



Nordic Sugar
Member of Nordzucker Group

The functional properties of sugar



These days, sugar comes in many varieties and can therefore be used in many different food products. Sugar has a range of unique properties that, either individually or in combination, make it an important ingredient in modern food production. Sugar is also one of the simplest structures in nature and, of all the staple products in our diet, has the broadest area of use.



At Nordic Sugar, we are happy to place our comprehensive knowledge of the role played by sugar in food at the disposal of our customers, either in the course of our daily business or when developing new products in partnership with others.

And this is not all that we are doing to provide information about the functional properties of sugar! We also offer a comprehensive set of resources, which are described in this brochure.

These resources are updated and expanded on an ongoing basis in order to provide you with valuable information, whether you work in product development, sales, marketing, PR or purchasing.

The information is set out in a multi-level format to enable you to quickly and easily find whatever you are interested in.

SWEETNESS



The primary functions of sugar in food products are to provide sweetness and energy. Our sense of taste can identify four basic tastes: sweet, sour, salty and bitter.

The first taste that we encounter (breast milk) is sweet, which may be why a sweet taste is appreciated and interpreted positively.

Our inherent affinity for sweetness may also be explained by the fact that, in nature,

sweet products are rarely poisonous, in contrast to many bitter substances.

The only definition of a sweet taste is that it "tastes like sugar". Sugar has a uniquely clean sweetness that is entirely free from off-taste or aftertaste.

We can only measure sweetness by tasting. In other words, it is a subjective sensation that is transferred via the gustatory nerves in the taste buds on the tongue and passed on to the brain.

Several factors affect the sensation of sweetness. The concentration of sweetener, temperature, pH value, other ingredients, and the sensitivity of the individual.

Subjective factors such as appearance and colour can also affect the sensation of taste. In order for a substance to taste sweet, it must be water-soluble and its concentration must exceed the taste threshold. In the context of food, sweeteners are often present in concentrations well above the threshold value. To specify the intensity of a

sweetener, we therefore calculate the substance's "relative sweetness".

Relative sweetness is a measure of how sweet a specific substance is in relation to sugar. We compare different concentrations of a sweetener with a reference solution consisting of saccharose (usually 5-10%). Ordinary sugar has a comparison figure of 1.

All natural varieties of sugar have a low relative sweetness compared with high-intensity sweeteners, which are often several hundred times sweeter than ordinary sugar.

Relative sweetness of sugars

Sugar	Sweetness
Sucrose	1
Glucose	0.6 - 0.7
Fructose	0.8 - 1.4
Invert Sugar	1
Glucose Syrup, DE = 60	0.3 - 0.6
Glucose Syrup, DE = 40	0.3 - 0.4

TASTE AND AROMA



An important property of sugar is that it can enhance tastes and aromas both above and below the sweetness threshold value. For example, a small amount of added sugar can enhance the taste of nutritious, but sour or bitter foods.

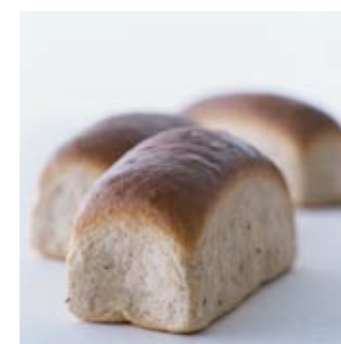
Sugar's aroma enhancing properties are used in a wide range of foods, such as bread and fruit products.

A small amount of added sugar can enhance the taste of cooked vegetables and meat without making them sweet.

In other words, we can use sugar as a flavouring in such low concentrations that it falls below the sweet taste threshold value, i.e. below approx. 1% sugar.

Traditionally, people have added small amounts of sugar to certain cooked meat products such as ham or liver pâté.

VOLUME



Sugar can affect the weight and volume of food. The volume of liquid is only affected slightly by sugar.

The volumes of bakery products can be affected in various ways.

Sugar increases the volume of bread because the yeast breaks down all or part of the sugar/syrup and transforms it into various components, including carbon dioxide. This carbon dioxide increases the volume of the bread and makes it more porous.

In sponge cakes and cup cakes sugar creates bulk – in other words volume. The sugar still has a physical presence. If we were to stop using sugar in these products the amount of energy obtained from fat would increase.

TEXTURE



Texture is an expression of the sensation in the mouth. Sugar affects this by providing volume and consistency in many products such as bread, jam and beverages.

In bread, sugar affects the volume of dough by speeding up the fermentation process. This gives the bread a more porous structure and softer crumb.

In the manufacture of jam, marmalade and jelly, it is important to strike the correct balance between sugar, pectin and acid. Sugar's ability to gel when combined with pectin is vital to the consistency of the product.

Too much sugar may crystallise, while too little sugar will cause the gelling process to

fail. If the pH value is too high, the gelling process will be incomplete, whereas if the pH value is too low, the jelly will be unstable and runny.

When combined with the fruit pectin and acids in the correct proportions, sugar brings the jelly, marmalade or jam to the correct consistency. However, certain fruits with very low pectin levels may require added pectin in order to achieve the correct consistency.

Sugar is important in defining the body of beverages, i.e. how filling they are. This affects the sensation in the mouth, and hence the sense of taste.

SHELF LIFE



The preservative properties of sugar are exploited in products such as jams, juices and pickling solutions. Foods are preserved to avoid or inhibit the growth of microorganisms that destroy the product and to avoid pathogenic microorganisms that cause diseases

Microorganisms need water in order to grow. They absorb water via the outer layer of the cell. If the concentration of sugar in food is raised to a certain level, all water is bound by the sugar. This inhibits the growth of microorganisms, because the availability of water is reduced and water activity drops.

Adding sugar to the solution increases the osmotic pressure, thereby reducing the opportunities for microorganisms to grow.

By creating the most unfavourable combination of e.g. pH, water activity and temperature for microorganisms, it is possible to reduce the proportion of preservatives. Sugar can play an important role in this.

Since sugar binds water, adding sugar reduces water activity. The less water activity there is, the longer the product will last. Microorganisms can only live in "free" water. If the water activity level is low enough, microorganisms cannot destroy the food.

A sugar level of 500 g per kg of berries or pulp is equivalent to a water activity of 0.97, while a sugar level of 1 kg per kg of berries or pulp reduces the water activity to 0.92. When the mixture is boiled, this proportion of sugar inhibits moulds.

FERMENTATION



The fermentation process has been used for centuries to produce or preserve foods. The fermentation process often involves the use of yeast and some kind of carbohydrate, e.g. sugar, as an energy source.

In breadmaking, it is common to add a small quantity of sugar to the dough to kick-start the yeast as it begins creating carbon dioxide. In baking, sugar feeds the yeast; the yeast's enzymes transform the sugar into alcohol and carbon dioxide. For this reason, sugar is not always present in

the end product. A little sugar (or syrup) makes the yeast ferment faster and more effectively than when no sugar is added. The carbon dioxide makes the dough rise and the bread porous

REDUCING THE FREEZING POINT



Sugar affects the freezing point of foods. The higher the concentration of sugar, the lower the freezing point.

A low freezing point is important in ice cream and frozen desserts. It reduces the risk of large crystals of ice forming.

Small ice crystals have a positive effect on the sensation in the mouth, and hence on the taste.

The freezing point depression is due to the number of molecules per unit of weight.

This means that glucose, fructose and invert sugar are more effective than ordinary sugar in reducing the freezing point of foods.

COLOUR



Sugar can give many food products an appetising colour. This may be through caramelisation, the Maillard reaction, or because sugar is able to preserve colour.

The Maillard reaction (a reaction between sugar and amino acids) gives rise to browning and flavouring in products such as bread, coffee, heated desserts and cakes. The Maillard reaction is an extremely complex reaction and its end products include pigmentation, which causes coloration and aroma.

Caramelisation refers to the thermal decomposition of sugar and occurs when a sugar solution is heated to above 100°C. The degree of caramelisation increases as

the temperature rises and is dependent on the pH value. Sugar molecules are initially broken down, after which the decomposition substances react with one another, with water and with sugar that has not yet been broken down and transform into a mass of delicate brown, sweet-tasting molecules. Products such as caramel sauce and caramel browning are based on caramelisation.

Caramel browning is a food colorant that is usually manufactured by heating up alkaline sugar solutions to create caramelisation. It is used in soft drinks, beer, confectionery products, soups and sauces.

A certain content of sugar ensures that jams and marmalades retain their colour.

MOISTURE RETENTION



In products such as biscuits and boiled sweets, which contain small amounts of water and large amounts of sugar, the relative moisture level is lower than the ambient humidity. Without protective packaging, these products will absorb moisture from the air.

Sugar's ability to bind water in foods is based on the ratio between crystallised and dissolved. Any change in this ratio during production or storage affects the amount of water that the food can bind. Because sugar

binds water, reactions that need water are delayed if sugar is present. The shelf life of bread is extended because sugar causes water to be retained for longer in the bread.

Bread and cakes baked with syrup will be more moist and have a longer shelf life than products made with sugar. This is due to the fructose content of the syrup, because fructose binds more water than sugar.

Sugar helps to ensure the high quality of our food.

Without sugar, jam would soon go off, ice cream would crystallise, and bread would lose its freshness and dry out. In addition, the taste of foods would be disappointing without the ability of sugar to round off and enhance natural taste components.

Sugar has one or more unique, quality-enhancing properties to offer almost all types of food production involving both solid and liquid foods.

	Sweetness	Taste and aroma	Volume	Texture	Shelf life	Fermentation	Reducing the freezing point	Colour	Moisture retention
Beverages	●	●		●	●			●	
Pickling mixtures	●	●		●	●			●	
Jam/marmalade	●	●	●	●	●			●	
Sauces/dressings	●	●		●	●				
Confectionery	●	●	●	●	●			●	
Dairy products	●	●	●	●			●		
Bakery products	●	●	●	●	●	●		●	●
Pharmaceuticals/ non-food	●	●	●	●		●			

>CLICK<
Shelf life

The quality of foodstuffs deteriorates over time for physical, chemical or microbial reasons. Foods are preserved to eliminate or inhibit the growth of fooddamaging microorganisms and to eliminate pathogenic microorganisms.

>CLICK< >CLICK<

Adding sugar to a solution increases the osmotic pressure, thereby reducing the opportunities for microorganisms to grow. By creating the most unfavourable combination of e.g. pH value, water activity, and temperature for microorganisms, it is possible to reduce the amount of preservatives. Sugar can play an important role in this process, which is called "hurdle technology".

CLICK for information

Whether you want to know about the specific properties of sugar for the product group that you are working with, or about the functional properties of sugar, you can find the information on our website at www.nordicsugar.com

Here are a couple of examples of what you will find when you CLICK through the information.

Clicking through level after level brings up increasingly specific information.

>CLICK<

Bakery products

Sugar and various qualities of syrup are used in baking (both home and industrial baking).

The role of sugar is to:

- Give the bakery product the right level of natural sweetness.
- Nourish the yeast.
- Provide volume.
- Bind water and thereby extend the shelf life of the product.
- Form good quality crusts.
- Provide aroma and colouring.

>CLICK<

Jam and marmalade

Sugar extends the shelf life of jam and marmalade. Because sugar binds water, adding sugar to jam reduces the water activity. The less the water activity is, the longer the shelf life. Microorganisms can only live in "free water". If the water activity is low enough, microorganisms cannot destroy the food.

>CLICK< >CLICK<

A sugar level of 500 g per kg of berries or pulp is equivalent to a water activity of 0.97, while a sugar level of 1 kg per kg of berries or pulp reduces the water activity to 0.92. When the last mixture is boiled, this proportion of sugar prevents growth of most microorganisms.



Search!

You will soon find what you need to know

This brochure forms part of Nordic Sugar's set of resources for industrial customers.

Website – www.nordicsugar.com

This is updated and expanded on an ongoing basis and provides relevant information in a multi-level format. It caters for anyone who needs a quick overview of sugar, as well as for those requiring more specific information. A few relevant links are also listed.

Sugar and sweetener glossary

Brief information about sugar and sweeteners in Swedish, Danish and English. The text is available on our website at www.nordicsugar.com

Feel free to contact us!

At Nordic Sugar, we are keen to help in the creation of new, high-quality food products, and we hope that these resources will contribute to this process. We are always happy to receive feedback. Please contact us if you need further information.

Simple and informative!

Information about the functional properties of sugar is compiled on our website: www.nordicsugar.com

