Preservation by salt and sugar

Dear Students, in to-day's lecture, we will discuss about "Food preservation by salt and sugar.

Introduction.

Since the beginning of time, people have looked for ways to preserve food for future use. There are no records when the first preservation method was discovered. Perhaps people noticed that a fire dried food and that the smoke preserved it. By chance, people could have left food in the snow and once retrieved, found that the frozen food lasted longer than the fresh. In these ways, people might have learned how to protect foods against the effects of time. Protection of foods from microbial spoilage using salt

Curing may utilize solid forms of salt and sugar or solutions in which salt or sugar is mixed with water. For instance, brine is the term for salt solutions used in curing or pickling preservation processes. Examples of foods preserved with salt or sugar include the aforementioned corned beef as well as bacon, salt pork, sugar-cured ham, fruit preserves, jams and jellies, among others.

This episode deals with:

1. Common methods of preservation

2. Preservation by salt
3. Currying of Meat and Fish
4. Preservation by sugar
5. Conclusion

1:Common methods of preservation

There are several ways in which salt and sugar inhibit microbial growth. The most notable is simple osmosis, or dehydration. Salt or sugar, whether in solid or aqueous form, attempts to reach equilibrium with the salt or sugar content of the food product with which it is in contact. This has the effect of drawing available water from within the food to the outside and inserting salt or sugar molecules into the food interior. Yeasts and molds, on the other hand, usually require even lower aw preventing growth.

Salt and sugar's other antimicrobial mechanisms include interference with a microbe's enzyme activity and weakening the molecular structure of its DNA. Sugar may also provide an indirect form of preservation by serving to accelerate accumulation of antimicrobial compounds from the growth of certain other organisms. Examples include the conversion of sugar to ethanol in wine by fermentative yeasts or the

conversion of sugar to organic acids in sauerkraut by lactic acid bacteria.

The preservation of fruit by jam making using sugar is a familiar process carried out on a small scale by housewives in many parts of the world. Factory jam making has become a highly complex operation, where strict quality control procedures are employed to ensure a uniform product, but the manufacturing operations.

2: Preservation of food by using salt

Salt as a Preservative

Salt preserves food in the following ways:

1. Salt dries food. Salt draws water out of food and dehydrates it. All living things require water and cannot grow in the absence of water. Salt is used to preserve beef jerky by keeping it dry, and it prevents butter from spoiling by drawing water out, leaving just the fat.

2. Salt kills microbes. High salt is toxic to most microbes because of the effect of osmolarity, or water pressure. In very high salt solutions, many microbes will rupture due to the difference in pressure between the outside and inside of the organism. High salt can also be toxic to internal processes of microbes, affecting DNA and enzymes. Solutions high in sugar

also have the same effects on microbes, which is why it is used as a preservative of foods such as jams and jellies.

Misconceptions about Salt Preservation

Many people believe that saltier foods are more resistant to microbial growth. As a result, they are more willing to consume questionable foods if they have higher salt contents.

Here are the facts. Most bacteria, with the exception of halophiles (salt-loving bacteria), cannot grow in conditions where salt is greater than 10%. Molds can withstand even higher salt levels. Seawater is 3.5% salt. Imagine drinking seawater that is 3 times saltier.

Nitrates and nitrites:

Nitrates and nitrites not only help kill bacteria, but also produce a characteristic flavor and give meat a pink or red color. Nitrite (NO_2^-), generally supplied bysodium nitrite or potassium' nitrite.

Nitrite further breaks down in the meat into nitric oxide (NO), which then binds to the iron atom in the center of myoglobin;s heme group, reducing oxidation and causing a reddish-brown color (nitrosomyoglobin) when raw, and the characteristic cooked-ham pink color (nitrosohemochrome or nitrosyl-heme) when cooked.

The use of nitrite and nitrate salts for meat curing goes back to the Middle Ages, and in the US has been formally used since 1925. Because of the relatively high toxicity of nitrite (the lethal dose in humans is about 22 milligrams per kilogram of body weight), the maximum allowed nitrite concentration in meat products is 200 ppm. At these levels, some 80 to 90% of the nitrite in the average U.S, diet is not from cured meat products, but from natural nitrite production from vegetable nitrate intake.

Nitrosyl-heme

Curing is a method of food preservation and flavoring processes of foods such as meat,fish and vegetables.

Salting or curing draws moisture from the meat through a process of osmosis. Meat is cured with salt or sugar, or a combination of the two. Nitrates and nitrites are also often used to cure meat and contribute the characteristic pink color, as well as inhibition of Clostridium botulinum. It was a main way of preservation in the medieval time/ and around the 1700s.

There are numerous descriptions and permutations of curing which may include additional preservation techniques such as smoking or ingredients such as spices. However, all curing

processes fundamentally depend on the use of salt and/or sugar as the primary preservation agent(s). Incidentally, these processes not only prevent spoilage of foods, but more importantly serve to inhibit or prevent growth of food-borne pathogens such as Salmonella or Clostridium botulinum when properly applied.

The primary way sodium acts as a food preservative is by inhibiting microbial growth. Many foods contain enough water to encourage growth of microorganisms (such as yeast, bacteria, or mold), especially at room temperature. When microorganisms overgrow in foods (spoilage), both flavor and nutrition are compromised and the food may actually become dangerous to eat. Foods with high water content, such as fresh meat and fish, some cheeses, and sauces made with vegetables or fruits, are susceptible to spoilage by the microorganisms, which can grow rapidly in an abundance of water.

Salt, an added ingredient in these and other foods draws water out of the cells of both the food and the microorganism in a process known as osmosis. Microorganisms that do not have enough access to water will not grow and reproduce as fast as those with ample access to water. In this manner, added salt helps to prevent spoilage of the food. In addition to salt, sodium nitrate and sodium nitrite are often used to prevent spoilage by bacterial growth in meat and fish. Bacteria growth

that produces toxins, such as C. botulinum, can have serious health consequences (in this case, botulism) when that specific food is consumed. Other compounds such as sodium lactate, sodium benzoate are added to deli-style meat, hotdogs, and poultry products to inhibit microbial growth of L. monocytogenes, a type of bacteria that can cause the food borne illness listeriosis. –

Chemical actions:Salt: Table salt is the primary ingredient used in meat curing. Removal of water and addition of salt to meat creates a solute -rich environment where ostmotic pressure draws water out of microorganisms, slowing down their growth. salt slows the oxidation process, effectively preventing the meat from going rancid.

Dry curing: The dry cure method is characterized by fast action and it can be used under wider temperature variations than other curing methods. There is a greater loss of meat weight due to the loss of water, product will have more pronounced flavor, will be saltier and will be better preserved. Suitable for meats that will not be cooked but smoked and air- dryed or just air-dryed. Wet curing: The wet curing method, sometimes called brine (salt and water), sweet pickle (sugar added), or immersion curing has been traditionally used for larger cuts of meat like butts or hams that were smoked. It is accomplished

by placing meats in a wet curing solution (water, salt, nitrites, sometimes sugar). Sugar is added only when curing at refrigerator temperatures, otherwise it may begin fermentation and start to spoil the meat.

There are two ways of applying wet cure into meats

1. Immersing meat in curing solution (water, salt and nitrite)
2. Spray pumping meats with needles and curing solution

3:Preservation of foods by using Sugar

Sugar is an organic compound in the form of carbohydrate. Carbohydrates are composed of molecules of carbon, hydrogen and oxygen. There are different types of sugar- simple sugars (known as monosaccharides)which includes glucose (dextrose), fructose (fruit sugar) and galactose and disaccharides which includes sucrose (table/granulated sugar). Sugar has a very long history in food preservation- it has been used extensively in the preservation of fruits such as apples and pears and in the production of a wide range of products such as jams and jellies, fruit juice and sweetened products such as condensed milk.

Action of sugar: When sugar is added to foods it binds to the water in the foods reducing the amount of water that is available for the growth of microorganisms . Like salt water also has an osmotic effect i.e. when foods are placed in a

concentrated sugar solution water is drawn out of the cells of foods and microorganisms so that microorganisms can no longer survive.

Different ways of using sugar to preserve foods:

1. Desiccate fruits by drying them and then packing them with pure sugar. Fruits which are traditionally preserved through this method include ginger, cherries and the peel of citrus fruits. Alternatively foods may be stored in a sugar syrup or cooked in sugar until they crystalise.

2. To produce jams and marmalade; fruits are initially boiled to reduce the water content of fruit and to reduce contaminating microorganisms. Sugar is then added to the fruit to prevent the regrowth of bacteria.

3. Other food preservation techniques involve combining sugar with alcohol to enable the preservation of fruit in alcoholic spirits such as Brandy.

4. Sugar is also used with salt to preserve certain foods especially fish and meat. Sugar may either be added to salt to create a dry mixture which covers food or may be dissolved in a liquid to make a brine to surround the food. Adding sugar to a salty brine helps to confer a sweetness to meat and fish and also helps to reduce the harsh flavour of salt.

While sugar can act as a preservative in a controlled water tight environment such as a sealed jar, sugar itself attracts moisture so where water is available e.g. moisture in the air, sugar will attract water and the resulting environment will become more attractive to microorganisms such as yeast.

The value of sugar in food preservation is dependent on the amount of sugar used and adding too little sugar to a food will still enable the development of microorganisms. This is seen in the production of jams and jellies where adding too little sugar promotes the growth of mold and yeast.

Due to the health effects of sugar you may consider reducing the amount of sugar used in home food preservation but remember that any reduction in the sugar concentration of a product can make a food more susceptible to microorganisms. In addition, while the use of an artificial sweetener to replace sugar can help retain the taste of a product, artificial sweeteners do not have the same preservative action of sugar, this is why sugar free jams and marmalade must also be refrigerated to aid their preservation.

Jams:

The preservation of fruit by jam making is a familiar process carried out on a small scale by housewives in many parts of the world. Factory jam making has become a highly complex operation, where strict quality control procedures are

employed to ensure a uniform product, but the manufacturing operations employed are in essence the same as those employed in the house.

Fresh or pre-cooked fruit is boiled with a solution of cane or beet sugar until sufficient water has been evaporated to give a mixture which will set to a gel on cooling and which contains 32-34% water.

Gel formation is dependent on the presence in the fruit of the carbohydrate pectin, which at a pH of 3.2 - 3.4 and in the presence of a high concentration of sugar, has the property of forming a viscous semi-solid.

During jam boiling, all micro-organisms are destroyed within the product, and if it is filled hot into clean receptacles which are subsequently sealed, and then inverted so that the hot jam contacts the lid surface, spoilage by micro-organisms will not take place during storage.

The high moisture content of jam (equivalent to an equilibrium relative humidity of about 82%) makes it susceptible to mould damage once the receptacle has been opened and exposed from some time to the air. No problems of microbiological spoilage are likely to arise in the canned product during storage.

General procedure for the preparation of jams, jellies and marmalade

a. Boil the pulp or the juice (with water when necessary)

b. Add the pectin

c. Boil for about 2 minutes to assure a complete dissolution

d. Add the sugar while keeping the batch boiling

e. Boil down quickly to desired Brix

f. Add the acid (usually citric acid) and remove the froth

g. Fill hot into the (previously cleaned) jars and close

h. Invert the jars for three minutes to pasteurize the cover
The pectin in solution can also be added at the end of the step

The more salt added to the item (or sugar, which has the same effect and is often used to help get around the strong salt flavor), the longer the preservative effect will last.

4:Curing of meat and Fish:

Curing is the traditional processes ,addition to meats of some combination of salt, sugar, nitrite and/or nitrate for the purposes of preservation, flavor and color. Some publications distinguish the use of salt alone as salting, corning or salt curing and reserve the word curing for the use of salt with

nitrates/nitrites. The cure ingredients can be rubbed on to the food surface, mixed into foods dry (dry curing), or dissolved in water (brine, wet, or pickle curing). In the latter processes, the food is submerged in the brine until completely covered. With large cuts of meat, brine may also be injected into the muscle. The term pickle in curing has been used to mean any brine solution or a brine cure solution that has sugar added.

1. Salting

Salt inhibits microbial growth by plasmolysis. In other words, water is drawn out of the microbial cell by osmosis due to the higher concentration of salt outside the cell. A cell loses water until it reaches a state first where it cannot grow and cannot survive any longer. The concentration of salt outside of a microorganism needed to inhibit growth by plasmolysis depends on the genus and species of the microorganism. The growth of some bacteria is inhibited by salt concentrations as low as 3%, e.g.,Salmonella, whereas other types are able to survive in much higher salt concentrations, e.g., up to 20% salt for Staphylococcus or up to 12% salt for Listeria monocytogenes. Fortunately the growth of many undesirable organisms normally found in cured meat and poultry products is inhibited at relatively low concentrations of salt

Salting can be accomplished by adding salt dry or in brine to meats. Dry salting, also called corning originated in Anglo-Saxon

cultures. Meat was dry-cured with coarse "corns" or pellets of salt. Corned beef of Irish fame is made from a beef brisket, although any cut of meat can be corned. Salt brine curing involves the creation of brine containing salt, water and other ingredients such as sugar, erythorbate, or nitrites. Age-old tradition was to add salt to the brine until it floated an egg. Today, however, it is preferred to use a hydrometer or to carefully mix measured ingredients from a reliable recipe. Once mixed and placed into a suitable container, the food is submerged in the salt brine. Brine curing usually produces an end product that is less salty compared to dry curing. Injection of brine into the meat can also speed the curing process.

2. Nitrate/ Nitrite Curing

Most salt cures do not contain sufficient levels of salt to preserve meats at room temperature andClostridium botulinum spores can survive. In the early 1800's it was realized that saltpeter ($NaNO_3$ or KNO_3) present in some impure curing salt mixtures would result in pink colored meat rather than the typical gray color attained with a plain salt cure. This nitrate/nitrite in the curing process was found to inhibit growth of Clostridium. Recent evidence indicates that they may also inhibit E. coli, Salmonella, and Campylobacter if in sufficient quantities.

5:Conclussion:

Since the beginning of time, people have looked for ways to preserve food for future use. There are no records when the first preservation method was discovered. When sugar is added to foods it binds to the water in the foods reducing the amount of water that is available for the growth of microorganisms Perhaps people noticed that a fire dried food and that the smoke preserved it. By chance, people could have left food in the snow and once retrieved, found that the frozen food lasted longer than the fresh. In these ways, people might have learned how to protect foods against the effects of time. Curing is a method of food preservation and flavoring processes of foods such as meat,fish and vegetables. Out of all the methods of preservation canning is the one that is still used most often. Examples of foods preserved with salt or sugar include the aforementioned corned beef as well as bacon, salt pork, sugar-cured ham, fruit preserves, jams and jellies,ect.