases. It has about 74% of the antimicrobial activity of the sorbic acid, thus requiring higher concentrations to obtain the same results that pure sorbic acid provides. It is effective against yeasts, molds, and select bacteria, and is widely used at 0.025 to 0.10 % levels in cheese, dips, yogurt, sour cream, bread, cakes, pies and fillings, baking mixes, doughs, icings, fudges, toppings, beverages, margarine, salads, fermented and acidified vegetables, olives, fruit products, dressings, smoked and salted fish, confections and mayonnaise.

It is important to know that the addition of sodium benzoate and/or potassium sorbate to a food product will raise the pH by approximately 0.1 to 0.5 pH units depending on the amount, pH, and type of product. Additional adjustment of the pH might be needed to keep the pH at a safe level.

In many food products, sorbate and benzoate are used together to provide greater protection against a wider variety of microorganisms. This only makes sense if the pH of the product is below 4.5.

Propionic acid

Propionic acid occurs naturally in strawberries, apples, violet leaves, grains. It is produced during the fermentation of some cheeses such as Swiss cheese, in concentrations as high as 1%, thus inhibiting the growth of molds. The acid is effective against bread molds and the spores of the bacterium *Bacillus mesentericus*, which cause an inedible condition in baked goods called rope. It is an oily liquid, soluble in water, with a slight pungent, disagreeable, rancid odour. It is also corrosive and flammable, thus requiring special handling.

Propionic acid and its salts, sodium and calcium propionates, are approved in the United States as GRAS (Generally Recognized As Safe) substances for food use. Their antimicrobial action is directed to molds and rope bacteria, with almost no effect on yeast, thus making them an ideal choice for products that use commercial yeast as an ingredient.

Like other preservatives, propionates effectiveness is affected by the pH of the food, with 5.5 pH being the upper effective limit. They are used mainly as mold and rope inhibitors in bread; although they are also useful in cheese, non-alcoholic beverages, confections, fillings, frostings, fresh dough, pizza crust, puddings, gelatins, jams, jellies and some meat products.

The sodium and calcium salts are transparent and white crystals with a mild cheese like flavour. The sodium form is more soluble in water than the calcium salt. Sodium propionate is recommended in baked products that use baking powder and baking soda instead of yeast as the leavening agent, because the presence of calcium ions (if you were to use calcium propionate) disrupts the leavening process. Calcium propionate is preferred in baked foods that use yeast, such as breads and rolls, because the nutritional value is increased by the added calcium.

Typical usage level of propionic acid and propionates is 0.1 to 0.4 %. Federal regulations limit the maximum level for flour, white bread and rolls at 0.32% based on the weight of the flour; for whole wheat products at 0.38% based on the weight of the flour; and for cheese products at 0.3 %.

It is important to know that the addition of sodium and calcium propionate to a food product will raise the pH by approximately 0.1 to 0.5 pH units depending on the amount, pH and type of product. Additional adjustment of the pH might be needed to keep the pH at a safe level.

Parabens

The parabens are esters of para-hydroxibenzoic acid. The two most common esters are methyl and propyl parabens, which are approved for food use in the United States under the GRAS classification. The maximum concentration allowed is 0.1 %. They are most active against yeasts and molds.

Parabens are white powders with faint odour and fair solubility in water at room temperature. The solubility is greatly increased by heating the water to 71.1°C-82.2°C. Methyl paraben is more soluble in water but less effective against molds than propyl paraben. To balance these differences, mixtures of 2 to 3 parts of methyl paraben with 1 part propyl paraben are normally used.

Important advantages of parabens are their effectiveness at higher pH values, from 3 up to 8, and stability to high and low temperatures, even to steam sterilization. Despite these properties, parabens are not as widely used as other antimicrobial agents, probably due to higher cost and flavour objections. Applications include bakery products (formulated without yeast), beverages, flavour extracts, food colours, fruit products, jams, jellies, preserves (artificially sweetened), gelatin, marinated and smoked fish, pickles, salad dressings, syrups, wine and olives.

Lactic acid

This acid is the main product of many food fermentations; it is formed by microbial degradation of sugars in products such as sauerkraut and pickles. The acid produced in such fermentations decreases the pH to levels unfavourable for growth of spoilage organisms such as putrefactive anaerobes and butyric-acid-producing bacteria. Yeasts and molds that can grow at such pH levels can be controlled by the inclusion of other preservatives such as sorbate and benzoate.

Acetic acid

Acetic acid is a general preservative inhibiting many species of bacteria, yeasts and to a lesser extent molds. It is also a product of the lactic-acid fermentation, and its preservative action even at identical pH levels is greater than that of lactic acid. The main applications of vinegar (acetic acid) includes products such as pickles, sauces and ketchup.

12.4.2 Gaseous Chemical Food Preservatives

Sulphur dioxide and sulphites

Sulphur dioxide (SO_2) has been used for many centuries as a fumigant and especially as a wine preservative. It is a colourless, suffocating, pungent-smelling, non-flammable gas and is very soluble in cold water (85 g in 100 ml at 25°C).

Sulphur dioxide and its various sulphites when dissolved in water at low pH yield sulphurous acid, bisulphite and sulphite ions. The various sulphite salts contain 50-68% active sulphur dioxide. A pH dependent equilibrium is formed in water and the proportion of SO_2 ions increases with decreasing pH values. At pH values less than 4.0 the antimicrobial activity reaches its maximum.

Sulphur dioxide is used as a gas or in the form of its sulphite, bisulphite and metabisulphite salts which are powders. The gaseous form is produced either by burning Sulphur or by its release from the compressed liquefied form.

Metabisulphite are more stable to oxidation than bisulphites, which in turn show greater stability than sulphites.

Mode of action

Sulphites inhibit microbial growth through a number of actions. They react with the energy rich compound, adenosine triphosphate; inhibit some metabolic pathways; and block cellular transport systems. Other antimicrobials alter microbial membrane or cell wall permeability or destroy the genetic material. In addition to its antimicrobial action, sulphur dioxide inhibits degradation reactions in fruits. It keeps raisins and other dried fruits from losing their light colour by blocking both enzymatic browning and a nonenzymatic browning reaction between reducing sugars and amino acids called the Maillard reaction. The reaction darkens raisins, alters their flavour, and reduces essential amino acid levels.

Uses

Sulphites are used to prevent or reduce discolouration of light-coloured fruits and vegetables, such as dried apples and dehydrated potatoes. These are added to sun-dried tomatoes, dried apricots, dried sweet potatoes, balsamic vinegar, red wine vinegar, lemon juice, and Hawaiian coconut syrup. These are also commonly used to lengthen the life of fruit juices. They are also used in wine-making because they inhibit bacterial growth but do not interfere with the desired development of yeast. Sulphites are also used in other ways, such as for bleaching food starches and as preventives against rust and scale in boiler water used in making steam that will come in contact with food. Some sulphites are used in the production of cellophane for food packaging.

Precautions

FDA prohibits the use of sulphites in foods that are important sources of thiamin (vitamin B1), such as enriched flour, because sulphites destroy the nutrient. It causes severe allergic reactions, especially in asthmatics though, for the majority of the population, they are safe.

According to FDA sulphites used specifically as preservatives must be listed on the label, regardless of the amount in the finished product. Sulphites used in food processing but not serving as preservatives in the final food must be listed on the label if present at levels of 10 parts per million or higher.

According to FDA the use of sulphites on fruits and vegetables intended to be eaten raw is banned. These were used to maintain the colour and crispness of fresh produce.

Carbon dioxide (CO_2)

CO_2 is a colourless, odourless, non-combustible gas, acidic in odour and flavour. In commercial practice it is sold as a liquid under pressure (58 kg per cm^3) or solidified as dry ice.

Carbon dioxide is used as a solid (dry ice) in many countries as a means of low-temperature storage and transportation of food products. Beside keeping the temperature low, as it sublimes, the gaseous CO_2 inhibits growth of psychrotrophic microorganisms and prevents spoilage of the fruits and vegetables, etc.

It is used as a direct additive in the storage of fruits and vegetables. In the controlled/ modified environment storage of fruit and vegetables, the correct combination of O_2 and CO_2 delays respiration and ripening as well as retarding mold and yeast growth.

The final result is an extended storage of the products for transportation and for consumption during the off-season. The amount of CO_2 (5-10%) is determined by factors such as nature of product, variety, climate and extent of storage.

Chlorine

The various forms of chlorine constitute the most widely used chemical sanitizer in the food industry. These chlorine forms include chlorine (Cl_2), sodium hypochlorite (NaOCl), calcium hypochlorite ($Ca(OCl)_2$) and chlorine dioxide gas (ClO_2).These compounds are used as water adjuncts in processes such as product washing, transport, and cooling of heat-sterilised cans; in sanitising solutions for equipment surfaces, etc.

Important applications of chlorine and its compounds include disinfection of drinking water and sanitation of food processing equipment.

12.4.3 Nitrites and Nitrates

Nitrites and nitrates are used mainly among the packaged meats. Sodium nitrate is added to meats such as ham, bacon, hot dogs and smoked fish. Nitrates break down in the body to nitrites and this stops the growth of bacteria, especially the bacteria that cause botulism poisoning. They are the food industry's primary chemical defense against the bacterium *Clostridium botulinum*.

It also stabilizes the red colour in cured meat and stops it turning grey. Nitrates readily convert to nitrites, which then react with the protein myoglobin to form nitric oxide myoglobin. During cooking, this is converted to nitrosohemochrome, a stable, pink pigment. They also impart a pink, fresh hue to cured meat. This chemical stabilises the red colour of the meat and gives an appearance of fresh meat. That is why nitrites are a favourite preservative of meat processors even though its excess use is restricted in many countries.

Precaution

Nitrite salts can react with certain amines in food to produce nitrosamines, which are known to cause cancer. Addition of Sodium ascorbate or sodium erythorbate inhibits nitrosamine formation and reduces the problem of nitrosamines.

The use of nitrite and nitrate has decreased greatly because of refrigeration and restrictions on the amounts used. Even though nitrite and nitrate cause only a small risk, it is always better to have fresh meat and meat product.

Check Your Progress Exercise 3

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Name four important organic acids used as chemical preservatives?

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2. What precautions should be observed before using SO_2 as preservative?

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3. How does nitrates impart red colour to meat?

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12.5 GENERAL RULES FOR CHEMICAL PRESERVATION

- Chemical food preservatives have to be used only at a dosage level which is needed for a normal preservation and not more.

- "Reconditioning" of chemical preserved food, e.g. a new addition of preservative in order to stop a microbiological deterioration already occurred is not recommended.

- The use of chemical preservatives MUST be strictly limited to those substances which are recognised as being without harmful effects on human beings' health and are accepted by national and international standards and legislation.

Factors which determine/ influence the action of chemical food preservatives

a) Factors related to micro-organisms:

As a general rule it is possible to take the following facts as a basis:

- Sulphur dioxide and its derivatives can be considered as an "universal" preservative as; they have an antiseptic action on bacteria as well as on yeasts and molds;

- Benzoic acid and its derivatives have a preservative action which is stronger against bacteria than on yeasts and molds;

- Sorbic acid acts on molds and certain yeast species; in higher dosage levels it acts also on bacteria, except lactic and acetic ones;

- The initial number of microorganisms in the treated product determines the efficiency of the chemical preservative.

- The efficiency is less if the product has been contaminated because of preliminary careless hygienic treatment or an incipient alteration. Therefore, with a low initial number of microorganisms in the product, the preservative dosage level could be reduced.

b) Factors related to the product:

- Chemical composition of the product.

- *pH value of the product:* the efficiency of the majority of chemical preservatives is higher at lower pH values, i.e. when the medium is more acidic.

- *Physical presentation and size which the product is sliced to:* the chemical preservative's dispersion in food has an impact on its absorption and diffusion through cell membranes on microorganisms and this determines the preservation effect. Therefore, the smaller the slicing of the product, the higher the preservative action. Preservative dispersion is slowed down by viscous foods (concentrated fruit juices, etc.)

c) Miscellaneous factors

- *Temperature:* chemical preservative dosage level will be established as a function of product temperature and characteristics of the micro-flora;
- *Time:* at preservative dosage levels in employed in industrial practice, the time period needed in order to obtain a "chemical sterilisation" is a few weeks for benzoic acid and shorter for sulphurous acid.

Check Your Progress Exercise 4

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What is general rule about the dosage level of chemical preservative?

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2. Name one universal preservative?

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3. How does particle size of product affect the efficiency of preservative?

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12.6 LET US SUM UP

In this unit you have learnt about the chemical preservatives. Herein we have discussed the characteristics of approved chemical preservatives. Various types of preservatives grouped according to their mode of action have been discussed. More stress has been laid on antimicrobial preservatives owing to their importance. Factor influencing the effectiveness of various preservatives have also been discussed. We hope that after reading this unit you will become more conscious about reading the label of processed product before consuming it.

12.7 KEY WORDS

Food Spoilage : Undesirable change in flavours, odours appearances or texture of food.

Preservation : Safeguarding

Preservative : Additive

Anti microbial : Which act against microorganisms.

Anti oxidant : Which removes the oxygen.

GRAS : Generally recognized as safe.

12.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1. Your answer should include the following points:

   Chemical food preservatives are substances which, under certain conditions, either delay the growth of microorganisms without necessarily destroying them. These are added in very low quantities and which do not alter the organoleptic and physico-chemical properties of the foods at all or only very little.

2. Your answer should include the following points:

   i) It should have GRAS (Generally recognized as safe) status.
   ii) It should be properly declared on the label of the food in which used.
   iii) It should be used only at approved dosage level.

3. Your answer should include the following points:

   In its petition for approval, the manufacturer must demonstrate that the preservative is safe for consumers, considering:

   - the probable amount of the preservative that will be consumed with the food product, or the amount of any substance formed in or on the food resulting from use of the preservative
   - the cumulative effect of the preservative in the diet
   - the potential toxicity (including cancer-causing) of the preservative when ingested by humans or animals.

Check Your Progress Exercise 2

1. Your answer should include the following points:

   The two important antioxidant preservatives are:

   - butylated hydroxytoluene
   - butylated hydroxyanisole

2. Your answer should include the following points:

   Ascorbic acid (vitamin C) inhibit phenolase by making the pH uncomfortably low for the enzyme.

3. Your answer should include the following points:

   - nisin
   - natamycin

4. Your answer should include the following point:

   There is no limit for traditional food preservatives like salt and sugar.

Check Your Progress Exercise 3

1. Your answer should include the following points:

   The four important organic acids used as chemical preservatives are:

   - Benzoic Acid
   - Sorbic acid
   - Propionic acid
   - Acetic acid

2. Your answer should include the following points:

   1. Sulphites should not be used in foods that are important sources of thiamin (vitamin B1), such as enriched flour, because sulphites destroy the nutrient.
   2. It should not be consumed by asthmatic patients because it may cause severe allergic reactions.

3. Your answer should include the following points:

   Nitrates readily convert to nitrites, which then react with the protein myoglobin to form nitric oxide myoglobin. During cooking, this is converted to nitrosohemochrome, a stable, pink pigment. That is how they impart a pink, fresh colour to cured meat.

Check Your Progress Exercise 4

1. Your answer should include the following points:

   Chemical food preservatives have to be used only at a dosage level which is needed for a normal preservation and not more.

2. Your answer should include the following point:

   Potassium meta bisulphate

3. Your answer should include the following points:

   - The smaller is the slicing of the product, the higher is the preservative action.
   - Preservative dispersion is slowed down by viscous foods

12.9 SOME USEFUL BOOKS

1. Adams, M.R. and Moss, M.O. (2000) Food Microbiology. Royal Society of Chemistry, Cambridge, U.K.
2. Branen, L.A. and Davidson, P.M. (1983) Antimicrobials in Food. Marcel Dekker, New York.
3. Igoe, R.S and Hui, Y.H. (1996) Dictionary of Food Ingredients – 3rd ed. Chapman & Hall, New York.
4. Jay, J.M. (2000) Modern Food Microbiology, Van Nostrand Company, New York.
5. Lewis, R.J. (1989) Food Additives Handbook. Van Nostrand Reinhold, New York.