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## An introduction to low/no calorie sweeteners

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### **What is a low/no calorie sweetener?**

Low/no calorie sweeteners (LNCS) are sweet-tasting food ingredients with no, or virtually no, calories that are used to confer the desired sweetness to foods and drinks, while contributing very little or no energy at all to the final product (*Fitch et al, 2012; Gibson et al, 2014*).

## Commonly used low/no calorie sweeteners

The most known and commonly used LNCS worldwide are acesulfame potassium (or acesulfame-K), aspartame, cyclamate, saccharin, sucralose and steviol glycosides. Other LNCS that have been approved for use in Europe and around the world include: thaumatin, neotame, neohesperidine DC and advantame.

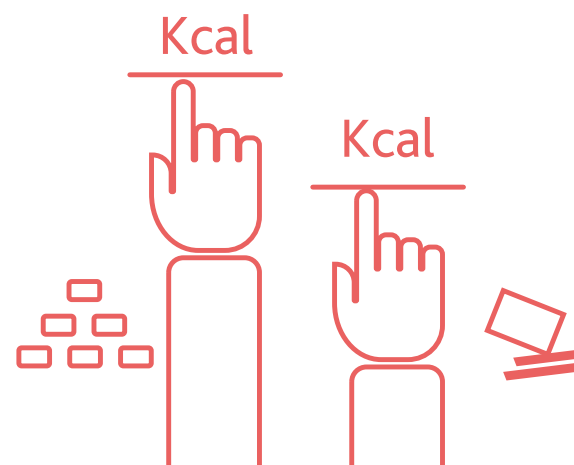
## The history behind the discovery of low/no calorie sweeteners

Low/no calorie sweeteners have been safely used and enjoyed by consumers all over the world for more than a century. The first commonly used LNCS, saccharin, was discovered at Johns Hopkins University in 1879. Since then, a number of other LNCS have been discovered and are now in use in foods and drinks around the world ([Figure 1](#)).

Before approval, all LNCS used in foods and drinks today are subject to a rigorous safety evaluation process ([Serra-Majem et al, 2018](#); [Ashwell et al, 2020](#)). This is discussed in detail in the next chapter ([Chapter 2](#)).

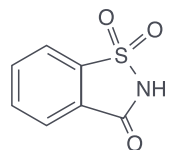
Different terms are frequently used to describe LNCS in the scientific literature. The term *low/no calorie sweeteners (LNCS)* is used throughout this booklet, while other common terms include: intense sweeteners, high intensity sweeteners, high potency sweeteners, low-calorie sweeteners, non-nutritive sweeteners and non-sugar sweeteners.

Low/no calorie sweeteners impart no, or virtually no, calories to our foods and drinks, so they can be a helpful tool in reducing individuals' total energy intake.



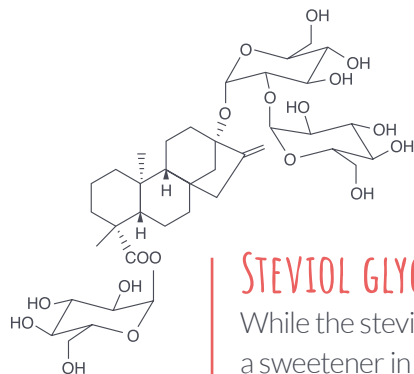


# History of the most commonly used low/no calorie sweeteners.



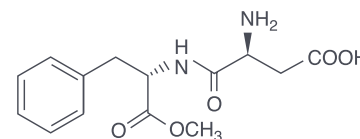
## SACCHARIN

was discovered in 1879 by Remsen and Fahlberg; saccharin is the “oldest” low calorie sweetener, used for more than a century in foods and drinks.



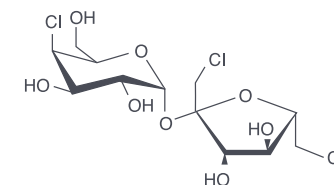
## STEVIOL GLYCOSIDES

While the stevia plant has been used as a sweetener in certain South American countries for centuries, it was around the 1900s that Dr. Moises Santiago Bertoni, a Swiss botanist, started studying the plant. In 1931, two chemists in France isolated the first steviol glycosides, which are purified extracts of the sweet components of the stevia leaf that are approved for use today.



## ASPARTAME

was discovered in 1965 by the chemist James Schlatter.



## SUCRALOSE

was discovered in 1976 during a research program on sugar by researchers at Queen Elizabeth College, University of London.

1879

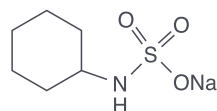
1931

1937

1967

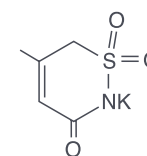
1965

1976



## CYCLAMATE

was discovered in 1937 at the University of Illinois and it is the term given to the low calorie sweetener cyclamic acid and its calcium or sodium salts.



## ACESULFAME-K

was discovered in 1967 by Dr Karl Clauss, a researcher at Hoechst AG in Germany.

**Figure 1:** History of the most commonly used low/no calorie sweeteners.

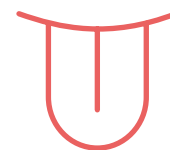
Source: In book: *Encyclopedia of Food Sciences and Nutrition*, Edition: 2nd, 2003. Publisher: Academic Press Ltd., Editors: B. Caballero, L. Trugo, P. Finglas.

## Commonalities and differences

While all LNCS used in food and drink production confer sweet taste with no, or practically no, calories and they all have a much higher sweetening power compared to sugar, each one of the different LNCS has a unique structure and metabolic fate, technical characteristics and taste profile (Magnuson et al, 2016). Some key characteristics of the most commonly used LNCS are presented in [Table 1](#).



LOW/NO CALORIE SWEETENERS SHARE A LOT IN COMMON,  
BUT THEY HAVE DIFFERENCES AS WELL, SUCH AS...



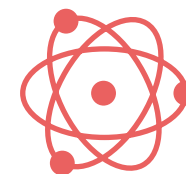
Taste profile



Sweetening potency



Metabolism



Technical properties

**Table 1:** Key characteristics of the most common low/no calorie sweeteners

	Acesulfame-K	Aspartame	Cyclamate	Saccharin	Sucralose	Steviol glycosides
<b>Year of discovery</b>	1967	1965	1937	1879	1976	1931
<b>Sweetening power (compared to sucrose)</b>	Approx. 200 times sweeter than sucrose*	Approx. 200 times sweeter than sucrose*	Approx. 30-40 times sweeter than sucrose*	Approx. 300-500 times sweeter than sucrose*	Approx. 600-650 times sweeter than sucrose**	Approx. 200 to 300 times sweeter than sucrose (depending on the glycoside)*
<b>Metabolic and biological properties</b>	Not metabolised and excreted unchanged.	Metabolised to its constituent amino acids (protein building blocks) and a very small amount of methanol, in quantities commonly found in many foods.	Generally not metabolised and excreted unchanged.	Not metabolised and excreted unchanged.	Minimally metabolised and excreted unchanged.	Steviol glycosides are broken down to steviol in the gut. Steviol is excreted in the urine as steviol glucuronide.
<b>Caloric value</b>	Calorie-free	4kcal/g (used in very small amounts thus providing practically no calories)	Calorie-free	Calorie-free	Calorie-free	Calorie-free

\*Commission Regulation (EU) No 231/2012 of 9 March 2012 laying down specifications for food additives listed in Annexes II and III to Regulation (EC) No 1333/2008 of the European Parliament and of the Council; \*\*Opinion of the Scientific Committee on Food on sucralose, September 2000

## References

1. Ashwell M, Gibson S, Bellisle F, Buttriss J, Drewnowski A, Fantino M, et al. Expert consensus on low-calorie sweeteners: facts, research gaps and suggested actions. *Nutr Res Rev* 2020;33(1):145-154
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7. Serra-Majem L, Raposo A, Aranceta-Bartrina J, Varela-Moreiras G, Logue C, Laviada H, et al. Ibero-American Consensus on Low- and No-Calorie Sweeteners: Safety, nutritional aspects and benefits in food and beverages. *Nutrients* 2018;10(7):818