

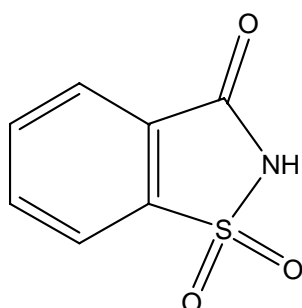
Sweet sensations

Topics

Organic chemistry, everyday chemistry

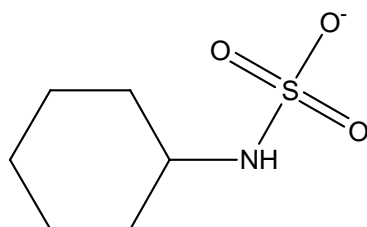
Smoking in the laboratory is not permitted, and you would expect to wash your hands thoroughly after leaving the lab and before eating. However, failure to follow these correct practices led to the discovery of three important artificial sweeteners.

Saccharin was discovered in 1879 by Ira Remsen, Professor of Chemistry at Johns Hopkins University in the USA, and his student Constantine Fahlberg. While eating dinner after a day's work in the lab, Fahlberg noticed that his bread tasted unusually sweet. He guessed that this must have been caused by chemicals he had been working on that day. He returned to the lab, was foolish enough to taste all the substances he had used, and eventually picked out the one we now call saccharin (named from the Greek word for sugar - as in saccharides).



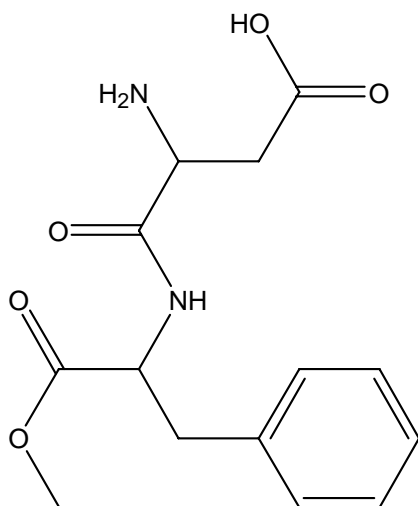
Saccharin

Sixty years later, the sweetener cyclamate was discovered by Michael Sveda. He was doing something that would definitely not be allowed today - smoking in the lab - and a chemical had become transferred to the butt of his cigarette. He noticed that it tasted sweet when he put the cigarette to his lips.



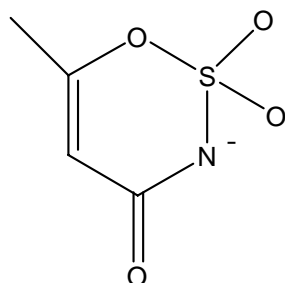
Cyclamate

In the 1960s, aspartame (marketed as Nutrasweet™, and 200 times sweeter than sucrose) and acesulfame were also discovered to be sweet by accident. In each case, some of the chemical got onto the hands of a researcher who later licked his fingers. Aspartame is a dipeptide - it is made from two amino acids - so James Schlatter, the discoverer, may justifiably have felt that it was unlikely to be toxic as this dipeptide is found naturally in the body. To be precise, aspartame is the methyl ester of the dipeptide made from aspartic acid and phenylalanine.



Aspartame

Acesulfame was discovered by Carl Claus.



Acesulfame

Other sweet compounds have been discovered accidentally by a chemist licking his fingers to turn over the page of a book and by a non English-speaking chemist who interpreted a request to *test* a chemical as an instruction to *taste* it.

In the 19th century, it was not uncommon to taste small quantities of newly-synthesised chemicals, and research papers often reported taste along with data such as colour, solubility and melting point. Going back even further to the 1750s, the Swedish Chemist Karl Scheele (who among other achievements discovered oxygen at around the same time as Joseph Priestly) was notorious for tasting the chemicals he worked on – including hydrogen cyanide! In 1786, Scheele was found dead in his laboratory surrounded by a number of chemicals, any one of which might have killed him.

Although these are examples of sloppy lab practice, the people involved were fortunate both in not being poisoned and by discovering something useful. Ultimately there is no way to tell whether a compound is sweet or not without humans tasting it. It is a long and expensive process to test for toxicity (long- and short-term) which is essential before tasting can be done safely. Until recently there was no theory to explain why some compounds are sweet and to predict structures of new sweet-tasting compounds. Nowadays theories such as the 'triangle of sweetness' – see below - mean that a systematic search for new, sweet molecules can be undertaken and toxicity tests need only be done for molecules which show some probability of being sweet-tasting. In order to apply this theory, chemists need to be able to determine the structures of new compounds which they have made. The proof of the pudding, however, remains in the eating.

The 'triangle of sweetness'

One theory of sweetness is that sweet-tasting molecules have a system AHBX with the approximate dimensions shown, where A and B are electronegative atoms which can form hydrogen bonds with a protein found in the taste buds. X is non-polar and this repels hydrogen bonds.

