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NATURAL PRESERVATIVES

Introduction

This disposition is confined to natural chemicals that act as preservatives. Additional chemical such as sulfite, benzoic acid, sorbic acid, propyl-ρ-hydroxy benzoate and propyl paraben (and other chemical preservat are not included here.

Many 'natural,' chemicals have been used to preserve food. They have been linked to the success of communities. A number of well-known everyday substances have been used to prevent food from spoiling and some are probably as old as civilisation.

1 Salt

Many medieval societies used salt as a preservative. The value of salt has been exalted and in the middle ages in Britain some workers were paid in salt. Salt has certainly been at a premium in central districts of India. Above 8% salt most bacterial activity will stop. However, this is an unacceptable level and must be removed either by boiling (salt pork) and discarding the cooking water or by adding other ingredients to that the concentration is at an acceptable level in a final alternative product.

1.1 Salt and Fermentation

At concentrations below 8% especially at about 3% salt, many troublesome bacteria are inhibited. A large group of bacteria will however grow at this lower level. Many that have been identified are deliberately added to food so that they grow and make a range of acids – specifically lactic acid. This is the principle behind the curing of many vegetables - including cabbage to make sauerkraut, onions, gherkins and olives and meat for biltong, salami and milk for the cheeses.

The so-called lactic acid bacteria use natural sugar in the raw state of these foods (eg lactose in milk). The combination of salt and lactic acid is rarely sufficient to extend shelf life so that water is commonly removed. This is done by dry curing which is the addition of dry salt. Water exuded from food by the familiar process of osmosis and is drained away. Milk separates into curds and draining whey which the cheesemaker's way of removing moisture.

Further shelf life can be added by chilling. Once again the shelf life of intermediate life products is doubled for each 10°C drop in temperature (see Temperature Monograph).

1.1.1 Other acids

The term pH is used as a measure of acidity. The scale runs from 0 (very acidic) to 14 (very alkali). A pH value of 7 is neutral and very few foods have pH above 7. Some foods are naturally very acidic. Limes for instance have a pH value of approximately 2.2 whereas avocadoes have low acidity with a pH of nearly 6.5. There are very few foods that have pH above 7 (alkaline).

1.1.2 Alcohol and Vinegar

There is evidence that fruit has been fermented since the earliest civilisations (~ 5,000 BC) probably as a means of preservation but more likely for its effects. Yeast will grow on substances with high sugar content (but they will not attack starch). High sugar fruits and fruits that are fully mature will support yeast growth. (Cereals must be allowed to germinate in order to produce sugar from starch). Most yeasts will not continue to act beyond approximately 12% - 14% alcohol – which is sufficient for shelf stability. At lower concentration or indeed during the fermentation process alcohol will utilised by other bacteria in the presence of air to produce acetic acid or vinegar.

Vinegar has been used throughout history as a preservative. It is commonly made by the oxidation of alcohol. It is the acid formed if wine is allowed access to oxygen. Yeast in wine produces about 12% and occasionally up to 15% alcohol. Hence wine vinegar or vinegar produces from other fruits like apples has approximately 12% acetic acid. Vinegar has a pH value between 2.8 and 3.2.

Most troublesome bacteria will only survive at pH values above 4.2. Below that figure only yeasts and moulds thrive. Hence vinegar, is an excellent preservative. However, it will only act if it is not diluted too much by other ingredients. Pickles for instance commonly contain onions which have a pH above 5 so that the proportion of onions to vinegar is important. All mixtures containing vinegar will keep provided that the pH is below 4.2.

The yeasts and moulds are easily destroyed by heat and so for full safety, foods with a pH below 4.2 are pasteurised by heating to 72^{o}C for 15 seconds.

1.1.3 Citric Acid

Citric acid is commonly added in its un-purified form – lemon or lime juice which have pH values below 2.5. Citric acid has a fruity flavour. Once again they are very effective providing an acidic environment that prevents most bacterial growth. Used in combination with sugar citric acid is used to prepare juices and cordials.

Citric acid is present in varying amounts in all the citrus fruits.

2 Sugar

Sugar is a frequent food ingredient in the preparation of confections in which is combined with the entire range of natural foods. As a distinctive preservative it is used to preserve fruits and occasionally ginger. Sugar is entirely soluble in water and thus makes water unavailable for bacteria to grow. Dry sugar used in the crystallising process determines that the food will keep indefinitely. However simply adding sugar to most fruits will draw out cellular fluid by osmosis. This has been the basis of a number of fruits in syrup. To avoid this in crystallising ginger or cherries, cellular fluid is drawn out using a pre-salt treatment followed by immersion in increasing concentrations of sugar syrup.

However in an environment that has a high relative humidity, water will condense on the exposed sugar and soften or add an undesirable water surface to the food product. So that sugar-based dry confectins will adsorb water sending them soft or slimy. Eventually such adsorption may support the growth ot yeasts and moulds. Moisture-proof packaging (50 micron polypropylene) will prevent this.

3 Smoking

Wood smoke is an aerosol produced by slow burning of wood at elevated temperatures and reduced oxygen. There are over 400 compounds identified in wood smoke or smoke flavor from a number of sources. So far, 40 acids, 22 alcohols, 131 carbonyls, 22 esters, 46 furans, 16 lactones, and 75 phenols have been identified. The, the composition of wood smoke will vary with the type of wood used in producing the smoke and the temperature and moisture content of the wood. Wood smoke performs several functional roles in food. Whether it is applied as a gas from smoldering wood chunks or chips or as liquid smoke, it is considered a natural flavor and need not be broken down into components in the label declaration. Wood smoke is also a colorant, where the stain is immediately produced upon contact between the food surface and smoke, or the color is formed when the smoke and food components react chemically at the elevated temperature used to process the food. The preservative role of wood smoke is well known. However, although specific components have been documented to possess inhibitory activity against bacteria and fungi, wood smoke is not a stand-alone preservative.

Smoking, in food processing, the exposure of cured meat and fish products to smoke for the purposes of preserving them and increasing their palatability by adding flavour and imparting a rich brown colour. The drying action of the smoke tends to preserve the meat, though many of the chemicals present in wood smoke are highly effective food preservatives (formaldehyde natural preservatives as well. At the same time partial drying and condensation of the wood smoke compo

Smoking is one of the oldest of food preservation methods, probably having arisen shortly after the development of cooking with fire.

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specific components have been documented to possess inhibitory activity against bacteria and fungi, wood smoke is not a stand-alone preservative. Wood smoke may be used as a component of a hurdle system for food preservation. Among the functional components of smoke, phenols and acids have shown the most antimicrobial activity, although there are data that show that carbonyls and acids can also have a wide spectrum of antibacterial activity even at low levels of phenols. Staining ability of wood smoke is associated with the acids and phenols, while reaction-developed color produced during the heating of meat can be attributed primarily to the acids and carbonyl compounds.

Smoke contains a wide range of highly effective anti-bacterial elements. As they condense on the surface of foods

4 Herbs and Spices

4.1 Garlic

Garlic contains a chemical – allicin (allicinially thiosulfonate) which has antibacterial effect on a some micro-organisms. However in the native garlic state the concentration is low and only as an alcoholic extract does it have significant effects. Allicin is particularly unstable in air or when heated so that the antibacterial properties are negligible after cooking or excessive storage.

4.2 Herbs

The oldest written evidence of medicinal plants' usage for preparation of drugs has been found on a Sumerian clay slab from Nagpur, approximately 5000 years old. It comprised 12 recipes for drug preparation referring to over 250 various plants. Safer preparations emerged in England during the middle ages and have proven antibacterial properties. Some examples are eugenol (cloves) thymol and carvacrol (thyme) cineole (sage) cinnamaldehyde (cinnamon) and of course the powerful preservative actions of both capsaicin (chillies) and ginger (zingiberene and gingero).l

Used singly or in combination they still enjoy significant use as pastes for the natural preservation of foods.

Turmeric

The evidence of turmeric that contains curcumin as a preservative is supported by rigorous bacterial trials. Since it is a common adjunct to curry powder there is significant preservative effect of the spice combinations. Health benefits will not be discussed here.

and know are inhibited and more desirable bacteria will grow. In particular there is a range that will tolerate lower levels of salt and act on foods to produce lactic acid. Not only does the effectively but the lactate part is also a preservative. There are about

At lower levels below 3% salt it acts to prevent certain types of bacterial from growing but allow other types of bacteria to grow. These are the so-called lactic bacteria of which there are some 30 different types. These are not dangerous bacterial and indeed add to flavour. When low concentrations of salt are added to fresh vegetables bacteria that produce acid – particularly lactic acid – will grow that acts as a preservative in products such as kimchi and sauerkraut. In some Pacific atoll states salt from the sea is used to allow the fermentation of breadfruit – the combination of salt and the lactic acid produced by the bacteria are sufficient to preserve the product.

These lactic acid bacteria are added to milk and the lactose in the milk is used by the bacteria to produce lactic acid. During the cheese-making process, whey – which is largely water – is drained away so that the low moisture and the lactic acid (and occasionally added salt) will preserve the cheese.

Lactic acid is also produced in some bacteria added to meat (with some sugar added) and the bacteria produce lactic and other acids to preserve salami-type products.

The same bacterial activity preserves anchovies, olives and some other pickles.

The general rule is that for lactic acid fermentation to take place the salt content should be adjusted to about 3% and some sugars must be present to allow the bacteria to make the lactic acid.

Vinegar

Vinegar has been evident in the earliest of civilisations. It is produced from alcohol simply by allowing air to oxidise it. It is commonly produced from wine that is not of sufficient quality for sale. The acetobacter bacteria will act on the alcohol to produce the active acid – acetic acid.

Yeast will produce a maximum of approximately 12% alcohol so that vinegar produced this way will have a maximum of about 12% acetic acid. This is usually sufficient to preserve foods provided that the other components (onions, cucumber capers etc) do not dilute the acid.

Most commonly vinegar is used in combination with sugar and salt that also have a preservative effect in such products as sauces and chutneys.

pH Values of Common Foods and Ingredients Note: Variation exists between varieties, condition of growing and processing methods. Item

Apple, eating 3.30-4.00

Cantaloupe 6.13-6.58

Corn 5.90-7.50 Artichokes 5.50-6.00

Cucumbers 12-5.78

Avocados 6.27-6.58

Grapefruit 3.00-3.75

Mangoes, green 3.40-4.80 5.80-6.00

Potatoes 5.40-5.90

Sauerkraut 3.30-3.60 Onions,

Onions, yellow 5.32-5.60

Squash, yellow, cooked 5.79-6.00

Oranges, Florida 3.69-4.34

Strawberries 3.00-3.90

Orange juice, California 3.30-4.19

Limes, 2.1-3.81

Sweet potatoes 5.30-5.60

Natural orange juice, 3.30-4.15

Papaya 5.20-6.00

Tomatoes 4.30-4.90

Vinegar, 3.10

Pineapple 3.20-4.00 Plums,

Butter 6.1-6.4

Corn starch 4.0-7.0

Corn syrup 5.0

Honey 3.9

Molasses 5.0-5.5

Sugar 5.0-6.0

<u>About: Professor Richard Beyer</u>

Dr. Richard Beyer is a prominent food technologist in the Pacific and considered a leader in food preservation. He is the author of over 15 commissioned reports relating to income generation and food security for the Pacific region. He has completed a textbook relating to the preservation and processing of root crops, bananas, plantain and breadfruit.

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Important Notes: *1) This chart reflects the particular food's impact on the pH balance in the human body which may or may not reflect the direct pH value of the food itself. For example, though lemons and limes are chemically acids, when metabolized in the body, they have an alkalizing effect and are very beneficial. By the same token, though undigested meats test as alkaline, after meat is eaten, it releases acids into body. 2) Results of pH testing may vary depending on testing conditions, product brand, growing region and numerous other factors which accounts for the number of conflicting charts and other published and on-line sources. I an effort to be as accurate as possible, this chart was compiled using extensive published and onsite research pulling from as many of the best quality charts and sources as possible and statistically averaging the results where there were conflicts. As such, while we believe this chart to be one of, if not the best, and most accurate available, we encourage users to treat it and all similar charts as a general guideline in improving body pH and related good health by consuming more healthy alkaline foods and ionized water and less fewer unhealthy acidic foods and beverages.*

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