

Sucrose composition determined by IR spectroscopy

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Abstract

Sucrose is a natural disaccharide, with the chemical formula $C_{12}H_{22}O_{11}$, composed of a glucose and a fructose molecule, joined by an $\alpha(1\rightarrow2)$ glycosidic bond. It is the main constituent of food sugar obtained from sugar cane and sugar beets. A crystalline, white, water-soluble substance, sucrose has a pronounced sweet taste and represents an important source of energy quickly available to the body, through enzymatic hydrolysis in the intestine. From a biochemical point of view, sucrose does not contain vitamins or minerals, being considered a "simple carbohydrate" with a caloric value of approximately 4 kcal/g. Its stability and ease of use make sucrose a widely used ingredient in food and industry, but excessive consumption is associated with metabolic risks, such as obesity, diabetes mellitus and cardiovascular diseases.

Keywords: Sucrose, composition, IR spectroscopy

Introduction

White sugar (granulated sugar) is called sucrose and is made up of 2 simple sugar molecules: glucose and fructose. Sucrose comes from plants such as sugar cane, and small amounts of fructose are found in berries, melons and apples, or in vegetables such as beets, sweet potatoes and onions. Fructose is sweeter than table sugar, and this can have negative effects on our health. We find fructose in many products such as flavored water, sports and energy drinks, cocoa milk, breakfast cereals, sweet yogurt, candied fruits, pastries^[1, 5].

Fructose is a simple sugar found in fruits. In the sweetest fruits (grapes, pears, dates, figs, raisins) fructose is found in greater quantities. Fructose is mainly metabolized by the liver, but unlike glucose, it does not require insulin to be used by the body and does not increase blood glucose, so it is better tolerated even by people with diabetes. Fructose

can improve the glycemic index in people with diabetes, if consumed in moderate amounts.

Fructose has indisputable benefits, here are the most important:

Unlike glucose and sucrose, fructose has a low glycemic index, which causes a moderate amount of insulin to be released into the bloodstream.

Fructose causes less tooth decay than other types of sugars.

Fructose is the sweetest of all nutritive sweeteners, therefore it is recommended to consume it in small quantities.

Fructose is resistant to freezing, so it prevents the formation of ice crystals that could destroy fruit tissue^[6, 11].

Materials and methods

FT-IR spectrum were accomplished and recorded with Fourier-Transform infrared spectrophotometer (Bruker, Alpha ATR) between 4000 and 375 cm^{-1} , with resolution of 4 cm^{-1} .

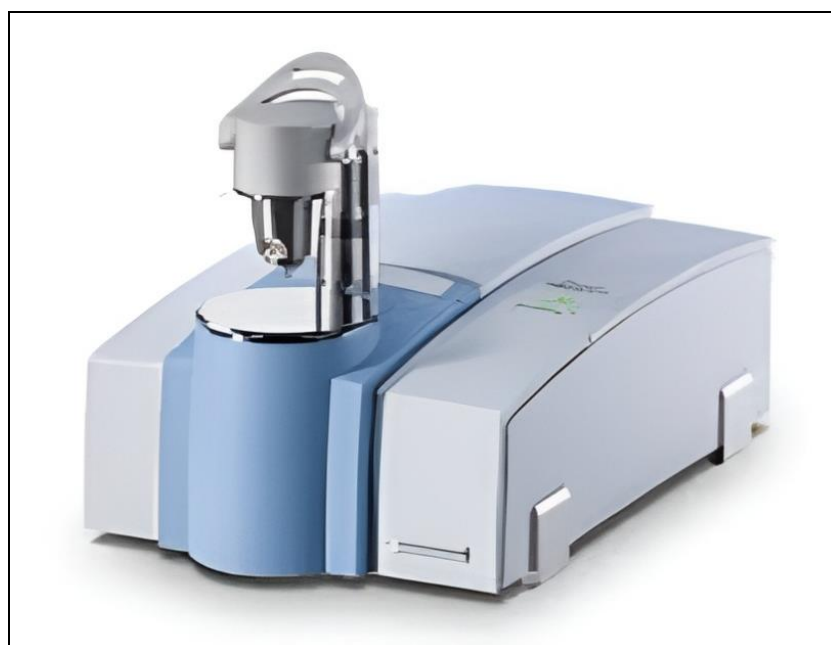


Fig 1: Infrared spectrophotometer Bruker

Result and discussion

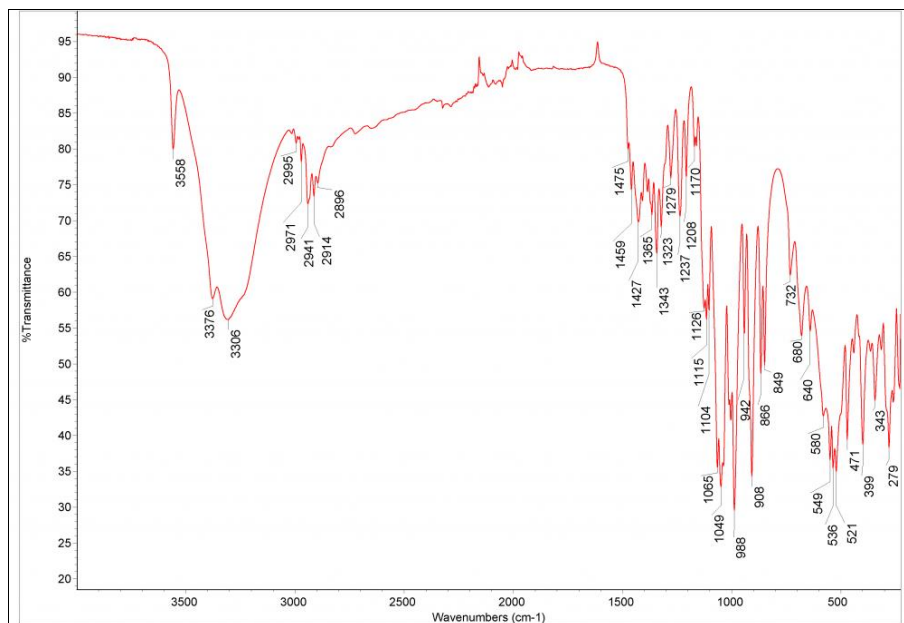


Fig 2: IR spectrum of sucrose

All FT-IR spectra were pressed into KBr tablets. The spectra contained several bands in some regions specific to carbohydrates. In the first of them, about 3300 cm^{-1} , there is a wide asymmetric band due to the stretching vibrations of the $-\text{OH}$ group. The strong interaction between the functional groups of the macromolecules in the modified sucrose is the reason in the spectrum considered, bands arise due to complex vibrations, which can be defined as oscillations of both the furanose ring and the macromolecule as a whole. The stretching vibrations ($\text{C}-\text{C}$), ($\text{C}-\text{O}$), ($\text{C}-\text{O}-\text{C}$) of the furanose structure are observed between 1000 cm^{-1} and 1200 cm^{-1} [12, 14, 17].

Depending on the degree of substitution, the maximum of this band is shifted and at the same time the half-width changes. This is due to the hydroxyl groups which form the hydrogen bonds as well as to the esterification of some of them.

A new band in the spectrum of the sucrose palmitate (Fig. 2) is clearly visible in the spectrum of esters at 1734 cm^{-1} due to the stretching vibrations ($\nu\text{C}=\text{O}$) of the ester. The presence of such a band at 1720 cm^{-1} - 1728 cm^{-1} was reported by Song [15] in sucrose octanoates (ester obtained by transesterification of sucrose with ethylcaprylate), as well as in the spectrum of sucrose octanoate obtained by ultrasonic synthesis [16].

Conclusion

Sucrose is a disaccharide formed by a glucose and fructose molecule, joined by an $\alpha(1\rightarrow2)$ glycosidic bond. It is a crystalline substance, soluble in water and with a sweet taste, representing a quick source of energy for the body. Sucrose does not contain vitamins or minerals, being a simple carbohydrate with a caloric value of approximately 4 kcal/g. It is widely used in food and industry due to its stability and ease of handling. Excessive consumption of sucrose can have negative effects on health, including metabolic and cardiovascular risks.

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