Sugar Substitutes

What you need to know

The following is a short reference glossary of alternative sweeteners. Much of this information comes from an American Association of Cereal Chemists book, called "Sweeteners: Alternative," by Amy L. Nelson (Eagen Press, St. Paul, Minnesota).

Acesulfame K: An accident of chemistry, discovered in 1967 by a Hoechst Company researcher in Germany, who noticed a sweet taste on his fingers, while reacting a couple of chemicals. (As you'll see from the entries that follow, this is how more than a few artificial sweeteners got discovered. There seems to be a pattern among chemists to stick their fingers in their mouths, a habit that seems to violate every basic tenant of safe laboratory behavior.)

Acesulfame potassium, or AceK as it is often called, is a synthetic, white, crystalline powder about 200 times sweeter than sucrose. Positives include having no demonstrated health risks so far (approved in the United States in 1988) and good stability. It's not thought to decompose and is excreted unchanged from the GI tract. Drawbacks: really no serious ones, except that it is truly "artificial," which, by itself, is enough to turn some people off. It's sold commercially under the name Sunette. Most doctors believe there is no problem with its use in moderation, as all sweeteners should be used.

Aspartame: Sold under the brand name NutraSweet, the compound was also an accidental discovery in 1965 by a chemist at Searle & Company. (Another finger sucker, apparently.) It is a synthetic, white, crystalline powder, made of two amino acids (L-aspartic acid and L-phenylalanine) with about 160-220 times the sweetness of sucrose. Positives include a clean taste without metallic bitterness.

Drawbacks include its notorious instability in acidic aqueous solutions or when heated, at which point it loses its sweetness and potentially becomes toxic. When the molecule breaks apart, one potential decomposition compound is methanol or wood alcohol – the stuff sometimes found in moonshine that makes you go blind if you drink it. Just image what could be happening to those aspartame molecules inside all those cans of diet soda in the back of a delivery truck on a sweltering August day in Atlanta Anecdotal drawbacks include severe stomach cramping, sleeplessness, hives, emotional disturbance and memory loss. There's some evidence (again, anecdotal) that these potential ills might even be of greater risk to people on a low-carb dietary structure

Cyclamate: Another accidental discovery, in 1937 by a graduate student at the University of Illinois. Cyclamate is a synthetic, white, crystalline powder about 30 times sweeter than sucrose. Drawbacks include a bitter-tasting breakdown product and questionable health risk. Based on studies in the late 1960s that suggested the product

might cause bladder cancer in rats, cyclamate was banned in the United States in 1970, never to return. Subsequent studies in the 50-plus countries that didn't ban the product showed no carcinogenic potential, but its petition for reinstatement in the United States still languishes 25 years later.

Erythritol: A naturally occurring sugar alcohol (found in small quantities in mushrooms, pears, melons, grapes and wine) that is produced commercially by fermentation of table sugar (or other sugars) in a process somewhat akin to making yogurt. It's only about 70 percent as sweet as sugar, but has only a fraction (about 0.2) of a calorie per gram -- basically low enough to qualify it as "zero calories."

Erythritol is a small molecule, rapidly absorbed by the small intestine, meaning little of it gets to the colon to cause the typical intestinal misery common to other sugar alcohols. On the good side, research has shown that more than 90 percent of what's absorbed is excreted unchanged in the urine within 24 hours. (That does beg the question of what happens to the other 10%, but let's not split hairs.) Positives: Most people feel it has a clean taste. Some perceive a slight cold, faintly metallic taste that disappears to a large extent when it's added to a food or beverage.

Saccharine (Sweet 'n' Low): Discovered, again by accident, in 1878 at a Johns Hopkins University laboratory, saccharine is a synthetic, white, crystalline powder 300-600 times sweeter than sucrose. Drawbacks include bitter aftertaste.. The substance had been shown in a 1977 Canadian study to cause bladder cancer in male rats fed an amount of saccharine equal on a human scale to that in 800 to 1,000 cans of diet soda per day. Subsequent study on humans has failed to show a connection to cancer. According to Ms. Nelson's book, President Theodore Roosevelt, who championed the cause of keeping saccharine available to the American consumer, is said to have remarked, "Anyone who says saccharin is injurious to health is an idiot!"

Sorbitol, Mannitol and Maltitol: All are sugar alcohols produced by the fermentation of corn, wheat or potato starch into either a crystalline powder or a syrup. Depending on how the starch is broken down (by which enzymatic reaction and for how long) the same starch can yield any of these sugar alcohols. Glucose converts to sorbitol, mannose to mannitol, and maltose to maltitol. None are as sweet as sugar, though maltitol comes closest at 90 percent.

Positives: they have fewer calories than sugar (about 1.5 to 2.5 per gram versus the 4 per gram in sugar). Drawbacks: All these sugar alcohols cause the notorious intestinal side effects common to the group – rumbling, gas, bloating, and often diarrhea – if consumed in more than small amounts, which limits their usefulness. Although some food purveyors will completely subtract all grams of any sugar alcohol they use in a product from the carb total, that's probably not entirely kosher, since some portion of the substance does get absorbed (although there's no good data on how much of which one) and therefore has to at least count as calories in.

Although not double-blind, placebo-controlled research data, it's long been advised to count sugar alcohols as contributing about a third of a gram of carb per gram of sugar alcohol (or 3 grams for every 10), which serves to curb intake somewhat in people watching their carbs.

Stevia: This sweetener was first extracted in the early 1900s from the leaves of a South American plant, Stevia rebaudiniana, but had been used as an herb for centuries before that to sweeten bitter medicines. The leaves are about 30 times sweeter than sucrose and the purified extract (the stuff sold in little green packets in stores nowadays) is about 200 times sweeter. Positives include its natural origins and purported safety, demonstrated by its lengthy use in folk medicine.

Drawbacks include its bitter afterbite, which make it difficult to cook with, since just enough to make a dish properly sweet is a molecule away from the too much that makes it bitter. A good Stevia cookbook is a worthwhile purchase for anyone wanting to use this product. Stevia extract has been denied GRAS (Generally Recognized As Safe) status from the FDA and, therefore, can only be sold as a dietary supplement, not a sweetener. Go figure.

Sucralose (Splenda): One of the few artificial sweeteners actually developed on purpose (by researchers at Queen Elizabeth College in London), sucralose is a synthetic compound made directly from the sugar molecule by selectively replacing three hydroxyl (-OH) groups with chlorine (-Cl) molecules to produce a substance about 400 to 800 times sweeter than the sucrose molecule it came from.

Positives include its clean taste, stability both in solutions across a wide range of pH values and at high temperatures. Additionally, it is minimally metabolized, being mostly excreted in the stool unchanged – i.e. with all its added chlorine molecules still bound in their positions, not wandering around in the body somewhere as some alarmists would have you believe. To date, we have seen no credible evidence (either with our own eyes or in published controlled studies) to indict this sweetener as a health risk. Therefore Splenda in its little yellow packets or in bulk packages is fine, used in moderation, as all sweeteners should be.

Tagatose: Derived from the milk sugar lactose, this sweetener is slightly less sweet than sucrose (about 92 percent as sweet). Positives include having only 1.5 calories per gram versus 4 for table sugar and honey (so although not no calorie, it's low calorie), not rotting your teeth, and exerting a pre-biotic effect in the gut by stimulating the cells of the colon to crank up their production of butyrate (a short chain fatty acid) that helps nourish both the colonocytes and the friendly bacteria there.

Drawbacks: Makers suggest that it is metabolized in a manner similar to fructose (which might not be a good thing) but is only partially absorbed. About 15 to 20% is absorbed and the balance flows on downstream to cause all the same intestinal effects as other partially absorbable carbohydrates – namely, gas, bloating, and diarrhea – if used to excess. It's marketed in the United States in a product called Shugr.

Xylitol: A sugar alcohol, derived from xylan (a complex sugar chain, sort of like cellulose, which is found in corncobs, straw, almond shells and birch bark) which is then broken down into individual units of a simple sugar, called xylose, which are then hydrogenated to make xylitol. Positives are that its sweetness is exactly equal to sugar (but only half the calories) and so measures exactly like sugar, spoon for spoon, making for easy recipe conversion. Additionally, there are a pretty good number of research studies that point to its actually being of some health benefit for preventing cavities and ear infections in children.

Drawbacks: Users have reported the typical intestinal side effects of sugar alcohols, such as gas, bloating, rumbling and diarrhea, although some people aver having less misery with it than with other sugar alcohols, except, perhaps, erythritol. Additionally, some users perceive a slight cold, faintly metallic quality to its taste, although other people describe it as a clean taste. Once only found in chewing gum, it's now being manufactured in bulk and in individual single-serving packets. If you tolerate using it, and many people do, it's probably among the least offensive of the sugar alcohols.

Each of the five FDA-approved non-nutritive sweeteners (sucralose, acesulfame-K, saccharin, aspartame and neotame) provide no carbs to foods. It should be noted that all "consumer" versions of the high-intensity sweeteners (those with sweetness hundreds of times greater than sucrose) require a bulking agent to be used. This is because it would be difficult for any consumer to measure out an amount that would provide the desired sweetness. For example, less than 1/100 of a teaspoon is needed for any of these sweeteners to provide a sweetness equivalent to a teaspoon of sugar.

Most of what's in the little packets of any color is the bulking agent, most often maltodextrin and/or dextrose. They still qualify to be called "no calorie" sweeteners, because the amount of bulking agent is not great, having fewer than 5 calories per serving. When manufacturers use non-nutritive sweeteners in beverages and other food products, they indeed are carb-free, as they contain no bulking agent.

For carb counters it is recommended to count the half a gram of carbohydrate in each Splenda packet, and 24 grams of carbohydrate in a cup of granular Splenda.

Enjoy life's sweetness in the best of health!

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