9.Week: SWEETENERS

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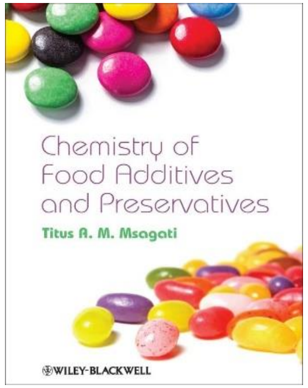
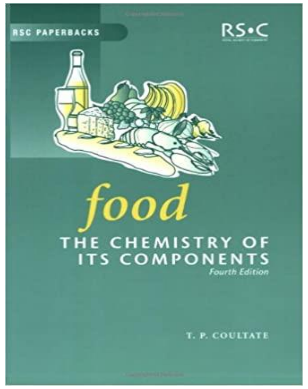
1. 

2. 

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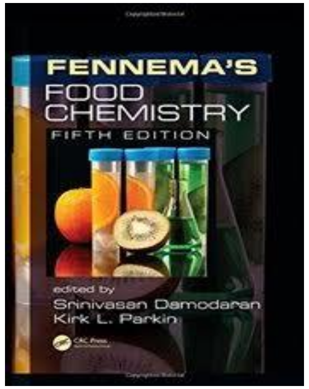
4. 

1. Msagati, Titus A.M. 2013. *Chemistry of Food Additives and Preservatives*, JohnWiley & Sons, Ltd, West Sussex, UK.

2. Coultate T. P. 2002. *FOOD: The Chemistry of Its Components*, RSC Paperbacks, Royal Society of Chemistry, Cambridge, UK.

3. Ekşi A., Tayfur M., Ercan A., Bağcı Bosi A. T., Kıvanç P., Soylu P., Berat Özdemir M. ve Şişik N. 2014. *A'dan Z'ye Gıda Katkı Maddeleri*, Detay Yayıncılık, Ankara.

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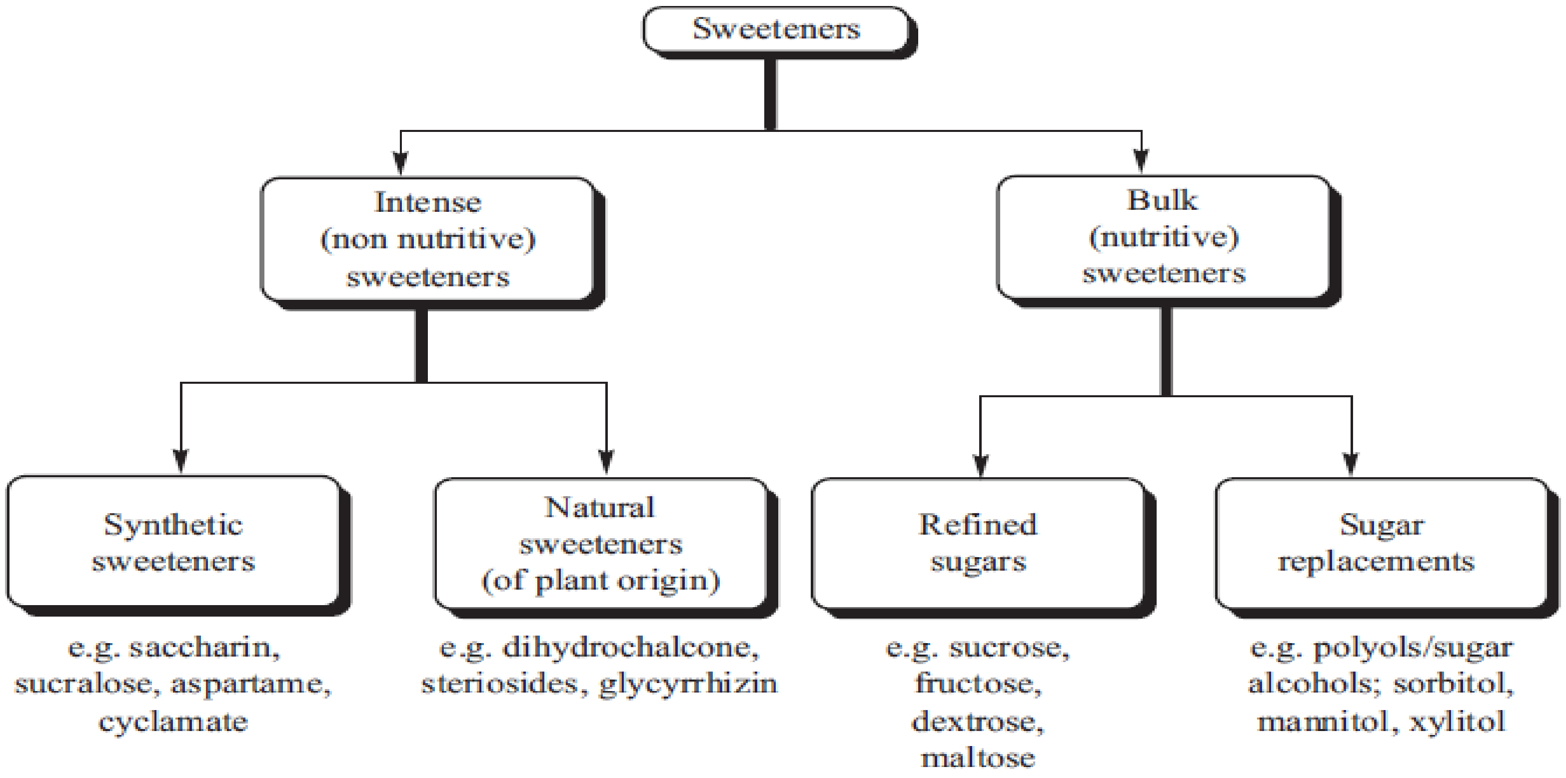
SWEETENERS

Sweeteners are additives that are added to foods mainly for flavouring purposes and also as supplements.

Classification of sweeteners based on their nutritive status



Source: Chemistry of food additives and preservatives / Titus A. M. Msagati / 2013 by John Wiley & Sons, Ltd. / ISBN 978-1-118-27414-9

Molecules referred to as sweeteners are numerous. A common method of classifying them is according to their nutritive status:

(**1**) intense (non-nutritive) sweeteners

(**2**) bulk (nutritive) sweeteners

INTENSE SWEETENERS IN FOODS

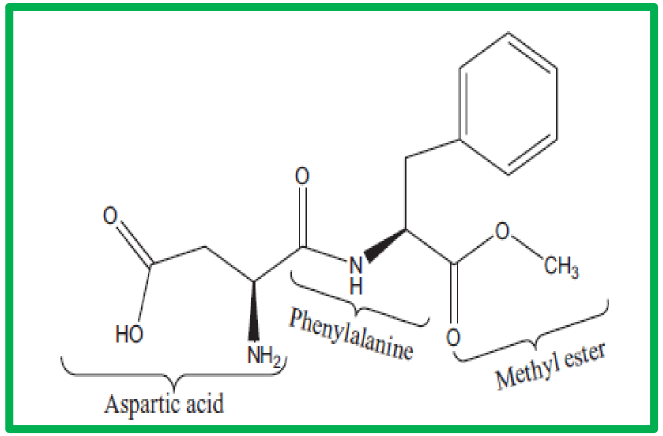
This group is comprised of very sweet molecules with a variety of chemical structures and functional groups, and they generally find application in products which are designed to reduce calories or in tooth-friendly types of confectionary.

Intense sweeteners are used as an alternative to sugar by people who, for health reasons, are trying to lose or control their weight. Since intense sweeteners do not promote tooth decay, they also have applications in items such as toothpaste and mouthwash solutions. These sweeteners contribute positively to the status of health diet without compromising the pleasure of sweetness in foods. The class is further subdivided into synthetic or artificial sweeteners and natural sweeteners.

Synthetic intense sweeteners

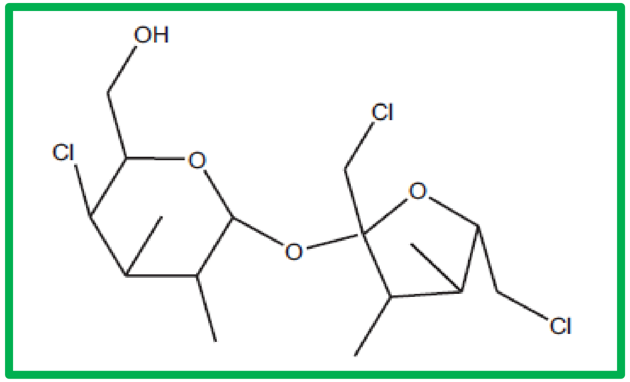
Aspartame

The synthetic subclass includes compounds such as aspartame, which is a methyl ester of the dipeptide compound of L-aspartic acid and L-phenylalanine amino acids. Aspartame is 200 times sweeter than table sugar (sucrose).



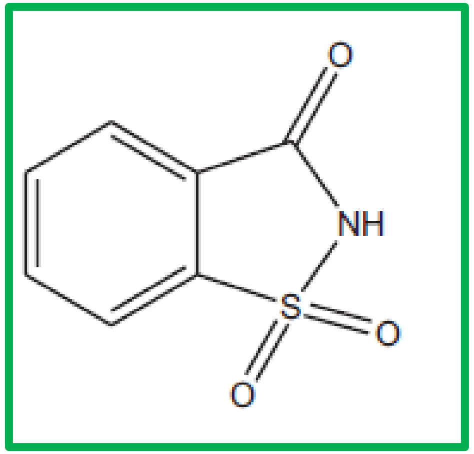
Sucralose

Another type of artificial intense sweetener is a chlorinated sugar known as sucralose, produced by substituting the three hydroxyl groups in sucrose with chlorine atoms. Sucralose is 600 times sweeter than sucrose.



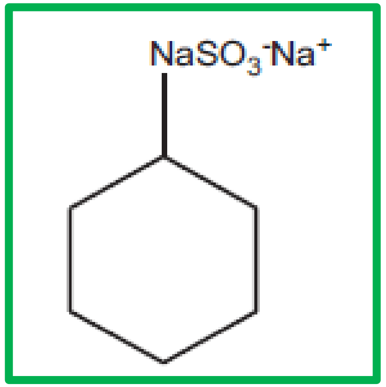
Saccharin

Saccharin, a chemical compound containing a benzoic sulphimide base structure, is another artificial sweetener that finds application in drinks, cakes and biscuits, among other products. It is also unstable at higher temperatures and is therefore used in synergy with other stable sweeteners. It is mostly used as a sodium salt which is very soluble, unlike its acidic form which is insoluble.



Cyclamate

The artificial sweetener which has been in existence longer than many others currently in use is cyclamate, which is 30 times sweeter than sucrose.



Natural intense sweeteners

Plants such as sugarcane, sugar beets, maple trees and corn produce sugars (sweeteners) via the process of photosynthesis. The sweeteners from natural or plant origin include perillaldehyde, stevioside, rabaudioside, glycyrrhizin, osladin, thaumatins, monellin, dihydrochalcones and miraculin. Although the former is not sweet, it has the property of modifying the taste of sour food into a delightfully sweet taste.

Perillaldehyde

Perillaldehyde, also known as perilla aldehyde, is a monoterpenoid natural organic compound found most abundantly in the perennial herb perilla.

Perillartine, the oxime of perillaldehyde which is also known as perilla sugar, is about 2000 times as sweet as sucrose and is used as an intense natural sweetener.

Glycyrrhizin

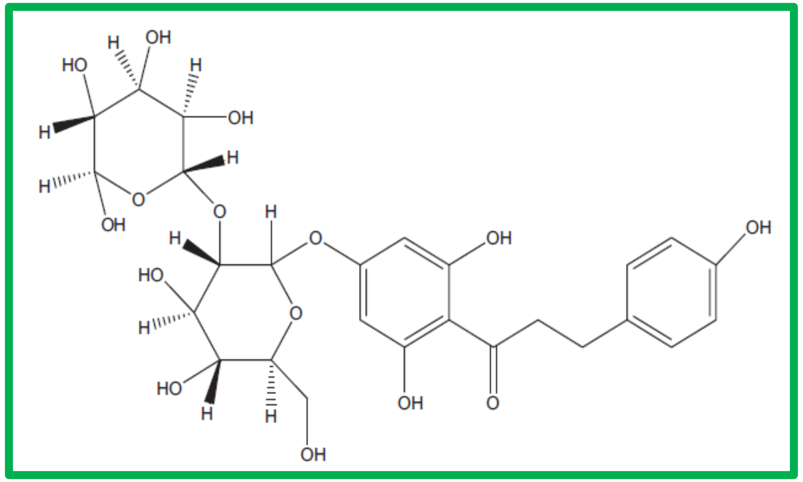
Glycyrrhizin is another natural intense sweetener that exists in liquorice and is about 170 times sweeter than sucrose.

Steviol glycosides

Steviol glycosides are natural sweeteners extracted from the leaves of *Stevia rebaudiana*. Stevioside compounds are prepared by connecting glucose molecules to the steviol molecule. Stevioside and rebaudioside are the two main compounds that are responsible for the sweet taste of stevia species.

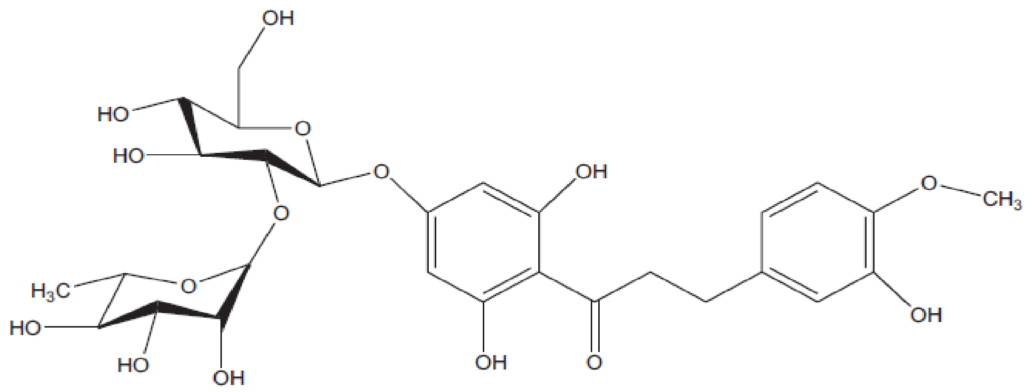
Naringin dihydrochalcone

From the dihydrochalcone class of natural intense sweetener, there is a compound known as naringin dihydrochalcone which is a phloretin glycoside. Naringin dihydrochalcone is about 300–1800 times sweeter than sucrose.



Neohesperidin dihydrochalcone

Another natural intense non-caloric sweetener derived from citrus is a glycosilated compound known as the neohesperidin dihydrochalcone which is about 1000 times as sweet as sucrose and very stable to heat.



Source of figures: Chemistry of food additives and preservatives / Titus A. M. Msagati / 2013 by John Wiley & Sons, Ltd. / ISBN 978-1-118-27414-9

BULK FOOD SWEETENERS

Bulk food sweeteners are bulking agents such as starch that increase the bulkiness of food products without compromising their nutritional integrity. This class of nutritive bulk sweeteners is composed of two subgroups:

(**1**) refined sugars (e.g. dextrose, fructose, sucrose, maltose, etc.)

(**2**) sugar replacements which are comprised of mainly sugar alcohols or polyols (e.g. sorbitol, lactitol, erythritol, isomalt, xylitol and mannitol).

Refined sugars

Refined sugars (sweeteners) such as dextrose are obtained naturally in foodstuffs, and have the attributes of a moderately sweet saccharide. Saccharide is a monosaccharide which forms the basic building block unit of carbohydrates ($C_6H_{12}0_6$) and has a high glycemic index (GI), a parameter reflecting the ability of digested carbohydrates to raise blood glucose. Another useful parameter is the glycemic load (GL), which gives a measure of blood glucose of any food product.

Polyols

Polyols have a cooling effect and play the role of distribution of taste over time where they have a high molecular weight (xylitol, sorbitol and 1-mentol). For consumers with effective metabolism, polyols are slowly and incompletely absorbed in the intestines. They normally require no or very little insulin and do not cause spikes in blood sugar. For this reason, polyols are suitable for use by diabetics because they play a key role in reducing glycemic index as well as reducing the risk of tooth decay. However, some of the polyols have drawbacks in that they are not absorbed by the blood and instead just pass through the small intestines. Also, large consumption of polyols can result in intestinal gas or diarrhoea.

Sugar alcohols

The compounds here referred to as sugar alcohols are neither sugar by their nature nor alcohols; however, their chemical structures partially resemble that of sugars and of alcohols.

As food additives (sweeteners), they have a sweet taste which can mask the aftertaste of other sweeteners and can also add bulk and texture. They have the property of providing the cooling effect or taste, they inhibit browning during heating and retain moisture in foods.

Toxicity

Due to an increase in the use of sweeteners for the purpose of reducing calorie content of food products without compromising their taste, there exists the possibility of excessive levels of sugars in beverages and other foodstuffs.

There are two types of health risks to consumers associated with excessive sugars in food stuffs:

(**1**) allergenic reaction conditions (e.g. asthma)

(**2**) metabolic disruption.

* It should be noted on the label of the food; that if polyol is used, it may cause "laxative effect" and if aspartame is used, it contains "phenylalanine".

Methods of quality assessment

There are a number of tests and analyses that are normally used to ensure the quality of sweeteners, including the degrees Brix value, spectrometry, instrumental texture value as well as pH, sensory properties and the assessment of microbiological quality.

ANALYTICAL METHODS

A number of analytical methods have been developed for individual sweeteners as well as for combinations of them. Spectrometry, differential pulse polarography, potentiometry, micellar electrokinetic capillary chromatography, high-performance liquid chromatography (HPLC), high-performance anion exchange chromatography (HPAEC) and gas-liquid chromatography (GLC), capillary electrophoresis, immunochemical assays and measurement in an enzyme-linked immunosorbent assay.